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ENVIRONMENTAL MONITORING REPORT FOR PANTEX PLANT COVERING 1975

MASTER

Prepared by Ronald E. Alexander

March 5, 1976

Mason & Hanger-Silas Mason Co., Inc.
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AMARILLO, TEXAS 79177
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operated for the
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
under
U. S. GOVERNMENT Contract DA-11-173-AMC-487(A)

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Printed in the United States of America
Available from
National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161
Price: Printed Copy \$4.50; Microfiche \$3.00

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FOREWORD

This report has been prepared in accordance with the guidance provided by the United States Energy Research and Development Administration in ERDA Manual Chapter 0513.

Its purpose is to present objectively the environmental monitoring data collected at Pantex Plant during 1975.

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ABSTRACT

During 1975 Pantex Plant conducted a monitoring program to determine the concentration of specific radioactive and non-radioactive species in the local environment.

Although the plant activities involve the handling of significant quantities of uranium, plutonium and tritium, only small releases of uranium (depleted in the isotope ^{235}U) and tritium occurred which could have affected the local environment. Monitoring data indicate that concentrations of these nuclides in the environment are below established criteria for air and water and therefore should not present a health hazard either to employees or to the public.

INTRODUCTION

Pantex Plant is operated by Mason & Hanger - Silas Mason Co., Inc., as a prime contractor for the United States Energy Research and Development Administration. The facility is located in the Panhandle of Texas (Ref. Figures 1 and 6) and covers an area of approximately 10,200 acres.

Actual plant operations are performed within several zones (Ref. Figure 2). The remaining area is in native grasses and farmland, which is utilized by Texas Tech University for agricultural research purposes.

The mission of Pantex Plant includes atomic weapons assembly, retirement, atomic weapons stockpile surveillance, fabrication of chemical high explosives and testing of chemical high explosives. Weapons assembly and stockpile surveillance activities necessarily involve handling significant quantities of uranium, plutonium and tritium, as well as non-radioactive potential pollutants.

Radioactive material releases at the Pantex facility are restricted to certain infrequent high explosive test fires which disperse small quantities of depleted uranium (essentially ^{238}U) and other operations within the plant which involve the release of tritium (^3H) in small amounts. There are no sources of continuous release of radioactive materials and a viable environmental monitoring program has been established to assure that no public health hazard exists. Operating buildings where weapons are assembled/disassembled are provided with continuously operating radiation sensors to detect any accidental release of radioactive materials which might occur.

With few exceptions, radioactive material is handled only in sealed containers which are not opened at Pantex, thus avoiding the possibility of releasing materials during normal operating conditions. In all cases every feasible effort is made to control radioactive materials releases to assure that concentrations are well within existing criteria for radioactivity in the environment.

Both radioactive and non-radioactive effluents are minimal due to the relatively small amounts of material released and the local geological and meteorological conditions. There are no liquid streams flowing through or from the plant facility and the Panhandle climate is characteristically windy. All liquid effluents are diverted to an on-site retention playa and utilized by Texas Tech University for crop irrigation within the plant perimeter. This water is principally condensate and sanitary sewage and is not a by-product of specific industrial processes.

Geologically, Pantex Plant is located in the Llano Estacado or Staked Plains. The vicinity is characterized by rolling grassy plains and numerous natural playas. These playas, frequently dry, are fed by rainwater and melted snow. Normal total precipitation is slightly less than 20 inches per year, but may vary from 10 to 40 inches per year. During 1975 the Amarillo office of the National Weather Service reported 39.98 inches of precipitation. The annual evaporation rate is equivalent to over 70 inches per year.

Local winds are predominantly from the south and southwest (Ref. Figure 3) and during 1975 had an average speed of 6.3 meters per second. The Texas Panhandle is an area of high tornado risk with central Oklahoma as the only other area in the United States experiencing a higher tornado frequency. The reported probability of the Pantex Plant being hit by a tornado during any given year is three chances in one thousand or 0.003(1).

The probability of experiencing earthquakes, however, is relatively low. The Uniform Building Code places the Pantex area in Zone 1 which rates second lowest in earthquake occurrence on a scale from Zone 0 to Zone 3(2).

Underlying the Texas Panhandle is the Ogallala aquifer which serves as the primary source of water for Pantex and surrounding communities. A surface layer of clay 18 to 24 metres deep forms a barrier to surface moisture and prevents deep percolation from surface contamination(3, 4, 5). This clay layer is usually underlaid with caliche and dry Ogallala sands which cover the saturated aquifer. Producing water wells on the Pantex Plant site are up to 244 metres deep although small quantities of usable water are available at about 76 metres.

The Panhandle area is not densely populated having approximately 236,000 persons residing within an 80 kilometer radius of the Pantex Plant(6). Amarillo, Texas, located southwest of the plant site, is the largest single populated center with about 185,000 residents. Pampa, Texas, located about 40 miles northeast of the plant, is second in population density with about 21,000 residents. The remaining population is distributed throughout smaller communities, farms and ranches. Although there is a variety of industries in the area the local economy is influenced most significantly by agriculture and related industries.

Wheat and grain sorghums are the major field crops in the area with cattle ranching and cattle feeding also serving a large portion of the local economy.

SUMMARY

During 1975 Pantex Plant continued its environmental monitoring program which entailed the analysis of air, water, soil, vegetation and specific biota. The monitoring program highlights for 1975 were the establishment of two remote air monitoring stations, the drilling of two 350-ft test wells and use of the EPA climatological dispersion model for calculation of uranium and tritium concentrations at the various receptor points.

Air samples were obtained from eleven off-site continuously operating air collection devices which were equipped with particulate and water vapor collectors (Ref. Figure 4). These air samples were analyzed for gross alpha, gross beta, total uranium, plutonium-239, and tritium. The results of these analyses indicate that airborne radioactivity in the vicinity of the Pantex facility was well within established radioactivity concentration guides (RCG).

The activity that was observed is believed to be largely a result of natural radioactivity and worldwide fall-out from atomic or nuclear weapons tests and not from Pantex Plant activities.

Water sampling was performed for ground water from Pantex wells, an off-site playa located north of the facility (designated WS-1 on Figure 5) and for the on-site retention playa which collects all industrial and treated sanitary effluents prior to use in crop irrigation.

The data on radioactivity in water do not indicate the presence of radioactivity discernible above natural levels.

Soil samples were collected and subjected to analysis for total uranium, plutonium-239 and tritium content at locations indicated on Figure 5.

There are no official RCG's for radionuclides in soil. The concentrations resulting from analyses of the local soil for plutonium-239 show that local levels are indistinguishable from world-wide fallout.

Tritium and total uranium analyses are also consistent with what is considered natural activity.

Analysis of vegetation to determine total uranium and tritium concentrations was performed to determine whether unusual uptake of uranium or tritium from the soil or air had occurred. As with soil there are no established RCG's for uranium or tritium in vegetation although RCG's for water are sometimes used for purposes of comparison.

The data in tables XVI and XVII are consistent with past data on vegetation and do not indicate any upward trend. Local vegetation naturally contains uranium in concentrations comparable with those in Table XVI.

Beginning in 1974 the jackrabbit (*Lepus californicus* Gray) has been used for analysis in the environmental monitoring program. The jackrabbit was chosen as the subject because of its abundance, its prolific nature and its habit of maintaining a limited range as long as food is available.

Of the three types of analysis performed on the jackrabbits, only the uranium data showed concentrations above the detection limit (Ref. Tables XVIII, XIX and XX).

The individual organ mass is provided in Table XXI to assist in the evaluation of organ doses if desired.

On the basis of the estimated quantities of uranium-238 and tritium released during 1975 (Ref. Table I) the associated average concentrations and dose equivalents were calculated for persons residing within an 80 kilometer radius of Pantex Plant. Dose calculations for the site boundary and nearest inhabitants include kidney dose as well as total body dose equivalent since the kidney is the critical organ for uranium-238 exposure. The total body dose for all persons residing within an 80 kilometer radius of the Pantex Plant is expressed in person-rem.

Meteorological observations from the National Weather Service Office at the Amarillo Air Terminal were utilized in construction of a resultant wind rose for the Pantex vicinity. This, together with associated climatological data is utilized as input to a computer model for calculation of uranium and tritium concentrations within the 80 kilometer radius.

The computer model utilized for calculation of contaminant contributions is the Climatological Dispersion Model (CDM) written by the National Environmental Research Center of the U. S. Environmental Protection Agency(?). Use of the CDM should provide a more reliable and accurate projection of air contaminants than did the hand calculations used in previous years.

The uranium and tritium concentrations in Table III were used in calculating the dose values in Table IV. For the uranium calculations separate RCG's and associated doses were used for the total body and kidney determinations since the limiting dose equivalent is different in each case.

ENVIRONMENTAL MONITORING

AIR

Radioactive

Environmental air sampling is accomplished through the use of eleven continuously operating air samplers five of which are located along an approximate 5-mile radius of Pantex Plant (Ref. Figure 4).

These samplers are equipped with air pumps that operate continuously at a collection rate of ~ 28 l/min. Particulates are collected on a 47 millimeter diameter membrane filter which is collected on a weekly basis. Although severe weather and other factors influence collection frequency a typical weekly air sample will represent about 600 cubic meters of air.

During 1974 a silica gel column capability was added to the air pumps and tested for sampling of environmental tritium oxide. The silica gel, acting as a desiccant, removes water vapor from the air stream following removal of the particulates. Any tritium oxide present will be captured with the water vapor and may be recovered for analysis at some later date. Silica gel columns are exchanged on the same frequency as the air filters.

Each weekly air sample is evaluated for gross alpha and gross beta activity then composited on a monthly basis with other filters from the same air sampling station. These samples are then sent to an outside laboratory for total uranium and plutonium-239 analysis. Silica gel samples are also analyzed by an outside laboratory to determine tritium oxide content but are not composited as were the air filters.

