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Mr. David Neleigh, Section Chief
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Multimedia Planning and Permitting Division
U.S. Environmental Protection Agency, Region 6
1445 Ross Avenue, Mail Stop 6PD-N
Dallas, Texas 75202-2733

Dear Mr. Neleigh:

Enclosed are two copies of the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation for Sandia National Laboratories, New Mexico (SNL/NM), EPA ID Number NM5890110518. This satisfies the requirements of Module IV of the DOE/SNL RCRA permit.

Upon your review please contact Mark Jackson at (505) 845-6288 to arrange a meeting to resolve any potential open issues.

Sincerely,

A handwritten signature in cursive script that reads "Brenda J. Harrison".

for Michael J. Zamorski
Acting Area Manager

Enclosures

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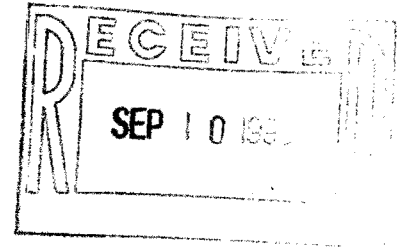
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REPORT OF THE MIXED WASTE LANDFILL
PHASE 2 RCRA FACILITY INVESTIGATION
SANDIA NATIONAL LABORATORIES
ALBUQUERQUE, NEW MEXICO

September 1996

Environmental
Restoration
Project



United States Department of Energy
Albuquerque Operations Office

**REPORT OF THE MIXED WASTE LANDFILL
PHASE 2 RCRA FACILITY INVESTIGATION
SANDIA NATIONAL LABORATORIES,
ALBUQUERQUE, NEW MEXICO**

September 1996

Sandia National Laboratories
Department 7585: Environmental Restoration
for Landfills and Test Areas
Albuquerque, New Mexico 87185
for the United States Department of Energy
under contract DE-AC04-94AL85000

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ACRONYMS AND ABBREVIATIONS

| | |
|------------------|---|
| ASTM | American Society for Testing and Materials |
| BH | borehole |
| BTEX | benzene, toluene, ethylbenzene, xylene |
| CLP | Contract Laboratory Program |
| C _n | Critical Number |
| CEC | cation exchange capacity |
| COC | contaminant of concern |
| CWL | Chemical Waste Landfill |
| DAC | Derived Air Concentration |
| DOE | U.S. Department of Energy |
| EDE | effective dose equivalent |
| EIFC | emission isolation flux chamber |
| EPA | U.S. Environmental Protection Agency |
| ER | Environmental Restoration |
| FID | flame ionization detector |
| FOP | field operating procedure |
| GC/MS | gas chromatography/mass spectrometry |
| Ge | germanium |
| GM | Geiger Müller |
| GR | gamma ray |
| HEAST | Health Effects Assessment Summary Tables |
| HI | hazard index |
| HSWA | Hazardous and Solid Waste Amendments |
| ICP | Inductively Coupled Plasma |
| IP | Instantaneous Profile |
| IRIS | Integrated Risk Information System |
| IT | International Technology Corporation |
| KAFB | Kirtland Air Force Base |
| KUMSC | Kirtland Underground Munitions Storage Complex |
| LLOQ | lower limit of quantitation |
| MCL | maximum concentration limit |
| MDA | Minimum detectable activity |
| MODFLOW | USGS Modular Three-Dimensional Groundwater Flow Model |
| MWL | Mixed Waste Landfill |
| NESHAP | National Emission Standards for Hazardous Air Pollutants |
| NMED | New Mexico Environment Department |
| NPDES | National Pollutant Discharge Elimination System |
| NTU | nephelometric turbidity units |
| OU | operable unit |
| PID | photoionization detector |
| PIP | Project Implementation Plan |
| PM ₁₀ | Particulate Monitor (10 micron) |
| PQL | practical quantitation limit |
| Précis | Probabilistic Risk Evaluation and Characterization Investigation System |
| QA/QC | Quality Assurance/Quality Control |
| RAGS | Risk Assessment Guidance for Superfund |
| RCRA | Resource Conservation and Recovery Act |
| RETC | Retention Curve Code |
| RFD | reference dose |
| RFI | RCRA Facility Investigation |
| RME | Reasonable Maximum Exposure |

