

ROCKY FLATS ENVIRONMENTAL
TECHNOLOGY SITE

DRAFT
Nature and Extent of
Air Contamination
Summary Report

Rocky Flats Environmental Technology Site
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1.0 INTRODUCTION

This Nature and Extent of Air Contamination Summary Report (SR) has been prepared pursuant to Task 9 of the *Final Work Plan for the Development of the Remedial Investigation and Feasibility Study Report (RI/FS Report)* (DOE, 2002a). The purpose of this SR is to summarize the sources and types of airborne contaminants present at the Rocky Flats Environmental Technology Site (RFETS) so that this information may be appropriately considered in evaluating final remedy alternatives. This SR will be incorporated into the Draft RI/FS Report in Section 3.6.

During the weapons production era at RFETS, the major sources of airborne contamination comprised releases of radionuclides, volatile organic compounds (VOCs), and metals from stacks venting building processes and operations; conventional pollutant sources such as fuel combustion in boilers and generators, street sanding, traffic, refrigerant leaks, and fugitive dust from soil disturbance; and resuspension of contaminants deposited on surface soil by prior events (such as fires or leakage of radioactively contaminated oils and VOCs from drums stored at the 903 Pad). During the cleanup phase, building decommissioning and environmental restoration (ER) activities represented additional sources of emissions to air. These sources were eliminated or decreased as buildings were demolished and soil contamination was cleaned up.

RFETS released a variety of contaminants into the air from these sources. These contaminants included the six "criteria" pollutants, or their precursors, for which the US Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards in Title 40 of the *Code of Federal Regulations* (CFR), Part 50: sulfur dioxide (SO₂), nitrogen oxides (NO_x), particulate matter (PM), VOCs (regulated as a precursors to ozone), carbon monoxide (CO), and lead. Radioactive particles and tritium, a gaseous pollutant, were also released, along with ozone depleting substances (ODS) and a number of hazardous or toxic contaminants.

Monitoring programs and other studies were conducted during both the production era and cleanup phase. Historical monitoring data are reviewed in Section 2.0 and compared with regulatory standards, benchmarks, or limitations. These data show that contaminant emissions and resulting ambient airborne concentrations during both the weapons production era and cleanup phase were always compliant with all regulatory requirements. With completion of accelerated actions, and consequently the removal of the historic air emissions sources, future RFETS air emissions will likely be less than those in the past.

2.0 HISTORIC AIR CONTAMINANT EMISSIONS SOURCES AT RFETS

This section discusses historic airborne contamination sources, monitoring, and related studies. The following discussion is supported by and draws from the more detailed information in the "Nature and Extent of Soil Contamination" (Section 3.2 of the Draft RI/FS Report). A summary of air emissions sources is provided in Table 1.

2.1 Radionuclide Sources

Radionuclide emissions to air have historically included releases from radionuclide processing and waste handling, emitted through building stacks and vents; releases caused by mechanical disturbance of contaminated soil or debris during project activities, including ER and decommissioning projects; and resuspension of contaminated surface soil by wind. Plutonium-239/240 and americium-241 (Pu/Am) were deposited on surface soils at RFETS by waste management practices (e.g., release from stored waste at 903 Pad) or by emissions from building stacks and vents (from accidental releases caused by building fires; as well as routine emissions). Wind or mechanical disturbance of the contaminated soil resulted in radionuclide-laden soil particles becoming airborne. These suspended particles were transported some

distance downwind before being redeposited on the ground or in water by a variety of mechanisms that remove particles from the air, such as rainout or dry deposition. Concentrations of Pu/Am in surface soil are low, with the aerial extent of surface contamination extending generally from the Industrial Area in decreasing concentrations eastward. Uranium (U) contamination in surface soil is also present but, unlike Pu/Am, is not widespread and instead exists in small, localized areas. (See Draft RI/FS Report, Section 3.2.1, "Nature and Extent of Surface Soil Contamination.")

A large-scale, continuous environmental air monitoring program for radionuclides has been conducted at RFETS since 1971. The program was designed to quantify potential public exposure to radionuclides as a result of RFETS activities, and to determine compliance with applicable regulatory limits. It included two distinct tasks: effluent monitoring, accomplished through the continuous extraction of entrained particulate matter from exhaust ducts of buildings with significant potential to release radionuclides, and ambient monitoring, accomplished through the continuous collection of airborne particulate matter at representative locations on and around RFETS. Limited effluent monitoring for tritium was also conducted for many years but was discontinued in November 2000 as no potential tritium sources remained at RFETS. Effluent monitoring was discontinued at all locations as the buildings where effluent monitoring was conducted were decommissioned and demolished.