Two additional air sampling locations were established and placed in operation during December 1975. These stations are designated OA-11 and OA-12 in Figure 4.

A summary of the results for gross alpha, gross beta, uranium, plutonium-239 and tritium oxide in air is presented in Tables V, VI, VII and VIII.

Non-Radioactive

Pantex Plant does not have any industrial processes which serve as significant sources of particulate matter, carbon monoxide, photochemical oxidants, hydrocarbons, oxides of nitrogen or oxides of sulfur. Steam is generated by natural gas fired boilers which are low in sulfur dioxide emissions. Other sources of pollutants are generally absent since most of the work performed is mechanical rather than chemical. Estimated emissions from Pantex Plant steam generation operations include 147 metric tons of carbon monoxide and 59 metric tons of oxides of nitrogen.

Some emissions occur from test fires of chemical high explosives, burning of waste high explosives and "flashing" of high explosives contaminated scrap metal. These operations occur so infrequently, however, (a few hours per week) that off-site environmental sampling for related non-radioactive contaminants is not performed. During 1975 an estimated 68,000 kg of waste chemical high explosives were burned and 76,000 litres of toluene were disposed of by evaporation.

WATER

Radioactive

Local geologic characteristics of the Pantex vicinity are such that there are no streams or rivers which flow through or near the plant site. Plant effluents flow into an on-site playa prior to use for irrigation.

This on-site retention playa, a nearby natural playa (designated WS-1 in Figure 5) and groundwater from plant wells are the only available locations for collecting environmental water samples. Plant wells include deep water wells from the Ogallala aquifer and two special shallow test wells designated WS-19 and WS-20. Playa water is not considered potable as it is high in natural dissolved alkali salts. The nearby natural playa was dry during most of 1975.

From the sources available one-gallon water samples are collected monthly and sent to an outside laboratory for analysis of gross alpha, gross beta, total uranium, plutonium-239 and tritium oxide content. A summary of these data for 1975 is presented in Tables IX, X, XI and XII.

Non-Radioactive

Analysis of environmental water samples is also accomplished for non-radioactive species but on a quarterly rather than monthly basis. The actual analytical work is performed by an outside laboratory and comparisons are made with proposed Environmental Protection Agency and Public Health service drinking water standards.

A summary of analysis for non-radioactive species for 1975 is presented in Table XXII.

SOIL

Radioactive

Thirty-one environmental soil samples are collected monthly at the locations indicated in Figure 5 according to standard soil sampling protocol. Each sample consists of two plugs from a "cookie cutter" which is 8.9 centimeters in diameter and 5.1 centimeters in depth. A sample may also contain a small amount of roots/vegetation.

After collection, the samples are sent to an outside laboratory where any uranium, plutonium or tritium is chemically extracted according to standard methods and then analyzed to determine the amount of each isotope of interest.

A summary of soil sampling results is presented in Tables XIII, XIV and XV for uranium, plutonium-239 and tritium oxide respectively.

Non-Radioactive

No environmental sampling for non-radioactive contaminants in soil was performed during 1975.

VEGETATION

Radioactive

Environmental vegetation samples are collected from 16 locations (Ref. Figure 5) each month for analysis of total uranium and tritium oxide content. These samples consist primarily of native and domestic grasses although it is not uncommon for a small percentage of other vascular plants to be present in some samples.

Following collection and labeling the samples are sent to an outside laboratory for the actual analysis. The analytical procedures used are essentially the same as for analysis of nuclides in soil and a summary of the results is presented in Tables XVI and XVII.

Non-Radioactive

Analysis of environmental vegetation samples for non-radioactive contaminants was not performed during 1975.

BIOTA

Radioactive

During 1975 eleven jackrabbits (*Lepus californicus* Gray) were collected from within the plant perimeter and analyzed for the presence of uranium, plutonium-239 and tritium oxide. The locations where the specimens were collected were chosen as carefully as possible to provide the clearest indication of whether other than natural levels of uranium, plutonium-239 or tritium oxide was present in the biological cycle.

Following collection the specimens were frozen and sent to an independent laboratory where dissection and analyses of lung, liver, kidney, bone and muscle tissue were performed to determine the quantity of uranium, plutonium-239 and tritium oxide present in each organ.

These data are presented in their entirety in Tables XVIII, XIX and XX.

Non-Radioactive

The analysis of biota for the presence of non-radioactive species was not performed during 1975.

CALCULATION OF POTENTIAL RADIATION DOSE TO THE PUBLIC FROM PANTEX ACTIVITIES FOR 1975

Radiation exposure to the public from Pantex activities is minimal. An estimation of the overall impact to the public from routine activities was made by application of atmospheric diffusion calculations to average annual radioactivity release rates using local meteorological data.

Table I provides estimated curies of depleted uranium and tritium released during 1975. These releases are considered ground level releases since the uranium and tritium were released from structures or facilities not having stacks. Average resultant wind speed and directional frequency (Ref. Figure 3) were determined for each of the sixteen compass points using official climatological data for Amarillo, Texas for 1975(8).

Population estimates were based on figures presented in the Texas Almanac for each city, town and county within an 80 kilometer radius of Pantex Plant(6,9).

The computer model utilized in describing local atmospheric dispersion utilizes six atmospheric stability classes and six wind speed classes to describe the atmospheric characteristics of the sixteen wind sectors contained within the 80 kilometer radius. Meteorological parameters were chosen from data obtained at the Amarillo Office of the National Weather Service and utilized as input parameters for the Climatological Dispersion Model (CDM). Following input of approximate parameters, source data and receptor points the CDM calculates average annual concentration of contaminants at each receptor point.

Estimates dose equivalents from the inhalation of depleted uranium and tritium were evaluated according to equation (1) which uses a simple ratio of the calculated concentration to the appropriate RCG as the basis for dose determination:

$$D_x = \frac{x \cdot D}{RCG} \quad (1)$$

Where

D_x = dose to critical organ in rem

x = concentration of nuclide (Ref. Table III)

RCG = RCG for uncontrolled area expressed in curies/cubic meter(10)

D = dose to critical organ associated with the appropriate RCG(10)

For Pantex operations, three groups of receptors were chosen in performing dose calculations: (a) hypothetical site boundary receptors, (b) nearest inhabitants to the plant reservation, and (c) cities, towns and communities within an 80 kilometer radius of Pantex Plant. Dose estimates are expressed in rem or person-rem where the term person-rem refers to the product of dose times population for the various receptor groups.

The 80 kilometer person-rem is determined according to contaminant concentration and population in sixteen sectors (Ref. Figure 6) as described by equation (2):

$$D_{80K} = \sum_{n=1}^K \frac{x_n D_{wb} P_n}{RCG_{wb}}$$

where

D_{80K} = 80 kilometer total body dose in person-rem

x_n = average concentration for each receptor location (Ref. Table III)

RCG_{wb} = radioactivity concentration guide associated with the whole body as the critical organ

D_{wb} = dose to whole body associated with the appropriate RCG

P_n = population for receptor considered (Ref. Table II)

K = number of receptor location

Figure 1. Pantex Plant 30 Mile (48-kilometer) Vicinity Map

Figure 2. Pantex Plant Facility Map

RESULTANT DIRECTION (FROM)	AVERAGE RESULTANT SPEED METERS/SECOND	PERCENT OCCURENCE
N	4.5	7.1
NNE	5.2	5.2
NE	3.6	4.6
ENE	2.4	1.9
E	3.5	2.2
ESE	2.7	2.4
SE	4.8	4.1
SSE	8.5	5.2
S	5.9	18.0
SSW	5.8	17.7
SW	5.0	6.3
WSW	5.1	7.4
W	4.4	5.7
WNW	3.6	3.8
NNW	3.5	4.1
NNW	4.6	4.3

Figure 3. Resultant Winds for Amarillo, Texas for 1975

Figure 4. Pantex Environmental Air Sampling Network

LEGEND

===== SOIL SURFACED ROAD

———— PAVED ROAD

PLAYA

- - - - - BOUNDARY LINE

● SOIL SAMPLE - SS

○ VEGETATION SAMPLE - VS

⊗ WATER SAMPLE - WS

SCALE

5 km

Figure 5. Environmental Soil, Water and Vegetation Sampling Locations for Pantex Plant

Figure 6. Population Within an 80 Kilometer Radius of Pantex Plant

Table I. Estimated Atmospheric Releases of
Radioactive Material from Pantex
for 1975

<u>Nuclide</u>	<u>Curies</u>	<u>Average Source Emission (Curies/Second)*</u>
Depleted Uranium (^{238}U)	2×10^{-4}	6×10^{-12}
Plutonium	0	0
Tritium (^3H)	3×10^{-3}	1×10^{-10}

* Average over one year (3.16×10^7 seconds)

Table II. Population of Area Receptors Used in 1975 Uranium and Tritium Calculations

<u>Receptor</u>	<u>Sector</u>	<u>Population</u>
Fritch	I	1,795
Sanford	I	185
Stinett	I	2,025
Rural/Suburban	I	795
Buena Vista	II	1,410
Borger	II	14,560
Phillips	II	2,540
Rural/Suburban	II	2,234
Skellytown	III	701
Rural/Suburban	III	91
Pampa	IV	20,979
White Deer	IV	1,102
Kings Mill	IV	65
Rural/Suburban	IV	2,240
Panhandle	V	2,190
Lefors	V	816
Alanreed	V	60
Rural/Suburban	V	92
Groom	VI	808
Jerico	VI	100
Lark	VI	26
Rural/Suburban	VI	1,669
Conway	VII	50
Ashtola	VII	20
Clarendon	VII	2,400
Goodnight	VII	25
Rural/Suburban	VII	646
Claude	VIII	1,017
Rural/Suburban	VIII	831
Wayside	IX	40
Rural/Suburban	IX	2,774
Washburn	X	70
Happy	X	680
Rural/Suburban	X	1,127
Canyon	XI	8,758
Umbarger	XI	327
Dawn	XI	94
Rural/Suburban	XI	3,816
Amarillo	XII	134,576
Bushland	XII	130
Wildorado	XII	180
Rural/Suburban	XII	4,328
Vega	XIII	839
Rural/Suburban	XIII	668
Channing	XIV	352
Boys Ranch	XIV	410
Rural/Suburban	XIV	841
Masterson	XV	85
Rural/Suburban	XV	1,541
Dumas	XVI	9,850
Rural/Suburban	XVI	2,791