ACRONYMS AND ABBREVIATIONS (Continued)

| | |
|--------|--|
| RPD | relative percent difference |
| SNL,NM | Sandia National Laboratories, New Mexico |
| SVOC | semi-volatile organic compound |
| SWHC | Site-Wide Hydrogeologic Characterization |
| SWMU | Solid Waste Management Unit |
| TA | technical area |
| TAL | target analyte list |
| TCE | trichloroethylene |
| ULOQ | upper limit of quantitation |
| USAF | U.S. Air Force |
| USGS | U.S. Geological Survey |
| UTL | upper tolerance limit |
| VOC | volatile organic compound |
| WRS | Wilcoxon Rank Sum |

| | |
|------------------------|---------------------------------------|
| bgs | below ground surface |
| °C | degrees Celsius |
| Ci | curie |
| cm | centimeter |
| E _H | Redox Potential |
| famsl | feet above mean sea level |
| fbgs | feet below ground surface |
| ft | foot |
| g | gram |
| gal | gallon |
| in. | inch |
| K _{sat} | saturated hydraulic conductivity |
| m | meter |
| mg/kg | milligrams per kilogram |
| mg/L | milligrams per liter |
| mi | mile |
| mm | millimeter |
| mmho/cm | micromhos per centimeter |
| mph | miles per hour |
| mrem/yr | millirem per year |
| mS/m | milliSiemens per meter |
| mV | millivolt |
| ng/m ² /hr | nanograms per square meter per hour |
| ng/m ² /min | nanograms per square meter per minute |
| pCi/g | picocuries per gram |
| pCi/L | Picocuries per liter |
| pCi/m ² /hr | picocuries per square meter per hour |
| ppbv | parts per billion by volume |
| ppmv | parts per million by volume |
| ppt | parts per thousand |
| s | second |
| μCi/m ³ | microcuries per cubic meter |
| μg/kg | microgram per kilogram |
| μg/L | microgram per liter |
| yr | year |

Conversion Factors For Selected SI (Metric) Units

| Multiply U.S. Customary Unit | By | To Obtain SI (Metric) Unit |
|---|-----------|---------------------------------------|
| Inches (in.) | 2.54 | Centimeters (cm) |
| Feet (ft) | 0.304 | Meters (m) |
| Miles (mi) | 1.6 | Kilometers (km) |
| Square feet (ft ²) | 0.093 | Square meters (m ²) |
| Acres | 0.4 | Hectares (ha) |
| Cubic feet (ft ³) | 0.028 | Cubic Meters (m ³) |
| Gallons (G) | 3.8 | Liters (L) |
| Ounces (oz) | 28.6 | Grams (g) |
| Pounds (lbs) | 0.45 | Kilograms (kg) |
| Parts per billion (ppb) | 1 | Micrograms per kilogram (µg/kg) |
| Parts per million (ppm) | 1 | Milligrams per kilogram (mg/kg) |
| Fahrenheit (°F) | -32 x 5/9 | Celsius (°C) |

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EXECUTIVE SUMMARY

The Mixed Waste Landfill is located approximately 5 miles southeast of Albuquerque International Airport and 4 miles south of Sandia National Laboratories Technical Area 1. The landfill is a fenced, 2.6 acre compound in the north-central portion of Technical Area 3. Mean elevation is 5381 ft.

The Mixed Waste Landfill was established in 1959 as a disposal area for low-level radioactive and mixed waste that was generated at Sandia National Laboratories research facilities. The landfill was opened originally as the "Area 3 Low-Level Radioactive Dump" when the low-level radioactive dump in Technical Area 2 was closed in March 1959. The Area 3 dump accepted low-level radioactive waste and minor amounts of mixed waste from March 1959 through December 1988. Approximately 100,000 ft³ of low-level radioactive waste containing approximately 6300 curies of activity were disposed of at the landfill.