Radionuclide emissions from RFETS are subject to 40 CFR Part 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon From Department of Energy Facilities" (Colorado Air Quality Control Commission [CAQCC] Regulation No. 8, Part A, Subpart H) (EPA, 1989). Since 1998, 14 ambient air samplers arrayed around the RFETS perimeter have been used to demonstrate compliance with the emission limits of 40 CFR 61, Subpart H. Filters were exchanged monthly and analyzed for the plutonium, americium, and uranium isotopes of interest. The maximum measured monthly off-site dose rates for 1999 through 2004, presented as a percent of the 10-millirem (mrem) annual dose limit in 40 CFR 61, Subpart H, are shown in Figure 1. On an annual basis, maximum measured radionuclide concentrations, including uranium isotopes that are largely naturally occurring in the environment, totaled less than 3% of the annual dose limit between 1998 and 2004. Cleanup of surface soil contamination and completion of radionuclide processing, waste handling, and decommissioning has lessened this dose potential even more (DOE, 1999; DOE, 2000; DOE, 2001; DOE, 2002b; DOE, 2003a; DOE, 2004b).

Ambient samplers were also used to monitor fugitive radionuclide emissions from decommissioning, demolition, and ER activities. In addition to the perimeter compliance demonstration network, for many years RFETS operated an internal network of samplers in and around the Industrial Area during project activities that could result in radionuclide emissions. The measurements indicate that RFETS has remained in compliance with all regulatory requirements even during periods of substantial decommissioning and ER activities. For example, a 7-year record of radionuclide concentrations (1997-2003) at a sampler located downwind of the 903 Pad shows average dose rates three orders of magnitude below the 40 CFR 61, Subpart H, 10-mrem benchmark, with peak monthly dose rates two orders of magnitude below the 10-mrem level, even though this standard only applies beyond the RFETS fence line, 2 to 3 kilometers further downwind. Both off-site and on-site measurements have been reported at quarterly data exchange meetings with EPA and Colorado Department of Public Health and Environment (CDPHE) staff and representatives from surrounding municipalities. These results are documented in the RFETS *Quarterly Environmental Monitoring Reports* (see, for example, DOE, 2003b, etc.).

2.2 Landfill Sources

Both the Present and Original Landfills represent potential sources of VOC and hazardous air pollutant (HAP) emissions primarily due to the decomposition of buried, decomposable waste. Decomposition of waste, along with possible volatilization of certain constituents and/or chemical reactions within the waste, generates landfill gas (LFG). Methane and carbon dioxide (CO₂) are the primary constituents of

LFG, and are produced by microorganisms within the landfill under anaerobic conditions. LFG generation proceeds through several phases as the waste "ages," and the gas composition changes with each phase. Typically, LFG also contains a small amount of nonmethane organic compounds (NMOC). NMOC can contain various HAPs, greenhouse gases, and compounds associated with stratospheric ozone depletion. The NMOC fraction also contains VOCs. Maximum VOC and HAP emission potential occurs at the time waste is last placed in a landfill and shortly thereafter; emissions from waste decomposition decrease with time as the waste decays.

2.2.1 Present Landfill

The Present Landfill is located in the No Name Gulch drainage and occupies approximately 20 acres. It was placed into service in August 1968 for the disposal of solid wastes, including office trash, paper, rags, personal protective equipment, construction and demolition debris, scrap metal, empty waste containers, used filters, and electrical components. Although originally planned as a sanitary landfill, refuse disposed of also included materials containing polychlorinated biphenyls; combustible materials contaminated with small amounts of Be; containers partially filled with paints, solvents, and foam polymers; Kimwipes and rags contaminated with organic compounds; metal cuttings and shavings (primarily stainless steel); tear gas powder; a tank containing Mercaptan™ (an odor additive to natural gas); a drum of solidified polystyrene resin; soil contaminated with approximately 700 gallons of diesel fuel; wood contaminated with chromium and aluminum oxide; and unknown chemicals and reactive chemical residues. Wastes with hazardous constituents ceased to be disposed of in the landfill by the fall of 1986. Sludge from the sanitary waste treatment plant was routinely disposed of at the Present Landfill from August 1968 through May 1970, and may have contained low levels of plutonium and depleted uranium. (DOE, 2004c)

Wastes delivered to the landfill were spread across the work area, compacted, and covered with a daily soil cover. From 1968 to 1978, the landfill received approximately 20 cubic yards of compacted waste per day. The Present Landfill remained in operation until March 1998, at which time it was placed in a contingent closure status and seeded to stabilize soil and control erosion. The volume of material in the landfill at the time it became inactive was estimated at 415,000 cubic yards, including any daily soil cover incorporated as the waste was placed. (DOE, 2004c)

A Rocky Flats Cleanup Agreement (RFCA) accelerated action at the Present Landfill to install a landfill cover was completed in 2005. Barometric gas vents were placed into the landfill prior to placement of the final cover to allow pressure equalization (DOE, 2004c). These vents represent a preferred pathway for LFG migration to the atmosphere. The rate of gas generation and release is a function of the waste composition in the landfill, the waste volume, and the age of the landfill.