Table III. Calculated Uranium-in-Air and Tritium-in-Air Contributions from Pantex Plant for 1975

Reactor	Calculated Tritium Contribution ($\mu\text{Ci}/\text{m}^2 \times 10^{-18}$)		% RCG	Calculated Uranium Contribution ($\mu\text{Ci}/\text{m}^2 \times 10^{-19}$)		% RCG
Fritch	3		3×10^{-9}	2		2×10^{-5}
Sanford	7		7×10^{-9}	5		5×10^{-5}
Stinnett	4		4×10^{-9}	3		3×10^{-5}
Rural/Suburban Sector I	6		6×10^{-9}	4		4×10^{-5}
Buena Vista	9		9×10^{-9}	6		6×10^{-5}
Borger	4		4×10^{-9}	3		3×10^{-5}
Phillips	4		4×10^{-9}	3		3×10^{-5}
Rural/Suburban Sector II	6		6×10^{-9}	4		4×10^{-5}
Skellytown	4		4×10^{-9}	2		2×10^{-5}
Rural/Suburban Sector III	4		4×10^{-9}	2		2×10^{-5}
Pampa	2		2×10^{-9}	1		1×10^{-5}
White Deer	6		6×10^{-9}	4		4×10^{-5}
Kings Mill	4		4×10^{-9}	3		3×10^{-5}
Rural/Suburban Sector IV	4		4×10^{-9}	3		3×10^{-5}
Panhandle	9		9×10^{-9}	6		6×10^{-5}
Lefors	3		3×10^{-9}	2		2×10^{-5}
Alanreed	1		1×10^{-9}	0.9		9×10^{-6}
Rural/Suburban Sector V	3		3×10^{-9}	2		2×10^{-5}
Groom	3		3×10^{-9}	2		2×10^{-5}
Jerico	2		2×10^{-9}	1		1×10^{-5}
Lark	3		3×10^{-9}	2		2×10^{-5}
Rural/Suburban Sector VI	2		2×10^{-9}	2		2×10^{-5}
Conway	3		3×10^{-9}	2		2×10^{-5}
Ashtola	2		2×10^{-9}	1		1×10^{-5}
Clarendon	1		1×10^{-9}	0.8		8×10^{-6}
Goodnight	2		2×10^{-9}	1		1×10^{-5}
Rural/Suburban Sector VII	2		2×10^{-9}	2		2×10^{-5}
Claude	5		5×10^{-9}	3		3×10^{-5}
Rural/Suburban Sector VIII	3		3×10^{-9}	2		2×10^{-5}
Wayside	3		3×10^{-9}	2		2×10^{-5}
Rural/Suburban Sector IX	7		7×10^{-9}	5		5×10^{-5}
Washburn	3		3×10^{-9}	2		2×10^{-5}
Happy	0.8		8×10^{-10}	0.6		6×10^{-6}
Rural/Suburban Sector X	2		2×10^{-9}	1		1×10^{-5}
Canyon	2		2×10^{-9}	1		1×10^{-5}
Umbarger	1		1×10^{-9}	0.8		8×10^{-6}
Dawn	1		1×10^{-9}	0.8		8×10^{-6}
Rural/Suburban Sector XI	3		3×10^{-9}	2		2×10^{-5}
Amarillo	3		3×10^{-9}	2		2×10^{-5}
Rushland	1		1×10^{-9}	0.8		8×10^{-6}
Wildorado	0.7		7×10^{-10}	0.4		4×10^{-6}
Rural/Suburban Sector XII	1		1×10^{-9}	0.9		9×10^{-6}
Vega	0.3		3×10^{-10}	0.2		2×10^{-6}
Rural/Suburban Sector XIII	0.7		7×10^{-10}	0.4		4×10^{-6}
Channing	2		2×10^{-9}	1		1×10^{-5}
Boys Ranch	1		1×10^{-9}	0.8		8×10^{-6}
Rural/Suburban Sector XIV	2		2×10^{-9}	2		2×10^{-5}
Masterson	2		2×10^{-9}	1		1×10^{-5}
Rural/Suburban Sector XV	2		2×10^{-9}	2		2×10^{-5}
Dumas	1		1×10^{-9}	0.8		8×10^{-6}
Rural/Suburban Sector XVI	1		1×10^{-9}	0.7		7×10^{-6}
Nearest Inhabitant	31		3×10^{-8}	20		2×10^{-4}
Site Boundry	284		3×10^{-7}	188		2×10^{-3}

* Radioactivity Concentration Guide = 1×10^{-12} $\mu\text{Ci}/\text{m}^2$ for ^{238}U and
 1×10^{-7} $\mu\text{Ci}/\text{m}^2$ for ^3H

Table IV. Pantex Vicinity Dose Calculation for 1975*

<u>Reference Point</u>	<u>Uranium (^{238}U)</u>	<u>Tritium (^3H)</u>
Site Boundary		
Total Body	2×10^{-7} Rem	7×10^{-10} Rem
Kidney	9×10^{-6} Rem	N/A
Nearest Individual		
Total Body	2×10^{-8} Rem	8×10^{-11} Rem
Kidney	1×10^{-6} Rem	N/A
80 Kilometer		
Total Body	4×10^{-4} Person-Rem	2×10^{-6} Person-Rem

*For Uranium-238, the kidney is the critical organ, the total body is the critical organ for Tritium exposures. Total body RCG's were used in total body and person-rem determinations.

Table V. Summary of Gross Alpha and Gross Beta Activity in Air for 1975

Sample Station	Number Samples		Average ($\mu\text{Ci}/\text{m}^3$)		Maximum ($\mu\text{Ci}/\text{m}^3$)		Minimum ($\mu\text{Ci}/\text{m}^3$)		% RCG Total Average
	Alpha	Beta	Alpha (10^{-16})	Beta (10^{-16})	Alpha (10^{-14})	Beta (10^{-16})	Alpha (10^{-16})	Beta (10^{-14})	
1	53	42	16.6 ± 7.5	8.4 ± 0.7	384.6 ± 6.8	43.4 ± 2.0	0.0 ± 12.3	0.2 ± 0.1	0.3
2	40	41	16.5 ± 9.3	7.5 ± 0.6	188.2 ± 30.5	43.4 ± 2.0	0.0 ± 1.0	0.4 ± 0.1	0.2
3	40	29	13.4 ± 9.1	3.9 ± 0.4	63.9 ± 19.2	13.7 ± 0.8	0.0 ± 1.0	0.4 ± 0.1	0.1
4	41	41	19.7 ± 10.7	8.1 ± 0.7	348.7 ± 41.5	38.8 ± 1.8	0.0 ± 1.0	0.0 ± 0.1	0.3
5	41	41	23.1 ± 11.0	9.0 ± 0.7	383.3 ± 43.5	42.7 ± 2.0	0.0 ± 1.0	0.1 ± 0.1	0.3
6	23	23	42.3 ± 14.7	10.2 ± 0.8	769.8 ± 61.6	33.0 ± 1.6	0.0 ± 1.0	0.1 ± 0.2	0.3
8	42	42	21.4 ± 10.7	8.7 ± 0.7	479.6 ± 48.7	34.8 ± 1.7	0.0 ± 1.0	0.0 ± 0.1	0.3
9	42	42	19.9 ± 10.2	6.7 ± 0.6	471.9 ± 48.3	30.4 ± 1.6	0.0 ± 1.0	0.0 ± 0.1	0.2
10	38	38	13.9 ± 8.6	5.4 ± 0.6	275.5 ± 36.9	30.9 ± 1.6	0.0 ± 1.0	0.0 ± 0.1	0.2
11	2	2	11.5 ± 10.1	1.9 ± 0.3	13.2 ± 10.7	2.1 ± 0.3	9.7 ± 9.5	1.8 ± 0.3	0.1
12	2	3	24.5 ± 13.6	2.1 ± 0.3	40.7 ± 16.9	3.2 ± 0.4	8.3 ± 9.2	1.0 ± 0.3	0.1

Minimum Detectable Limit = 1×10^{-16} (Alpha)

Minimum Detectable Limit = 1×10^{-15} $\mu\text{Ci}/\text{m}^3$ (Beta)

Radioactivity Concentration Guide = 3×10^{-11} $\mu\text{Ci}/\text{m}^3$ (Total)