The Mixed Waste Landfill consists of two distinct disposal areas: the classified area, occupying 0.6 acres, and the unclassified area, occupying 2.0 acres. Low-level radioactive and mixed waste has been disposed of in both areas. Classified wastes have been buried in a series of vertical, cylindrical pits in the classified area. These wastes included materials which, by shape or content, contained information important to national security. Unclassified wastes have been buried in shallow, parallel trenches in the unclassified area. These wastes included materials which were of little or no security concern.

A Phase 1 RCRA Facility Investigation was conducted in 1989 and 1990 to determine if a release of RCRA contaminants had occurred at the Mixed Waste Landfill and to begin characterizing the nature and extent of any such release. The Phase 1 investigation indicated that tritium was the contaminant of primary concern. No organic contaminants were identified. A Phase 2 RCRA Facility Investigation was initiated in 1992 to thoroughly determine contaminant source, define the nature and extent of contamination, identify potential contaminant transport pathways, evaluate potential risks posed by the levels of contamination identified, and recommend remedial action, if warranted, for the landfill.

The Phase 2 RCRA Facility Investigation incorporated the Streamlining Approach, combining Data Quality Objectives and the Observational Approach. Non-intrusive field activities were conducted first to facilitate the efficiency and cost-effectiveness of intrusive field activities. Data collected during the Phase 2 RCRA Facility Investigation were evaluated using EPA-approved methods. Initially, a constituent population was statistically compared to natural background. Any constituent failing the statistical comparison was further analyzed for spatial distribution. Constituents that failed the statistical comparison to background and showed a strong spatial correlation were identified as potential contaminants of concern.

After a constituent was identified as a potential contaminant of concern, the sample population was compared to RCRA proposed Subpart S action levels and studied in a transport and risk assessment. Reasonable Maximum Exposure was used to assess risk. The basic risk assessment methodology defined by EPA was modified to include a quantitative uncertainty analysis technique.

The Phase 2 RCRA Facility Investigation was completed in 1995. The Phase 2 RCRA Facility Investigation consisted of reconnaissance radiological surveys, air monitoring, passive and active soil gas surveys, non-intrusive geophysical surveys, soil sampling for background metals and radionuclides, surface soil sampling, borehole drilling and sampling, vadose zone tests, aquifer tests, and risk assessment. The Phase 2 RCRA Facility Investigation confirmed the findings of the Phase 1 RCRA Facility Investigation; tritium is the contaminant of primary concern.

Tritium levels range from 1100 pCi/g in surface soils to 20,600 pCi/g in subsurface soils in the classified area of the landfill. The highest tritium levels are found within 30 ft of the surface in soils adjacent to and directly below classified area disposal pits. Below 30 ft bgs, tritium levels fall off rapidly to a few pCi/g of soil.

Tritium also occurs as a diffuse air emission from the landfill. A total of 0.294 Ci/yr is released from the landfill surface. The maximum radiological dose to an off-site receptor is 1.1×10^{-5} mrem/yr due to internal exposure to tritium. The maximum radiological dose to an on-site receptor due to combined soil and vapor ingestion is 0.29 mrem/yr.

A detailed risk assessment was conducted for the MWL and the results indicate that the MWL will not significantly affect human health or the environment under an industrial land-use scenario. MWL contaminants present little risk to groundwater or as air emissions to potential receptors. Tritium activities at the MWL will decrease steadily with time due to its relatively short half-life of 12.3 years. Tritium activity at the landfill will decrease to approximately 10% of its original activity within 3 half-lives. The risk to human health and the environment due to natural radiological sources is much greater than risk posed by the MWL.

Based on Phase 2 RCRA Facility Investigation data and risk assessment, the MWL is recommended for No Further Action with continued groundwater monitoring for tritium to 1999.