In 2002, EPA's Landfill Emissions Model Version 2.0 (LANDGEM) was used to calculate total landfill gas emissions. Model results indicated relatively low rates of landfill gas generation, with the majority (approximately 80 percent) of methane and total LFG production occurring by the year 2025, and almost all potential production occurring by the year 2075 (Kaiser-Hill, 2002). Gas generation calculations were revised for this SR assuming a more appropriate arid area methane rate constant than was used in the 2002 modeling. The model-estimated peak year LFG generation rate (1998) was approximately 288,200 cubic meters per year (19.5 cubic feet per minute [cfm]).

LANDGEM was also used to estimate emissions of NMOC. The calculation assumed a conservative default NMOC concentration in the landfill gas from EPA's *Compilation of Air Pollutant Emission Factors* (AP-42; EPA, 1995). Peak year (1998) NMOC emissions were estimated at approximately 2.5 megagrams per year (Mg/yr) (approximately 2.8 tons per year). Note that emissions of LFG are not the target of regulation under the federal CAA because the principal components, methane and CO₂, are neither toxic nor precursors to other regulated pollutants, such as ozone or PM₁₀. CAA regulations

instead focus on controlling or limiting emissions of certain trace components of LFG, such as NMOC, that may include toxic contaminants or promote secondary pollutant formation.

Municipal solid waste landfill air emissions are regulated under 40 CFR 60, Subparts WWW and Cc (New Source Performance Standards and Emission Guidelines, respectively) (EPA, 1996a and EPA, 1996b). These regulations apply to new landfills (Subpart WWW) and to existing landfills (Subpart Cc). The applicability of these standards to the Present Landfill was evaluated in 1997 when these regulations became effective. Subpart Cc, which would apply to existing units such as the Present Landfill, applies to municipal solid waste landfills constructed or modified before May 30, 1991, which have design capacities greater than or equal to 3.3 million cubic yards. The maximum design capacity of the Present Landfill was determined to be 571,000 cubic yards, well below the 3.3 million cubic yard threshold. CDPHE was notified of the non-applicability of this regulation on July 10, 1997 (DOE, 1997).

For perspective, Subparts WWW and Cc only require emission controls for landfills meeting the above criteria that also have NMOC emissions exceeding 50 Mg/yr. The calculated emission rate from the Present Landfill in 1998 was only 2.5 Mg/yr, far below the control threshold. Because the maximum VOC and HAP emission potential occurs at the time the waste is last placed into the landfill and shortly thereafter, emissions from waste decomposition decreases with time as the waste decays. Consequently, future emission rates will be even lower, supporting the contention that airborne emissions from the Present Landfill do not pose a threat to health or the environment.¹

2.2.2 Original Landfill

Between 1952 and 1968, approximately 74,000 cubic yards of solid sanitary waste and construction debris were placed in the Original Landfill (OLF). The landfill was not designed or operated as an engineered landfill. The waste material was covered with a soil layer after disposal operations ceased. Accurate and verifiable records of the waste placed in the landfill are not available; however, the types of waste that may have been placed in the landfill include relatively small quantities of organic compounds, paint and paint thinner, oil, pesticides, and cleaners, as well as municipal-type solid waste.

Organic compounds commonly used from 1952 to 1968 may have included trichloroethene, carbon tetrachloride, tetrachloroethene, petroleum distillates, 1,1,1-trichloroethane, dichloromethane, and benzene. In the 1960s, the landfill may have received polychlorinated biphenyl wastes such as carbonless copy paper, transformer and vacuum pump clean-up paper and rags, small capacitors, and fluorescent light bulbs. Metals such as beryllium, lead, and chromium may also have been placed in the landfill. (DOE, 2004d)

Activities listed for the landfill in October 1954 included its use as a burn pit for the plant (EG&G, 1992). Ash from the plant incinerator, graphite, used caustic drums, and general trash may have been dumped in the burn pit, but no records of waste types have been found. In 1995, geotechnical investigations were conducted at the OLF and the fill material encountered was described, including sheet metal, wood, broken glass, plastic, rubber, metal shavings, graphite sand, solid blocks of graphite, concrete, asphalt, and portions of 55-gallon steel drums. Street cleaning wastes were also apparently dumped at the OLF area. (DOE, 2004d)

There is no information indicating that the OLF was used for routine disposal of radioactive material or other hazardous substance waste streams. During the period of operation of the OLF, several other areas within RFETS were used for the management and disposal of hazardous plant wastes, including

¹ LFG was also evaluated in the *Final Interim Measure/Interim Remedial Action for IHSS 114 and RCRA Closure of the RFETS Present Landfill* (DOE, 2004c).

radioactive waste. Various controls and practices were used to segregate and manage radioactive wastes separately from plant sanitary waste and construction debris. (DOE, 2004d)

EPA's *Compilation of Air Pollutant Emission Factors* (AP-42; EPA, 1995) describes methods to calculate methane and NMOC emissions from landfills using a theoretical first-order kinetic model of methane production developed by EPA (the same methodology employed by the LANDGEM model discussed above). Using 74,000 cubic yards of waste, arid area default values for methane generation potential and methane generation rate constant, and assuming co-disposal of hazardous wastes (worst-case assumption), the equations yield an estimated LFG production/emission rate of 14 cfm in 1968. NMOC emissions of 4 Mg/yr were estimated for the same time period.