Reported errors are at 95% confidence level

Table VI. Summary of Total Uranium in Air for 1975

<u>Sample Station</u>	<u>Number Samples</u>	<u>Average $\mu\text{Ci}/\text{m}^3 (10^{-17})$</u>	<u>Maximum $\mu\text{Ci}/\text{m}^3 (10^{-17})$</u>	<u>Minimum $\mu\text{Ci}/\text{m}^3 (10^{-17})$</u>	<u>% RCG (Average)</u>
1	12	48.8 $\pm$ 46.21	186.0 $\pm$ 68.6	0.0 $\pm$ 0.3	0.1
2	12	166.5 $\pm$ 79.5	885.6 $\pm$ 143.0	0.0 $\pm$ 0.2	0.2
3	12	5.2 $\pm$ 15.0	62.2 $\pm$ 52.1	0.0 $\pm$ 0.3	0.0
4	12	48.9 $\pm$ 37.2	390.4 $\pm$ 82.9	0.0 $\pm$ 0.3	0.1
5	12	47.2 $\pm$ 52.3	183.9 $\pm$ 104.0	0.0 $\pm$ 0.3	0.1
6	7	14.6 $\pm$ 29.0	102.2 $\pm$ 76.7	0.0 $\pm$ 0.2	0.0
8	12	60.3 $\pm$ 58.1	269.6 $\pm$ 102.0	0.0 $\pm$ 0.2	0.1
9	12	71.1 $\pm$ 44.2	426.8 $\pm$ 94.1	0.0 $\pm$ 0.2	0.1
10	12	36.4 $\pm$ 27.1	323.8 $\pm$ 78.1	0.0 $\pm$ 0.4	0.0
11	1	259.2 $\pm$ 156.0	259.2 $\pm$ 156.0	259.2 $\pm$ 156.0	0.3
12	1	0.0 $\pm$ 0.5	0.0 $\pm$ 0.5	0.0 $\pm$ 0.5	0.0

Minimum Detectable Limit = $2 \times 10^{-18} \mu\text{Ci}/\text{m}^3$ or $5 \times 10^{-12} \mu\text{g U}/\text{m}^3$

Radioactivity Concentration Guide = $1 \times 10^{-12} \mu\text{Ci}/\text{m}^3$

Reported errors are at 95% confidence level

Table VII. Summary of Plutonium-239 in Air for 1975

<u>Sample Station</u>	<u>Number Samples</u>	<u>Average $\mu\text{Ci}/\text{m}\ell$ (10^{-17})</u>	<u>Maximum $\mu\text{Ci}/\text{m}\ell$ (10^{-17})</u>	<u>Minimum $\mu\text{Ci}/\text{m}\ell$ (10^{-17})</u>	<u>% RCG (Average)</u>
1	12	3.0 ± 1.2	25.6 ± 2.8	0.0 ± 1.3	0.2
2	12	7.4 ± 2.2	45.0 ± 6.6	0.0 ± 1.3	0.4
3	12	3.4 ± 2.2	35.9 ± 6.6	0.0 ± 1.3	0.2
4	12	1.9 ± 1.8	22.3 ± 5.1	0.0 ± 1.3	0.1
5	12	0.0 ± 1.1	0.0 ± 1.2	0.0 ± 0.7	0.1
6	7	1.3 ± 1.3	5.8 ± 1.7	0.0 ± 1.2	0.7
8	12	35.8 ± 6.3	351.6 ± 19.6	0.0 ± 1.2	1.8
9	12	0.0 ± 1.0	0.0 ± 1.2	0.0 ± 0.8	0.1
10	12	9.1 ± 2.9	56.3 ± 6.0	0.0 ± 1.9	0.5
11	1	45.6 ± 10.1	45.6 ± 10.1	45.6 ± 10.1	2.3
12	1	0.0 ± 2.3	0.0 ± 2.3	0.0 ± 2.3	0.1

Minimum Detectable Limit = 1×10^{-17} $\mu\text{Ci}/\text{m}\ell$

Radioactivity Concentration Guide = 1×10^{-14} $\mu\text{Ci}/\text{m}\ell$

Reported errors are at 95% confidence level.

Table VIII. Tritium Oxide in Air for 1975

Sample Station	Number Samples	Average (10^{-12} $\mu\text{Ci}/\text{m}\ell$)	Maximum (10^{-12} $\mu\text{Ci}/\text{m}\ell$)	Minimum (10^{-12} $\mu\text{Ci}/\text{m}\ell$)	% RCG (Avg.)
OA- 1	27	0.1 ± 0.1	1.9 ± 1.2	0.0 ± 0.1	0.0004
OA- 2	26	0.1 ± 0.2	1.9 ± 1.7	0.0 ± 0.1	0.0004
OA- 3	26	0.0 ± 0.1	0.0 ± 0.1	0.0 ± 0.1	< 0.0004
OA- 4	26	0.1 ± 0.2	2.4 ± 2.1	0.0 ± 0.1	0.0004
OA- 5	26	0.0 ± 0.1	0.9 ± 0.6	0.0 ± 0.1	< 0.0004
OA- 6	14	0.1 ± 0.1	1.5 ± 0.5	0.0 ± 0.1	0.0004
OA- 8	27	0.0 ± 0.1	0.0 ± 0.1	0.0 ± 0.1	< 0.0004
OA- 9	27	0.0 ± 0.1	0.0 ± 0.1	0.0 ± 0.1	< 0.0004
OA-10	27	0.1 ± 0.2	1.9 ± 1.7	0.0 ± 0.1	0.0004
OA-11	3	0.0 ± 0.1	0.0 ± 0.1	0.0 ± 0.1	< 0.0004
OA-12	3	0.0 ± 0.1	0.0 ± 0.1	0.0 ± 0.1	< 0.0004

Minimum Detectable Limit = 8×10^{-13} $\mu\text{Ci}/\text{m}\ell$

Radioactivity Concentration Guide = 2×10^{-7} $\mu\text{Ci}/\text{m}\ell$

Reported errors are at 95% confidence level

Table IX. Summary of Gross Alpha and Gross Beta Activity in Water for 1975

Sample Identification	Number Samples	Average ($\mu\text{Ci}/\text{ml}$)		Maximum ($\mu\text{Ci}/\text{ml}$)		Minimum ($\mu\text{Ci}/\text{ml}$)		% RCG Total Average
		Alpha (10^{-9})	Beta (10^{-9})	Alpha (10^{-9})	Beta (10^{-9})	Alpha (10^{-9})	Beta (10^{-9})	
WS-1								
Suspended	8	1 ± 5	5 ± 3	7 ± 4	18 ± 4	0 ± 5	0 ± 2	0.6
Dissolved	8	12 ± 9	15 ± 4	65 ± 21	41 ± 8	0 ± 5	0 ± 2	2.7
Retention Playa								
Suspended	13	0 ± 5	1 ± 2	0 ± 5	6 ± 4	0 ± 5	0 ± 2	0.1
Dissolved	13	12 ± 9	12 ± 4	49 ± 11	24 ± 4	0 ± 5	0 ± 2	2.4
Ground Water								
Suspended	19	0 ± 5	2 ± 2	0 ± 5	34 ± 5	0 ± 5	0 ± 2	0.2
Dissolved	19	8 ± 7	8 ± 4	43 ± 11	24 ± 4	0 ± 5	0 ± 2	1.6
WS-19								
Suspended	9	0 ± 5	5 ± 3	0 ± 5	37 ± 5	0 ± 5	0 ± 2	0.5
Dissolved	9	3 ± 5	8 ± 3	11 ± 5	44 ± 5	0 ± 5	0 ± 2	1.1
WS-20								
Suspended	9	1 ± 5	8 ± 3	7 ± 3	40 ± 5	0 ± 5	0 ± 2	0.9
Dissolved	9	12 ± 7	5 ± 3	99 ± 14	9 ± 3	0 ± 5	0 ± 2	11.1

Minimum Detectable Limit = $5 \times 10^{-6} \mu\text{Ci}/\text{ml}$ (Alpha)
 $2 \times 10^{-6} \mu\text{Ci}/\text{ml}$ (Beta)

Radioactivity Concentration Guide = $1 \times 10^{-6} \mu\text{Ci}/\text{ml}$

Reported errors are counting error at 95% confidence level

Table X. Summary of Total Uranium in Water for 1975

Sample Identification	Number Samples	Average		Maximum		Minimum		% RCG Average
		(10^{-9} $\mu\text{Ci/ml}$)	($\mu\text{g U/l}$)	(10^{-9} $\mu\text{Ci/ml}$)	($\mu\text{g U/l}$)	(10^{-9} $\mu\text{Ci/ml}$)	($\mu\text{g U/l}$)	
WS-1	8	7.0 ± 2.8	21.0	23.0 ± 2.3	69.1	0.0 ± 0.5	≤ 1.5	0.07
Retention Playa	13	29.9 ± 5.4	89.8	282.0 ± 14.0	847	4.6 ± 4.0	13.8	0.30
Ground Water	18	10.2 ± 4.0	30.6	62.0 ± 6.2	186	0.0 ± 0.5	≤ 1.5	0.10
WS-19	9	3.6 ± 3.0	10.8	16.3 ± 4.4	48.9	0.0 ± 0.5	≤ 1.5	0.04
WS-20	9	6.3 ± 4.0	18.9	13.3 ± 5.3	39.9	0.0 ± 0.5	≤ 1.5	0.06

Minimum Detectable Limit = 5×10^{-10} $\mu\text{Ci/ml}$ (1.5 $\mu\text{g U/l}$)

Radioactivity Concentration Guide = 1×10^{-5} $\mu\text{Ci/ml}$ for general population

Table XI. Summary of Plutonium-239 in Water for 1975

<u>Sample Identification</u>	<u>Number Samples</u>	<u>Average</u> <u>(10^{-10} $\mu\text{Ci}/\text{m}\ell$)</u>	<u>Maximum</u> <u>(10^{-10} $\mu\text{Ci}/\text{m}\ell$)</u>	<u>Minimum</u> <u>(10^{-10} $\mu\text{Ci}/\text{m}\ell$)</u>	<u>% RCG</u> <u>(Average)</u>
WS-1	7	0.2 ± 0.2	1.5 ± 0.2	0.0 ± 0.2	0.0010
Retention Playa	12	0.1 ± 0.2	1.1 ± 0.2	0.0 ± 0.2	0.0005
Ground Water	17	0.1 ± 0.2	1.4 ± 0.1	0.0 ± 0.2	0.0005
WS-19	9	0.0 ± 0.2	0.0 ± 0.2	0.0 ± 0.2	< 0.0010
WS-20	9	0.0 ± 0.2	0.0 ± 0.2	0.0 ± 0.2	< 0.0010

Minimum Detectable Limit = 2×10^{-11} $\mu\text{Ci}/\text{m}\ell$.

Radioactivity Concentration Guide = 2×10^{-6} $\mu\text{Ci}/\text{m}\ell$

Reported errors are counting error at 95% confidence level

Table XII. Summary of Tritium in Water for 1975

Sample Identification	Number Samples	(10 ⁻⁶ μ Ci/ml)			% RCG (Average)
		Average	Maximum	Minimum	
WS-1	8	0.0 $\pm$ 0.2	0.0 $\pm$ 0.2	0.0 $\pm$ 0.2	< 0.02
Retention Playa	13	0.0 $\pm$ 0.2	0.0 $\pm$ 0.2	0.0 $\pm$ 0.2	< 0.02
Ground Water	18	0.0 $\pm$ 0.2	0.7 $\pm$ 0.5	0.0 $\pm$ 0.2	< 0.02
WS-19	9	0.1 $\pm$ 0.3	0.6 $\pm$ 0.6	0.0 $\pm$ 0.2	0.01
WS-20	9	0.0 $\pm$ 0.2	0.0 $\pm$ 0.2	0.0 $\pm$ 0.2	< 0.02

Minimum Detectable Limit = 2×10^{-7} μ Ci/ml.

Radioactivity Concentration Guide (RCG) = 1×10^{-3} μ Ci/ml

Errors are reported at the 95% confidence level.

Table XIII. Summary of Uranium in Soil for 1975

Sample Location	Number Samples	(10 ⁻⁷ μ Ci/g)		
		Average	Maximum	Minimum
SS-1	12	3.5 $\pm$ 0.6	6.5 $\pm$ 1.2	1.0 $\pm$ 0.2
SS-2	12	3.4 $\pm$ 0.7	7.3 $\pm$ 1.3	0.7 $\pm$ 0.2
SS-3	12	3.8 $\pm$ 0.7	17.5 $\pm$ 1.6	0.6 $\pm$ 0.1
SS-4	12	3.7 $\pm$ 0.7	7.4 $\pm$ 0.9	0.5 $\pm$ 0.1
SS-5	12	3.1 $\pm$ 0.6	4.7 $\pm$ 0.4	0.6 $\pm$ 0.1
SS-6	12	3.5 $\pm$ 0.7	13.8 $\pm$ 1.4	1.0 $\pm$ 0.2
SS-7	12	4.0 $\pm$ 0.8	19.7 $\pm$ 1.6	1.0 $\pm$ 0.2
SS-8	12	3.7 $\pm$ 0.7	7.4 $\pm$ 0.9	0.6 $\pm$ 0.1
SS-9	12	3.1 $\pm$ 0.7	5.1 $\pm$ 1.1	0.8 $\pm$ 0.2
SS-10	12	29.5 $\pm$ 5.8	254.7 $\pm$ 20.0	0.8 $\pm$ 0.2
SS-11	12	2.5 $\pm$ 0.6	3.9 $\pm$ 0.7	1.0 $\pm$ 0.2
SS-12	12	3.6 $\pm$ 0.7	6.1 $\pm$ 0.4	1.2 $\pm$ 0.2
SS-13	12	3.1 $\pm$ 0.6	5.1 $\pm$ 0.9	1.0 $\pm$ 0.2
SS-14	12	2.7 $\pm$ 0.6	5.6 $\pm$ 0.9	0.0 $\pm$ 0.2
SS-15	12	3.5 $\pm$ 0.7	8.0 $\pm$ 1.0	1.2 $\pm$ 0.2
SS-16	12	3.1 $\pm$ 0.7	5.3 $\pm$ 0.6	1.0 $\pm$ 0.2
SS-17	12	3.7 $\pm$ 0.7	7.9 $\pm$ 1.4	1.8 $\pm$ 0.2
SS-18	12	3.7 $\pm$ 0.7	6.1 $\pm$ 0.9	0.8 $\pm$ 0.2
SS-19	12	2.7 $\pm$ 0.6	3.6 $\pm$ 1.2	1.5 $\pm$ 0.5
SS-20	12	3.3 $\pm$ 0.6	7.2 $\pm$ 0.4	1.4 $\pm$ 0.5
SS-21	12	3.5 $\pm$ 0.7	9.2 $\pm$ 1.0	1.0 $\pm$ 0.2
SS-22	12	3.0 $\pm$ 0.7	4.9 $\pm$ 0.8	1.1 $\pm$ 0.2
SS-23	12	3.9 $\pm$ 0.7	5.5 $\pm$ 0.9	1.4 $\pm$ 0.5
SS-24	12	3.8 $\pm$ 0.6	9.1 $\pm$ 0.7	0.8 $\pm$ 0.5
SS-25	12	3.3 $\pm$ 0.7	6.3 $\pm$ 0.9	1.1 $\pm$ 0.2
SS-26	12	3.5 $\pm$ 0.6	9.6 $\pm$ 0.6	1.5 $\pm$ 0.3
SS-27	12	3.0 $\pm$ 0.6	4.4 $\pm$ 0.8	1.5 $\pm$ 0.2
SS-28	12	3.9 $\pm$ 0.7	12.7 $\pm$ 0.7	1.0 $\pm$ 0.1
SS-29	12	3.0 $\pm$ 0.6	4.7 $\pm$ 0.8	1.0 $\pm$ 0.3
SS-30	11	3.0 $\pm$ 0.7	5.8 $\pm$ 1.2	1.5 $\pm$ 0.3
SS-31	11	3.6 $\pm$ 0.7	5.1 $\pm$ 0.9	1.5 $\pm$ 0.3

Minimum Detectable Limit = 1.2×10^{-8} μ Ci/g

Results are per gram of dry soil

Table XIV. Summary of Plutonium-239 in Soil for 1975

Sample Location	Number Samples	Average (10^{-6} $\mu\text{Ci/g}$)	Maximum (10^{-6} $\mu\text{Ci/g}$)	Minimum (10^{-6} $\mu\text{Ci/g}$)
SS-1	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-2	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-3	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-4	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-5	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-6	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-7	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-8	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-9	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-10	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-11	12	0.05 ± 0.05	0.3 ± 0.16	0.0 ± 0.02
SS-12	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-13	12	0.05 ± 0.02	0.1 ± 0.01	0.0 ± 0.02
SS-14	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-15	12	0.0 ± 0.02	0.1 ± 0.01	0.0 ± 0.02
SS-16	12	0.05 ± 0.07	0.4 ± 0.23	0.0 ± 0.02
SS-17	12	0.0 ± 0.02	0.1 ± 0.01	0.0 ± 0.02
SS-18	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-19	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-20	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-21	12	0.0 ± 0.02	0.1 ± 0.02	0.0 ± 0.02
SS-22	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-23	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-24	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-25	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-26	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-27	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-28	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-29	12	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02
SS-30	12	0.0 ± 0.02	0.1 ± 0.01	0.0 ± 0.02
SS-31	7	0.0 ± 0.02	0.0 ± 0.02	0.0 ± 0.02

Minimum Detectable Limit = 0.02×10^{-6} $\mu\text{Ci/g}$
 Reported errors are at 95% confidence level
 Activity is per gram of dry soil

Table XV. Summary of Tritium in Soil for 1975

Sample Location	Number Samples	% Moisture	(10 ⁻⁶ μ Ci/g Moisture)		
			Average	Maximum	Minimum
SS-1	12	10.4	0.1 $\pm$ 1.0	1.5 $\pm$ 1.2	0.0 $\pm$ 1.0
SS-2	12	9.1	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0
SS-3	12	8.9	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0
SS-4	12	9.5	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0
SS-5	12	9.3	0.2 $\pm$ 1.1	2.2 $\pm$ 2.2	0.0 $\pm$ 1.0
SS-6	12	9.9	0.3 $\pm$ 1.2	3.5 $\pm$ 2.4	0.0 $\pm$ 1.0
SS-7	12	8.8	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0
SS-8	12	9.6	0.2 $\pm$ 1.1	3.0 $\pm$ 2.2	0.0 $\pm$ 1.0
SS-9	12	9.0	0.4 $\pm$ 1.2	2.6 $\pm$ 2.1	0.0 $\pm$ 1.0
SS-10	12	9.3	0.1 $\pm$ 1.0	1.0 $\pm$ 0.8	0.0 $\pm$ 1.0
SS-11	12	7.9	0.1 $\pm$ 1.0	1.0 $\pm$ 0.7	0.0 $\pm$ 1.0
SS-12	12	9.2	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0
SS-13	12	7.9	0.3 $\pm$ 1.2	3.3 $\pm$ 2.4	0.0 $\pm$ 1.0
SS-14	12	7.7	0.3 $\pm$ 1.2	3.6 $\pm$ 2.4	0.0 $\pm$ 1.0
SS-15	12	6.7	0.1 $\pm$ 1.0	1.0 $\pm$ 0.7	0.0 $\pm$ 1.0
SS-16	12	6.7	0.3 $\pm$ 1.0	3.8 $\pm$ 1.4	0.0 $\pm$ 1.0
SS-17	12	9.6	0.1 $\pm$ 1.0	1.3 $\pm$ 0.8	0.0 $\pm$ 1.0
SS-18	12	9.0	0.3 $\pm$ 1.1	2.8 $\pm$ 2.0	0.0 $\pm$ 1.0
SS-19	12	6.7	0.3 $\pm$ 1.2	3.4 $\pm$ 2.3	0.0 $\pm$ 1.0
SS-20	12	5.1	0.3 $\pm$ 1.1	2.7 $\pm$ 1.9	0.0 $\pm$ 1.0
SS-21	12	7.1	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0
SS-22	12	7.2	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0
SS-23	12	7.2	0.4 $\pm$ 1.1	5.4 $\pm$ 3.3	0.0 $\pm$ 1.0
SS-24	12	8.2	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0
SS-25	12	9.0	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0
SS-26	12	9.0	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0
SS-27	12	8.0	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0
SS-28	12	10.0	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0	0.0 $\pm$ 1.0
SS-29	12	7.9	0.2 $\pm$ 1.1	2.2 $\pm$ 1.9	0.0 $\pm$ 1.0
SS-30	12	6.7	0.0 $\pm$ 1.0	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0
SS-31	12	8.3	0.0 $\pm$ 1.0	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0