These emissions probably represent substantial overestimates because much of the disposed material was not organic (i.e., would not generate LFG) and hazardous wastes were not routinely disposed in the OLF. The OUS Phase I RFI/RI concluded that the OLF does not generate hazardous concentrations of LFG, so no gas collection or treatment action is required (DOE, 2004d). As with the Present Landfill, the OLF is not subject to 40 CFR 60, Subpart Cc, because its design capacity is below the threshold level of 3.3 million cubic yards. The estimated peak year NMOC emission rate (less than 4 Mg/yr) is also well below the control threshold (50 Mg/yr). Because the maximum VOC and HAP emission potential occurs at the time the waste is last placed into the landfill and shortly thereafter, emissions from waste decomposition decreases with time as the waste decays. Consequently, current and future methane and NMOC emissions will be less than those that occurred at the cessation of routine disposal operations in 1968. Thus, airborne emissions from the OLF do not pose a risk to health or the environment.²

2.3 Subsurface VOC Sources

VOCs such as carbon tetrachloride and 1,1,1-trichloroethane were used at RFETS as solvents, cleaning agents, etc., in support of weapons component manufacturing. Their use, storage, handling, and disposal at RFETS created some areas of known VOC contamination in soils. Areas of VOC-contaminated soil have been addressed through RFCA accelerated actions, or, after evaluation in accordance with RFCA, have been determined to qualify for No Further Accelerated Action.

A study of ambient airborne VOC concentrations in the Industrial Area was undertaken in June 1995 and completed in August 1996. Details of the study design may be found in the *Final Interim Measures/Interim Remedial Action (IM/IRA) Implementation Plan for the Rocky Flats Industrial Area* (DOE, 1995). Study results may be found in the *Annual Report, IM/IRA for the Rocky Flats Industrial Area* (RMRS and Kaiser-Hill, 1997). The airborne VOC data were evaluated to determine whether there may be evidence that unidentified VOC contamination exists as a potential source of airborne VOC emissions. The study tested for 31 different hydrocarbons known or believed to exist at RFETS. Of these, eight compounds were detected; one of these, acetone, is neither a HAP nor a VOC, and has no significance from an air quality perspective. The data from this study are considered to present a conservative snapshot of RFETS's VOC emissions potential for the following reasons: 1) they were collected at a time when RFETS still maintained an inventory of VOC-containing solvents, cleaners, etc., which have since been removed; 2) less soil remediation had been completed than is currently the case; and, 3) it is expected that a greater mass of VOC soil contamination existed at the time (i.e., some amount has volatilized since then) resulting in higher emissions potential than at present.

For comparison, ambient air concentration data for VOC HAPs were obtained for nearby sampling locations. Table 2 presents the results of this data assembly. The 1998 CDPHE ambient average data are

² LFG was also evaluated in the *Draft Interim Measure/Interim Remedial Action of IHSS Group SW-2, IHSS 115, Original Landfill and IHSS 196, Filter Backwash Pond, IHSS 196* (DOE, 2004d).

from five samplers located around the perimeter of RFETS (designated X-1, X-2, X-3, X-4, and X-5). The sampler locations are shown on Figure 2. **Note: current Figure 2 is a placeholder and requires revision to show the correct samplers.**

Quality assurance samples included as part of the study indicated that cross-contamination or insufficient cleaning of some of the sample canisters may have contributed to elevated results for acetone, toluene, and 1,1,1-trichloroethane throughout the project (RMRS and Kaiser-Hill, 1997). Also, several of the detected compounds, including benzene, toluene, and xylene, are common constituents of automobile exhaust and are often present at detectable concentrations throughout the Denver airshed (CDPHE, 2004). Finally, it should be noted that there was a known carbon tetrachloride source at RFETS that had not been remediated at the time of the study, but was remediated in 2004.

Table 2 also lists available toxicological benchmark levels, as well as background levels for pollutants included in EPA's 1996 National-scale Air Toxics Assessment (NATA; EPA, 2004). Average VOC HAP concentrations measured in the Industrial Area study were below detection levels for all compounds; therefore, no average concentrations are shown in Table 2. The maximum values from the RFETS study are 24-hour averages and are best compared to the short-term (acute) toxicological reference levels shown. Annual average concentrations from the CDPHE samplers located at the site perimeter may be compared with the chronic benchmarks to indicate the significance of VOC HAPs to which the general public may be exposed (including any RFETS-derived HAPs and HAPs from other regional sources).

Several conclusions may be drawn from the data (note that this discussion excludes acetone, since it is neither a HAP nor a VOC). First, the RFETS data, consisting largely of non-detects, reveal no significant persistent sources of VOC HAP emissions in the Industrial Area at the time of the study. Maximum 24-hour concentrations measured were orders of magnitude below any of the short-term toxicological benchmark levels and no adverse short-term health effects would be expected at these levels.