Minimum Detectable Limit = 1 $\times$ 10⁻⁶ μ Ci/g moisture

Reported errors are at the 95% confidence level

Table XVI. Summary of Total Uranium in Vegetation for 1975

<u>Sample Location</u>	<u>Number Sample</u>	<u>(10⁻⁷ μCi/g)</u>		
		<u>Average</u>	<u>Maximum</u>	<u>Minimum</u>
VS-1	12	1.3 $\pm$ 0.6	5.5 $\pm$ 0.4	0.0 $\pm$ 0.2
VS-2	12	3.3 $\pm$ 1.2	17.6 $\pm$ 0.7	0.4 $\pm$ 0.3
VS-3	12	1.9 $\pm$ 0.8	5.0 $\pm$ 1.3	0.0 $\pm$ 0.2
VS-4	12	2.4 $\pm$ 0.7	10.7 $\pm$ 1.2	0.0 $\pm$ 0.2
VS-5	12	4.6 $\pm$ 1.0	22.5 $\pm$ 0.8	0.0 $\pm$ 0.2
VS-6	12	2.7 $\pm$ 1.0	11.7 $\pm$ 1.0	0.0 $\pm$ 0.2
VS-7	12	2.2 $\pm$ 1.0	11.4 $\pm$ 1.0	0.0 $\pm$ 0.2
VS-8	12	2.8 $\pm$ 0.8	13.5 $\pm$ 1.1	0.0 $\pm$ 0.2
VS-9	12	2.2 $\pm$ 1.0	8.4 $\pm$ 2.0	0.0 $\pm$ 0.2
VS-10	12	1.1 $\pm$ 0.8	7.8 $\pm$ 1.9	0.0 $\pm$ 0.2
VS-11	12	1.1 $\pm$ 0.8	6.1 $\pm$ 1.1	0.0 $\pm$ 0.2
VS-12	12	2.4 $\pm$ 0.8	14.9 $\pm$ 2.0	0.0 $\pm$ 0.2
VS-13	12	2.1 $\pm$ 0.7	8.7 $\pm$ 1.1	0.0 $\pm$ 0.2
VS-14	12	13.1 $\pm$ 2.1	92.9 $\pm$ 6.9	0.0 $\pm$ 0.2
VS-15	12	1.4 $\pm$ 0.7	3.7 $\pm$ 0.8	0.0 $\pm$ 0.2
VS-16	12	2.5 $\pm$ 0.9	14.4 $\pm$ 1.5	0.0 $\pm$ 0.2

Minimum Detectable Limit = 2.7×10^{-8} μ Ci (0.05 μ g)

Results are per gram of dry vegetation

Errors are at 95% confidence level

Table XVII. Summary of Tritium in Vegetation for 1975

Sample Location	Number Samples	% Moisture	10 ⁻⁶ μ Ci/g Moisture		
			Average	Maximum	Minimum
VS-1	12	51.2	0.2 $\pm$ 0.3	1.3 $\pm$ 0.6	0.0 $\pm$ 0.2
VS-2	12	49.4	0.2 $\pm$ 0.3	1.3 $\pm$ 0.7	0.0 $\pm$ 0.2
VS-3	12	48.0	0.2 $\pm$ 0.3	1.1 $\pm$ 0.6	0.0 $\pm$ 0.2
VS-4	12	46.9	0.1 $\pm$ 0.2	0.5 $\pm$ 0.3	0.0 $\pm$ 0.2
VS-5	12	58.6	0.1 $\pm$ 0.2	0.8 $\pm$ 0.5	0.0 $\pm$ 0.2
VS-6	12	57.4	0.1 $\pm$ 0.3	1.1 $\pm$ 0.6	0.0 $\pm$ 0.2
VS-7	12	50.0	0.1 $\pm$ 0.3	0.8 $\pm$ 0.5	0.0 $\pm$ 0.2
VS-8	12	63.8	0.1 $\pm$ 0.3	0.9 $\pm$ 0.6	0.0 $\pm$ 0.2
VS-9	12	58.1	0.2 $\pm$ 0.3	1.1 $\pm$ 0.6	0.0 $\pm$ 0.2
VS-10	12	45.3	0.1 $\pm$ 0.3	1.2 $\pm$ 0.7	0.0 $\pm$ 0.2
VS-11	12	38.5	0.1 $\pm$ 0.2	0.6 $\pm$ 0.4	0.0 $\pm$ 0.2
VS-12	12	55.7	0.1 $\pm$ 0.2	1.0 $\pm$ 0.6	0.0 $\pm$ 0.2
VS-13	12	60.5	0.2 $\pm$ 0.3	0.7 $\pm$ 0.5	0.0 $\pm$ 0.2
VS-14	12	45.8	0.2 $\pm$ 0.3	0.7 $\pm$ 0.5	0.0 $\pm$ 0.2
VS-15	12	56.0	0.1 $\pm$ 0.3	1.0 $\pm$ 0.6	0.0 $\pm$ 0.2
VS-16	12	57.0	0.2 $\pm$ 0.3	1.1 $\pm$ 0.7	0.0 $\pm$ 0.2

Minimum Detectable Limit = 2×10^{-7} μ Ci/g Moisture

Reported errors are at the 95% confidence level

Table XVIII. Total Uranium in Jackrabbit for 1975

<u>Specimen Identification</u>	<u>(μg U/g ash)</u>				
	<u>Kidney</u>	<u>Liver</u>	<u>Lung</u>	<u>Muscle (Flesh)</u>	<u>Bone</u>
Sewage Treatment Plant (A)	3.3	47.8	31.7	15.0	1.1
(B)	2.0	3.9	12.1	12.2	3.6
Retention Playa (A)	192.0	5.7	18.2	10.9	0.6
(B)	12.4	11.3	16.6	8.5	1.5
Zone 12 (A)	34.1	14.2	4.8	23.5	0.8
(B)	35.1	32.2	12.4	25.3	0.2
Firing Site (A)	9.2	11.7	15.5	6.4	6.9
(B)	10.6	15.5	19.9	8.1	1.9
(C)	8.5	5.1	23.0	2.1	1.0
Radioactive Storage Area (A)	< 0.2	< 0.2	9.7	22.1	1.9
(B)	39.0	20.0	10.4	8.0	0.5

Minimum Detectable Limit = 0.05 μ g U/g Ash

Table XIX. Plutonium-239 in Jackrabbit for 1975

Specimen Identification	Kidney (10^{-6} μ Ci/g)	Liver (10^{-6} μ Ci/g)	Lung (10^{-6} μ Ci/g)	(Flesh) Muscle (10^{-6} μ Ci/g)	Bone (10^{-6} μ Ci/g)
Sewage Treatment Plant					
(A)	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.06 ± 0.05
(B)	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02
Retention Playa					
(A)	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02
(B)	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02
Zone 12					
(A)	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02
(B)	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02
Firing Site					
(A)	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02
(B)	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02
(C)	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02
Radioactive Storage Area					
(A)	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02
(B)	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02

Minimum Detectable Limit = 0.02×10^{-6} μ Ci/g Ash

Errors when reported are counting errors at 95% confidence level

Table XX. Tritium in Jackrabbit for 1975

<u>Specimen Identification</u>		<u>Kidney (pCi/g moisture)</u>	<u>Moisture (%)</u>	<u>Liver (pCi/g moisture)</u>	<u>Moisture (%)</u>	<u>Lung (pCi/g moisture)</u>	<u>Moisture (%)</u>	<u>(Flesh) Muscle (pCi/g moisture)</u>	<u>Moisture (%)</u>
Sewage Treatment Plant	(A)	0.00 ± 0.2	74.8	0.00 ± 0.2	74.2	0.00 ± 0.2	85.0	0.00 ± 0.2	82.7
	(B)	0.00 ± 0.2	68.8	0.00 ± 0.2	72.5	0.00 ± 0.2	84.0	0.00 ± 0.2	90.0
Retention Basin	(A)	0.00 ± 0.2	77.8	0.00 ± 0.2	79.2	0.00 ± 0.2	84.0	0.00 ± 0.2	78.7
	(B)	0.00 ± 0.2	75.7	0.00 ± 0.2	75.0	0.00 ± 0.2	80.0	0.00 ± 0.2	79.3
Zone 12	(A)	0.00 ± 0.2	66.7	0.00 ± 0.2	73.0	0.00 ± 0.2	81.0	0.00 ± 0.2	66.7
	(B)	0.00 ± 0.2	58.8	0.00 ± 0.2	76.0	0.00 ± 0.2	79.0	0.00 ± 0.2	66.7
Firing Site	(A)	0.00 ± 0.2	55.9	0.5 ± 0.4	71.7	0.00 ± 0.2	77.0	0.00 ± 0.2	76.7
	(B)	0.00 ± 0.2	48.9	0.3 ± 0.3	63.3	0.00 ± 0.2	76.0	0.00 ± 0.2	75.0
	(C)	0.00 ± 0.2	81.9	0.00 ± 0.2	73.3	0.00 ± 0.2	80.0	0.00 ± 0.2	74.6
Radioactive Storage Area	(A)	0.00 ± 0.2	91.0	0.00 ± 0.2	68.3	0.00 ± 0.2	56.0	0.00 ± 0.2	76.0
	(B)	0.00 ± 0.2	61.0	0.00 ± 0.2	78.3	0.00 ± 0.2	76.0	0.00 ± 0.2	82.0