Second, the longer-term CDPHE data show VOC HAP concentrations due to all sources at the RFETS perimeter close to or below background levels for pollutants included in the NATA study. EPA defines "background" levels as contributions resulting from natural sources, persistence in the environment of past year's emissions, and long-range transport from distant sources. In other words, background concentrations represent levels of pollution expected even if there had been no recent manmade emissions (EPA, 2004). Where applicable, measured HAP concentrations at the RFETS perimeter were also well below chronic inhalation effects levels published by various sources. CDPHE ceased sampling for VOCs at the RFETS perimeter in July 2001, citing low measured levels of contaminants and noting that the VOCs that were measured "appear to be mainly motor vehicle emissions, rather than Rocky Flats plant emissions" (CDPHE, 2001).

Based on the available ambient air monitoring data and the current knowledge of VOC contamination that remains at RFETS, no significant sources of VOC emissions remain following completion of accelerated actions.

2.4 Beryllium

The health effects of Be exposure in sensitive individuals have been well documented and the DOE Chronic Beryllium Disease Prevention Program rule, 10 CFR 850, establishes Be exposure limits and other requirements for RFETS workers. Beryllium is a HAP and EPA has promulgated Be emission limits for certain beryllium industry categories in 40 CFR 61, Subpart C. Unlike certain radioactive materials at RFETS, however, Be contamination was largely confined to building and equipment surfaces in areas where Be was processed, stored, or used and where Be-contaminated waste was managed. Soils and other environmental media at RFETS do not show significant levels or aerial extent of Be contamination; therefore, with the completion of accelerated actions, no significant source of airborne Be

emissions exists. It is important to note, however, that regional soils contain small amounts of naturally occurring Be, which will continue to be suspended in dust following closure.

DOE implemented project monitoring for Be in ambient air during decommissioning and demolition of facilities with a history of significant Be operations at RFETS (i.e., Buildings 444/447, 865, and 883). The scope of project monitoring is described in the *Integrated Monitoring Plan Background Document* (DOE et al., 1997) and in the final *Sampling and Analysis Plan (SAP) for Quantification and Characterization of Potential Beryllium Release to the Ambient Air During Building Demolition at The Rocky Flats Environmental Technology Site* (URS Group, 2001). Ambient monitoring performed around two demolition operations—Building 111 and Building 865—serves to quantify expected levels of airborne Be during and following accelerated actions.

Building 111 was demolished during November and December 2001. The building was not contaminated with Be; rather, the demolition provided an opportunity to establish “baseline” levels of Be in RFETS air (as noted above, Be occurs naturally in the RFETS environment in small amounts). Be concentrations were measured using six ambient air samplers arrayed in a circular fashion around Building 111, as close as possible to the demolition considering neighboring buildings and roads. Be samplers ran 8 to 10 hours per day during project activity, with the filters exchanged and analyzed daily. The results were statistically distinguishable from zero and from the Minimum Detectable Level, demonstrating that the sampling and analysis protocols were adequate to reliably quantify Be in ambient air at and below concentrations of interest.

The mean Be concentration for all six locations (30-day average) was $1.7E-5$ micrograms per cubic meter ($\mu\text{g}/\text{m}^3$). An appropriate benchmark for comparison is contained in the “National Emission Standard for Beryllium” (40 CFR 61, Subpart C), which limits ambient Be concentrations in the vicinity of a source subject to the standard to $1.0E-2$ $\mu\text{g}/\text{m}^3$ as a 30-day average (EPA, 1973). (Note that no RFETS sources existing at the time of this monitoring study, including building demolition, were subject to this regulation because the regulation only applies to certain specific source types. The concentration limit, however, provides an appropriate benchmark concentration for comparison because it has been established by EPA at levels designed to protect public health.) Measured concentrations around Building 111 demolition showed a qualitative correlation to the dustiness of the air around the project and to stronger winds, with environmental Be being detected even prior to demolition activity. The resulting baseline concentrations established by this monitoring program are likely to be representative of airborne Be concentrations following completion of accelerated actions.

Be monitoring was also performed during demolition of Building 865 and during removal of the slab. Building 865 was part of the RFETS’s research and development program. The building housed metalworking equipment for the study of non-plutonium metals and the development of alloys and prototype hardware. Operations included metalworking, machining, and metallurgical laboratory operations. Be contamination occurred from operations involving mixing of Be powders with other metals and compressing them into shapes, from casting and heat treating furnaces, and from beryllium electrorefining.

A six-sampler network was employed to measure ambient airborne Be concentrations during Building 865 demolition and slab removal between July 21, 2003 and December 12, 2003. The sampling schedule included a baseline sampling period prior to the start of demolition, a brief pause between building demolition and slab removal, and baseline confirmation sampling following completion of slab removal. Some results that were greater than the pre-demolition baseline were observed, but no results approached or exceeded the EPA benchmark concentration of $1.0E-2$ $\mu\text{g}/\text{m}^3$ 30-day average. These results confirmed that project controls were effective in minimizing the migration of Be contamination from the building and slab removal. The mean airborne Be concentration measured over the project was $1.2E-4$ $\mu\text{g}/\text{m}^3$, with a maximum measured concentration of $3.7E-3$ $\mu\text{g}/\text{m}^3$. Measured concentrations were

consistently an order of magnitude lower than the 40 CFR 61, Subpart C benchmark, indicating that Be in air will not be a concern following completion of all building demolitions and accelerated actions.

2.5 Other Contaminants

A variety of other air pollutants and emission sources at RFETS were historically subject to federal and State regulations. Regulated sources included the steam plant boilers; diesel-, gasoline-, and natural gas-fired equipment such as generators and compressors; vehicle refueling operations; sanitary landfill construction and operation; paint spray booths; sanitary waste filter press; the Building 776 Supercompactor; the Building 374 Spray Dryer; aggregate storage piles; tanks containing volatile substances; open burning activities; ODS releases from refrigerant leaks and maintenance operations; and fugitive dust emissions from earthmoving activities and other mechanical disturbances.

In addition to radionuclides, airborne emissions of ODS, CO, NO_x, SO₂, VOCs, and PM₁₀ have been regulated at RFETS. Maximum potential RFETS emissions of other pollutants, such as a number of HAPs and Colorado "noncriteria reportable" pollutants, while regulated under the CAAs, were historically emitted in such small amounts that specific regulatory requirements were not triggered.

Regulatory requirements applicable to RFETS emission sources included submitting Air Pollutant Emission Notices (APENs) for new emission units or activities with emissions above a reporting threshold; obtaining construction permits for non-exempt new or modified activities; and obtaining a site-wide Title V operating permit. An operating permit is required for all sources with potential emissions above certain thresholds. In RFETS's case, potential emissions of NO_x, primarily from the steam plant boilers and diesel-fired equipment, exceeded 100 tons per year, the applicable operating permit threshold, at the time that operating permit applications were due in 1996. RFETS's Title V operating permit (received July 1, 2002) was revised as decommissioning proceeded and sources of regulated emissions were removed from the site. The permit was retained as long as the aggregate potential NO_x emissions from diesel-fired equipment exceeded the 100-ton-per-year threshold. With completion of accelerated actions, activities covered by APENs and permits have been removed or shut down, and the APENs and permits have been cancelled. No sources remain that require APENs or permits.

3.0 REMAINING AIR CONTAMINANT EMISSIONS SOURCES AT RFETS

With the completion of accelerated actions under RFCA, sources of ongoing emissions to air include only: 1) resuspension of residual radioactive contaminants attached to surface soil particles; and 2) volatilization/release of VOCs from residual subsurface contamination and the closed landfills. However, as described in the "Site Background Summary Report" (Section 1.0 of the Draft RI/FS Report), sources of radionuclide and VOC contamination were removed during accelerated actions conducted pursuant to RFCA. Former processing and waste storage buildings have been decommissioned, decontaminated, and demolished. Soils have been evaluated in accordance with risk-based action levels established in RFCA Attachment 5, *Action Levels and Standards Framework for Surface Water, Groundwater, and Soils* (ALF) (DOE, EPA, and CDPHE, 1996), and have either been cleaned up in accordance with ALF or been determined to be subject to no further accelerated actions. As described in Section 2.2, VOC emissions are rapidly decreasing and offer no health or environmental concerns at present and future levels.

Airborne radionuclide contamination following completion of accelerated actions is primarily caused by resuspended Pu/Am in surface soils, because these substances were dispersed on- and off-RFETS by wind. Pu/Am in surface soil, as well as U, are persistent due their long radioactive half-lives. They will therefore represent an ongoing source of potential emissions for some time to come. Accelerated actions have removed surface soils contaminated with Pu/Am/U above the ALF soil action levels, greatly limiting potential future emissions. However, the diffuse, remnant contamination in surface soils will continue to result in small amounts of radionuclide particles in air due to the ongoing resuspension and movement of soil (fugitive dust) by wind, such as occurs on all open lands along the Front Range of Colorado. The remaining areas of Pu/Am/U contamination above background levels are described in more detail in the "Nature and Extent of Soil Contamination Summary Report," Section 3.2 of the Draft RI/FS Report.

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Table 1. Summary of Air Emissions Sources of Historical Interest and Current Status