Minimum Detectable Limit = 0.2 pCi/g moisture

Errors where reported are counting error at the 95% confidence level

Table XXI. Organ Weights of Jackrabbit for 1975

<u>Specimen Identification</u>		<u>Kidney (g)</u>	<u>Lung (g)</u>	<u>Liver (g)</u>
Sewage Treatment Plant	(A)	11.5	32.3	44.8
	(B)	16.0	42.1	51.2
Retention Playa	(A)	17.1	34.1	59.9
	(B)	7.1	32.9	46.0
Zone 12, 12-42	(A)	9.1	41.2	32.2
	(B)	12.8	31.8	38.7
Firing Site	(A)	28.5	44.9	89.1
	(B)	28.5	41.1	62.2
	(C)	17.0	43.0	67.7
Radioactive Storage Area	(A)	8.8	25.6	28.7
	(B)	16.9	29.0	51.0

Table XXII. Summary of Chemical Analysis of Water for 1975

Analysis	Sample Identification	Number Samples	(mg/ℓ)			Minimum Criteria (%)	Detectable Limit (mg/ℓ)
			Average	Maximum	Minimum		
As	Pantex Lake (PL)	2	0.01	--	--	<20	0.01
	Retention Playa (RP)	4	0.01	0.02	<0.01		
	Ground Water (GW)	10	0.01	0.02	<0.01		
	Test Wells (TW)	13	0.01	0.02	<0.01		
Cd	PL	2	<0.001	--	--	<10	0.001
	RP	4	<0.001	--	--		
	GW	10	<0.001	--	--		
	TW	13	<0.001	--	--		
Cr (Total)	PL	2	<0.006	--	--	<10	0.001
	RP	4	0.006	0.011	<0.005		
	GW	10	0.005	0.006	<0.001		
	TW	13	0.08	0.90	<0.001		
CR ⁺⁶	PL	2	<0.01	--	--	<45	0.001
	RP	4	0.01	0.01	0.01		
	GW	10	0.009	<0.01	<0.001		
	TW	13	0.09	0.95	0.01		
Cyanide	PL	2	<0.1	--	--	<45	0.01
	RP	4	<0.1	--	--		
	GW	10	0.09	0.1	<0.01		
	TW	12	<0.1	0.1	0.1		
Fe	PL	2	0.113	--	--	14	0.005
	RP	4	0.056	0.198	<0.001		
	GW	10	0.007	0.018	<0.001		
	TW	13	0.12	0.31	0.009		
Pb	PL	2	<0.001	--	--	< 2	0.001
	RP	4	0.001	0.002	<0.001		
	GW	10	<0.001	--	--		
	TW	13	<0.001	--	--		

Table XXII. Cont'd

Analysis	Sample Identification	Number Samples	(mg/ℓ)			Minimum Criteria (%)	Detectable Limit (mg/ℓ)
			Average	Maximum	Minimum		
Hg	PL	2	0.001	--	--	50	0.004
	RP	4	0.004	0.013	<0.0004		
	GW	10	0.001	0.003	<0.0004		
	TW	13	0.001	0.002	<0.0004		
NO ₃	PL	2	3.7	--	--	14	0.1
	RP	4	2.0	4.2	0.6		
	GW	10	1.4	2.5	0.7		
	TW	13	3.6	29.5	<0.1		
Phenol	PL	2	<0.001	--	--	<100	0.0001
	RP	4	<0.001	--	--		
	GW	10	<0.001	--	--		
	TW	13	<0.002	0.002	<0.001		
PO ₄	PL	2	0.1	--	--	200	0.1
	RP	4	0.92	1.5	0.60		
	GW	10	0.2	0.4	<0.1		
	TW	13	0.42	1.8	0.1		
SO ₄	PL	2	11.0	--	--	98	1.0
	RP	4	119.0	136.0	88.0		
	GW	10	48.8	149.0	10.7		
	TW	13	69.0	89.0	19.0		
Total Settleable Solids	PL	2	1.4 ml/ℓ	--	--	--	0.1
	RP	4	0.4 ml/ℓ	0.4 ml/ℓ	<0.1 ml/ℓ		
	GW	10	0.15 ml/ℓ	0.4 ml/ℓ	<0.01 ml/ℓ		
	TW	13	349.0 ml/ℓ	920.0 ml/ℓ	0.1 ml/ℓ		
Total Dissolved Solids	PL	2	206.0	--	--	59	1.0
	RP	4	558.0	576.0	525.0		
	GW	10	297.0	326.0	267.0		
	TW	12	564.0	594.0	308.0		

Table XXII. Cont'd

Analysis	Sample Identification	Number Samples	(mg/ℓ)			Minimum Criteria (%)	Detectable Limit (mg/ℓ)
			Average	Maximum	Minimum		
Zn	PL	2	0.009	--	--	20	0.001
	RP	4	0.04	0.085	<0.01		
	GW	10	0.01	0.03	<0.001		
	TW	13	0.02	0.1	<0.001		
pH	PL	2	7.50	--	--		--
	RP	4	7.78	7.98	7.55		
	GW	10	7.97	8.22	7.73		
	TW	13	8.46	8.85	7.86		
Oil/Grease	PL	2	65.8	--	--		1.0
	RP	4	122.0	303.0	18.0		
	GW	10	44.0	112.0	<1.0		
	TW	10	42.6	72.2	11.6		
Hardness	PL	2	138.9	--	--		1.0
	RP	4	227.0	245.0	196.0		
	GW	10	183.0	208.0	151.0		
	TW	13	152.0	218.0	125.5		
HMX	PL	2	<1.0	--	--		1.0
	RP	42	<1.0	--	--		
	GW	10	<1.0	--	--		
	TW	10	<1.0	--	--		
RDX	PL	2	<0.001	--	--		0.001
	RP	4	<0.001	--	--		
	GW	10	<0.001	--	--		
	TW	10	<0.001	--	--		
PETN	PL	2	<0.005	--	--		0.005
	RP	4	<0.005	--	--		
	GW	10	<0.005	--	--		
	TW	10	<0.005	--	--		

Table XXII. Cont'd

Analysis	Sample Identification	Number Samples	(mg/ℓ)			Minimum Criteria (%)	Detectable Limit (mg/ℓ)
			Average	Maximum	Minimum		
Chlorinated Pesticides (including DDT, DDE, DDD, B-BHC, Lindane, Aldrin, Dieldrin and Heptachloropoxide)	PL	1	<0.001	--	--	25 for Lindane	0.001
	RP	1	<0.001	--	--		
	GW	4	<0.001	--	--		
	TW	1	<0.001	--	--		
Se	PL	1	<0.01	--	--	<100	0.01
	RP	1	<0.01	--	--		
	GW	2	<0.01	--	--		
	TW	1	<0.01	--	--		
BOD	RP	12	12.0	37.6	3.57		0.5
Fluoride	PL	1	1.38	--	--	341	1.0
	RP	2	3.15	4.13	2.17		
	GW	4	6.15	12.0	1.68		
	TW	2	7.5	13.0	2.06		
Cu	PL	2	<0.001	--	--	300	0.001
	RP	4	0.003	0.031	<0.001		
	GW	10	0.03	0.108	<0.001		
	TW	13	0.001	0.005	<0.001		

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A P P E N D I X

STANDARDS FOR RADIOACTIVITY IN AIR AND WATER

Standards for radioactivity in air and water are derived from ERDA Manual Chapter 0524 and its appendix(10). The Radioactivity Concentration Guides (RCG's) for uncontrolled areas are generally the concentrations at which an individual if continually exposed would receive about 0.500 rem total body dose equivalent per year. RCG's for the general population are approximately 1/3 lower than RCG's for uncontrolled areas so that the general population will receive no more than 0.170 rem total dose equivalent per year or not more than 0.500 rem to the lungs or kidney when these serve as the critical organ.

In the case of mixtures of specific nuclides, the resultant RCG is determined such that the sum of the ratios of the concentrations of each nuclide to its respective RCG does not exceed unity. Nuclide concentrations are not considered part of a mixture whenever the concentration to RCG ratio is less than or equal to 0.1 and the sum of the ratios for all nuclides is less than 0.25.

RADIOACTIVITY CONCENTRATION GUIDES FOR SOIL AND VEGETATION

Presently there are no published generally accepted RCG's for radio-nuclides in soil and vegetation.

NON-RADIOACTIVE WATER QUALITY STANDARDS

Non-radioactive analyses are compared to applicable National Interim Primary Drinking Water Standards, Recommendations of the U. S. Federal Water Quality Administration and Public Health Service drinking water standards(11,12).

MINIMUM DETECTABLE LIMITS

Non-radioactive measurements are based on analog representations of physical parameters and a lower limit exists as to the sensitivity of the techniques and instrumentation employed. When measurements of non-radioactive parameters were performed and no indication in excess of lower detection limit was observed, the result was presented as less than (L) the minimum detectable limit. Average values were calculated by assuming the minimum detectable limit where positive indications were not obtained and portrayal of the final average as a less than value. The less than value for an average therefore indicates the assumption of the minimum detectable limit for one or more terms within the average.