Historic Source of Airborne Emissions	Primary Pollutants Emitted	Nature of Emissions	Status/Conclusions	Ongoing Emission Source?
Radionuclide processing/operations and waste handling/storage	Pu, Am, U	Point source emissions from stacks and vents	No potential sources remain following completion of accelerated actions	No
Radionuclide surface soil contamination (resuspension by wind)	Pu, Am, U	Fugitive emissions	Minor continuing emissions from residual soil contamination below RSALs	Yes
Tritium	Tritium	Primarily point source emissions from stacks and vents	No potential sources remain (since at least 2000)	No
Beryllium processing/operations and waste handling/storage	Be	Point source emissions from stacks and vents	No potential sources remain following completion of accelerated actions	No
Environmental restoration	Pu, Am, U VOCs PM/PM ₁₀ CO, NO _x , SO ₂ , VOCs, PM ₁₀ (from construction equipment and traffic)	Fugitive and tailpipe emissions	No potential sources remain following completion of accelerated actions	No
Decommissioning/building demolition	Pu, Am, U PM/PM ₁₀ CO, NO _x , SO ₂ , VOCs, PM ₁₀ (from construction equipment and traffic)	Fugitive and tailpipe emissions	No potential sources remain following completion of accelerated actions	No
Landfills	VOCs, HAPs LFG (methane and CO ₂)	Fugitive emissions	Minor continuing emissions; below regulated levels	Yes
VOC soil contamination	VOCs, HAPs	Fugitive emissions	Minor continuing emissions from residual contamination below action levels; past sampling during period of higher potential emissions shows ambient levels below levels of concern	Yes

Table 1. Continued

Historic Source of Airborne Emissions	Primary Pollutants Emitted	Nature of Emissions	Status/Conclusions	Ongoing Emission Source?
Uncontaminated fugitive dust sources (traffic, soil disturbances, stockpiles, street sanding, etc.)	PM/PM ₁₀	Fugitive emissions	No potentially significant sources remain following completion of accelerated actions; assuming no significant soil disturbing activities in future	Possible at low level if soil is mechanically disturbed, or from vehicle operations
Fuel combustion, gasoline dispensing, paint spray booths, tanks, refrigerant leaks, open burning, etc.	CO, NO _x , SO ₂ , PM ₁₀ , VOCs, HAPs, ODS	Both point source and fugitive emissions	No regulated sources/sources requiring permits or APENs remain following completion of accelerated actions	No

Notes:

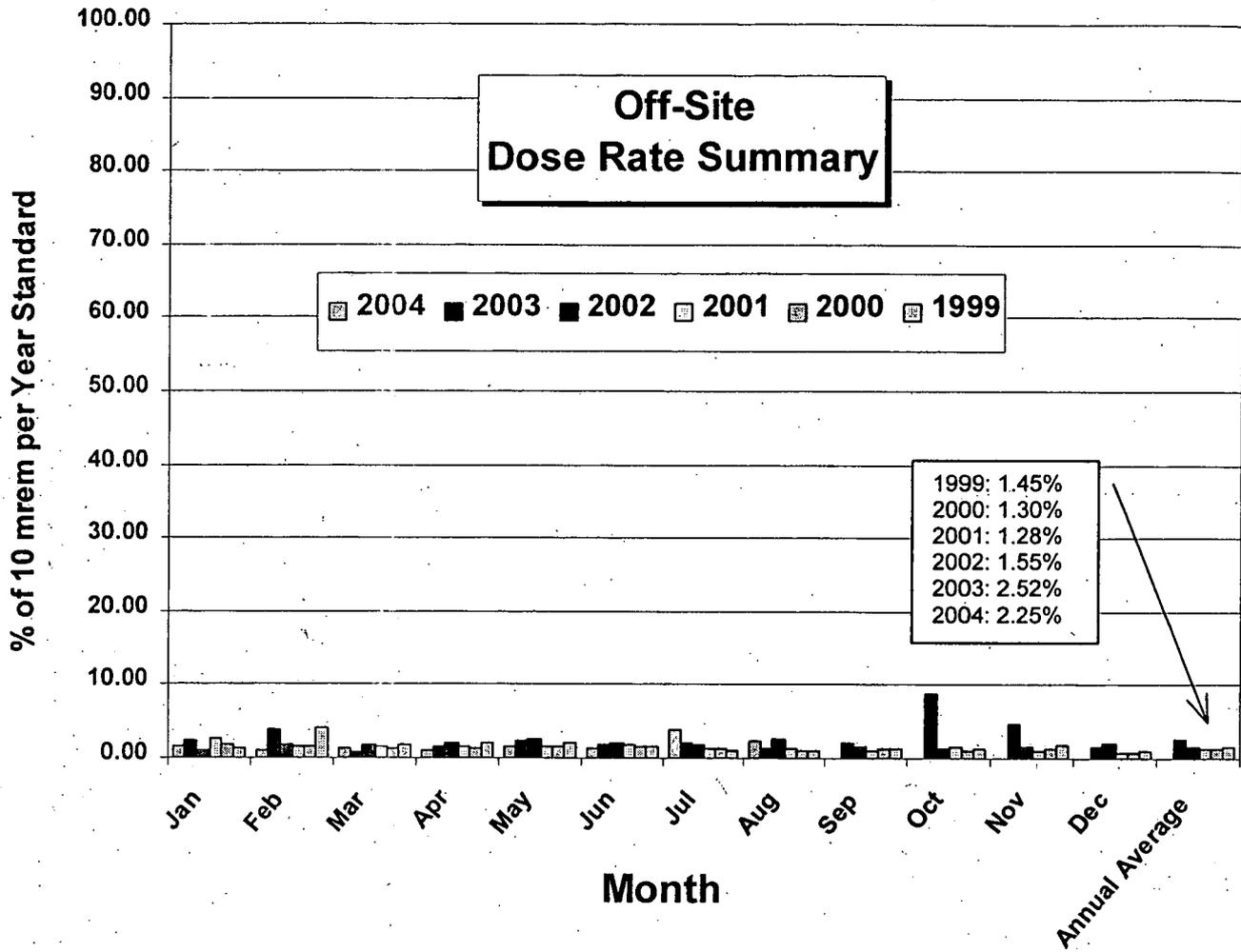
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|-----------------|---|---|---------------------|---|--|
| Am | = | Americium | APEN | = | Air Pollutant Emission Notice |
| Be | = | Beryllium | CO | = | Carbon monoxide |
| CO ₂ | = | Carbon dioxide | EPA | = | US Environmental Protection Agency |
| HAP | = | Hazardous air pollutant; as used here, also includes Colorado noncriteria reportable pollutants | LFG | = | Landfill gas |
| ODS | = | ozone depleting substances | NO _x | = | Nitrogen oxides |
| Pu | = | Plutonium | PM/PM ₁₀ | = | Particulate matter/fine particulate matter |
| SO ₂ | = | Sulfur dioxide | RSAL | = | Radionuclide Soil Action Level |
| VOC | = | Volatile organic compound | U | = | Uranium |