Radioactive measurements however are subject to the statistical nature of radioactive decay and are presented in conjunction with an associated statistical error. The minimum detectable limit of a radioactive parameter has been conservatively expressed as the standard deviation of the measurement at the point for which the technique is no longer sensitive

at the desired confidence level. This treatment is further conservative in that statistically significantly negative numbers are assumed to be zero. Negative numbers can arise from statistical fluctuations in the radioactive decay of the sample, the blank, or in the background of the counting device. Averages are taken using zero for values which are less than the minimum detectable limit and by determining the associated error.

ANALYTICAL METHODS - RADIOACTIVE

AIR

Air Filters

Gross Alpha, Gross Beta

Filter paper samples are counted for gross alpha radioactivity on a low background internal flow proportional counter while it simultaneously counts alpha and beta activity. Appropriate corrections are applied for absorption and counter efficiency.

Total Uranium

The sample is dissolved in 8N HNO_3 , taken to dryness and oxidized to remove organics. Then the sample is dissolved in 2N ALNO_3 and extracted into diethyl ether. The ether is dried and the sample transferred to a stainless steel planchet for counting in a proportional counter.

Plutonium-239

A Pu-236 tracer is added to the filter paper sample, totally dissolved and converted to the nitrate by additions of HNO_3 . The plutonium is separated using an ion exchange resin, eluted off the column, and electroplated on a stainless steel disc. A solid state Alpha Spectrometer is utilized to count the disc and chemical recovery is determined from the tracer peak.

Silica Gel

Moisture is removed from the silica gel using a distillation apparatus. A portion of the distillate is then mixed with a scintillation solution and counted in a liquid scintillation spectrometer. The atmospheric tritium concentration is related to the tritium concentration of the distillate through the absolute humidity.

Water

Gross Alpha (Dissolved Solids)

After thorough agitation a suitable aliquot is taken for analysis. The aliquot is acidified and evaporated to dryness on a hot plate after which the residue is dissolved in 0.5 NHNO_3 , and transferred to a tared planchet, polishing the beaker thoroughly. Gross alpha radioactivity is measured by counting the planchet in an internal flow proportional counter (Wide Beta II Instrument).

The result is corrected for counter efficiency and self-absorption if an appreciable solid residue is obtained. For thickness greater than 1 mg/cm^2 , a correction must be applied.

Gross Beta (Dissolved Solids)

This same method is used as described under Gross Alpha (Dissolved Solids). A self-absorption correction factor is applied when the sample weight exceeds 1 mg/cm^2 .

Gross Alpha (Suspended Solids)

One litre of water is filtered through a millipore filter; the filter is counted utilizing a Wide Beta II Instrument.

Gross Beta (Suspended Solids)

The same method is used as described under Gross Alpha (Suspended Solids).

Total Uranium

After evaporation of a suitable aliquot the sample is dissolved in 8N HNO_3 , taken to dryness and oxidized to remove organics. Then the sample is dissolved in 2N ALNO_3 and extracted into diethyl ether. The ether is dried and the sample transferred to a stainless steel planchet for counting in a proportional counter.

Plutonium-239

The total water sample is acidified and aliquoted. A Pu-236 tracer is added to the aliquot and the plutonium is precipitated as an alkaline-earth phosphate. The precipitate is separated, ashed and dissolved in nitric acid. Plutonium is separated using an ion exchange resin, eluted off the column and electroplated on a stainless steel disc. A solid state Alpha Spectrometer is utilized to count the disc and chemical recovery is determined from the tracer peak.

Tritium

The water sample is distilled to remove quenching materials and nonvolatile radioactive materials. Distillation is carried to dryness to ensure complete transfer of the tritium to the distillate. A portion of the distillate is mixed with scintillation solution and counted in a liquid scintillation spectrometer. Standard tritium and background samples are prepared and counted alternately to nullify errors produced by aging of the scintillation medium or instrument drift. Each sample is counted for 500 minutes.

Soil

Total Uranium

The sample is dissolved in 8N HNO_3 , taken to dryness and oxidized to remove organics. Then the sample is dissolved in 2N ALNO_3 and extracted into diethyl ether. The ether is dried and the sample transferred to a stainless steel planchet for counting in a proportional counter.

Plutonium

The soil sample is totally dissolved using a 40% solution of HF and a Pu-236 tracer is added before dissolution. After fuming with HF the sample is converted to sulfate and brought up with HNO_3 . An ion exchange column is enlisted to separate the plutonium which is subsequently eluted off the column and electroplated on a stainless steel counting disc. This disc is counted on a solid state alpha spectrometer and recovery is determined from the tracer peak.

Tritium

The water is extracted from the soil sample by azeotropic distillation with benzene. The distillation is carried to dryness to ensure complete transfer of the tritium. A portion of the distillate is mixed with scintillation solution and counted utilizing a liquid scintillation spectrometer. Standard tritium and background samples are prepared and counted alternately to nullify errors produced by aging of the scintillation medium or instrument drift. Each sample will be counted for 500 minutes.

Vegetation

Total Uranium

After ashing the sample is dissolved in 8N HNO_3 , taken to dryness and oxidized to remove organics. Then the sample is dissolved in 2N ALNO_3 and extracted into diethyl ether. The ether is dried and the sample transferred to a stainless steel planchet for counting in a proportional counter.

Tritium

The same method is used as described under Soil for Tritium analysis.

ANALYTICAL METHODS - NON-RADIOACTIVE

Water Quality

In general, non-radioactive analysis are performed in accordance with standard methods(13). Analysis for explosives and pesticides is accomplished using an electron capture vapor phase chromatography technique(14). Mercury analyses are performed in accordance with an Environmental Protection Agency Standard Method(15).

Quality Control

Except for the gross alpha and gross beta in air and BOD analyses, all analyses during 1975 were performed under contract by Controls for Environmental Pollution (CEP) Inc. of Santa Fe, New Mexico. The management of CEP administers the following three phase quality control programs(14).

1. All reagents, including carriers and tracer radionuclides, which are critical to the procedures in question are standardized and checked periodically by two different chemists. When possible the reagents are standardized using two different chemical procedures, e.g., strontium carrier-gravimetrically and atomic absorption.
2. All personnel within the laboratory are required to run spiked samples to prove their proficiency in determining accurately the content of the spiked sample in question. Furthermore, to eliminate the possibility of preferential treatment of a spiked sample by an analyst, spiked samples are slipped into routinely analyzed samples without the knowledge of the analyst. Also, every set of samples has a spike and a blank run concurrently with it.
3. All instrumentation is maintained on monthly preventative maintenance programs by the manufacturer. Each instrument is calibrated weekly. If the calibration detects any anomaly from the routine performance of the instrument no analysis is allowed to be performed by that instrument until it is functioning properly. All radioactive sources and solutions used for calibration are calibrated against National Bureau of Standards' standards where possible. Interlaboratory comparisons with the U. S. Public Health Service, Environmental Protection Agency, United States Energy Research and Development Administration, Department of the Navy, and the American Industrial Hygiene Association.

RADIOACTIVITY CONCENTRATION GUIDES (RCG's)*

Uncontrolled Area

	Air ($\mu\text{Ci}/\text{m}^3$)	Water ($\mu\text{Ci}/\text{m}^3$)
Total Plutonium	6×10^{-14}	5×10^{-6}
Tritium	2×10^{-7}	3×10^{-3}
Uranium	3×10^{-12}	4×10^{-5}
Gross Activity**	1×10^{-10}	3×10^{-6}

General Population

Total Plutonium	2×10^{-14}	2×10^{-6}
Tritium	1×10^{-7}	1×10^{-3}
Uranium	1×10^{-12}	1×10^{-5}
Gross Activity**	3×10^{-11}	1×10^{-6}

* Reference ERDA Manual Chapter 0524, "Standards for Radiation Protection"

** Since Ac-227, At-211, Bk-249, I-125, I-126, I-129, I-131, I-133, Pu-230, Pb-210, Po-210, Pu-241, Ra-223, Ra-224, Ra-226, Ra-228, Sr-90, Th(nat), Th-230, Th-232, Cm-248, Cf-254, and Em-256 were not used or were not released during 1974.

PERMISSIBLE POPULATION DOSES FOR KIDNEY AND WHOLE BODY EXPOSURES

<u>Reference Point</u>	<u>Kidney (rem)</u>	<u>Total Body (rem)</u>
Site boundary and highest exposed individual or group	1.500	0.500
General Population	0.500	0.170

WATER QUALITY CRITERIA

	EPA DRINKING WATER REGULATIONS (mg/ℓ)	FEDERAL WATER QUALITY ADMINISTRATION RECOMMENDED CRITERIA FOR POTABLE WATER (mg/ℓ)	PHS RECOMMENDED CRITERIA (mg/ℓ)
Arsenic	0.05	0.01	0.01
Barium	1.0	0.5	1.0
Cadmium	0.010	0.01	0.01
Chromium (Total)	0.05	--	0.01
Chromium (+6)	--	0.02	0.05
Copper	--	<0.01	1.0
Cyanide	--	0.20	0.2
Fluoride	1.8*	--	--
Iron	--	0.05	0.3
Lead	0.05	0.01	0.05
Mercury	0.002	0.002	--
Nitrate	10	0.1	10
Phenol	--	--	0.001
Phosphate	--	0.1	--
Sulfate	--	50	250
Selenium	0.01	<0.01	0.01
Total Dissolved Solids	--	--	500
Zinc	--	0.05	0.5
<u>Pesticides:</u>			
Aldrin	--	--	0.017
Chlorodane	--	--	0.003
DDT	--	--	0.042
Dieldrin	--	--	0.017
Endrin	0.0002	--	0.001
Heptachlor	--	--	0.018
Heptachlor Epoxide	--	--	0.018
Lindane	0.004	--	0.056
Methoxyohlor	0.1	--	0.035
Toxaphene	0.005	--	0.005

*This value for fluoride is based on an annual average maximum daily air temperature of 69.8°F for Pantex Plant for 1975.

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