Table 2. Results Summary—1995-1996 RFETS Ambient HAP Sampling

Compound	S-104 (ppb)	S-301, -302 (ppb)	S-008 (ppb)	S-205 (ppb)	S-116 (ppb)	Inhalation Short-term Benchmark Concentrations (ppb)	1998 CDPHE Annual Average Concentrations (ppb)	Inhalation Long-term Benchmark Concentrations (ppb)
1,1,1-trichloroethane	--	1/--	1/--	--	--	ATSDR MRL: 2,000 Cal REL: 12,500	0.06±0.2	Cal REL: 183
1,1,2-trichloroethane	--	1/--	1/--	--	--	ACGIH TLV: 10,000 OSHA PEL: 10,000	--	--
Carbon tetrachloride	2/--	--	2/--	--	--	ATSDR MRL: 200 Cal REL: 300	0.13±0.04	ATSDR MRL: 30 Cal REL: 6.4 Background: 0.14
Methylene chloride	--	1/--	--	--	--	ATSDR MRL: 600 Cal REL: 4,000	0.05±0.13	ATSDR MRL: 300 Background: 0.04
Benzene	--	2/--	3/--	3/--	--	ATSDR MRL: 50 Cal REL: 400	0.18±0.09	Chronic Inhalation RfC: 9.3 Background: 0.15
Toluene	--	4/--	3/--	5/--	--	ATSDR MRL: 1,000 Cal REL: 9,800	0.31±0.18	ATSDR MRL: 80 Chronic Inhalation RfC: 105
Xylene (m,p)	--	--	1/--	--	--	ATSDR MRL: 1,000 Cal REL: 5,050	0.10±0.08	ATSDR MRL: 100 Chronic Inhalation RfC: 22.7

Notes: "--" indicates a non-detect. For RFETS results, first value is maximum concentration, second value is average concentration (all below detection levels). Results based on 24-hour samples. S-116 was the upwind (control) sampler for most of the 1-year study due to predominant wind directions. Colorado Department of Public Health and Environment (CDPHE) HAP samplers were installed at sampling locations X-1, X-2, X-3, X-4, and X-5 at the RFETS fence line (see Figure 2). The Agency for Toxic Substances and Disease Registry (ATSDR) Minimum Risk Levels (MRL) are daily exposures for the specified duration that are likely to be without an appreciable risk of non-cancer adverse effects. Short-term MRLs are for 1-14 days exposure; chronic MRLs are for > 365 days of exposure. The California Environmental Protection Agency (Cal) Reference Exposure Levels (REL) are concentrations at which no health effects are anticipated. MRLs and RELs are listed on the US Environmental Protection Agency's (EPA's) Air Toxics Website at www.epa.gov/ttn/atw/toxsource/summary.html. ACGIH TLV, OSHA PEL are 8-hour time weighted average concentrations based on a normal workweek. ACGIH and OSHA benchmark concentrations from ATSDR at www.atsdr.cdc.gov/mrls.html. Chronic inhalation RfC, from the EPA's Integrated Risk Information System (IRIS), gives effects level for non-cancer effects due to chronic exposure (see www.epa.gov/iris). Background levels from EPA's 1996 National-scale Air Toxics Assessment. Long-term benchmark concentrations converted to ppb, where necessary, from milligrams or micrograms per cubic meter at sea level pressure.

ACGIH = American Conference of Governmental Industrial Hygienists OSHA = Occupational Safety and Health Administration
 PEL = Permissible exposure level ppb = Parts per billion
 RfC = Reference concentration TLV = Threshold limit value



Note: "Off Site" refers to locations outside current RFETS fenceline (outside future wildlife refuge)

Figure 1. Maximum Monthly Measured Off-Site Dose Rates 1999-2004

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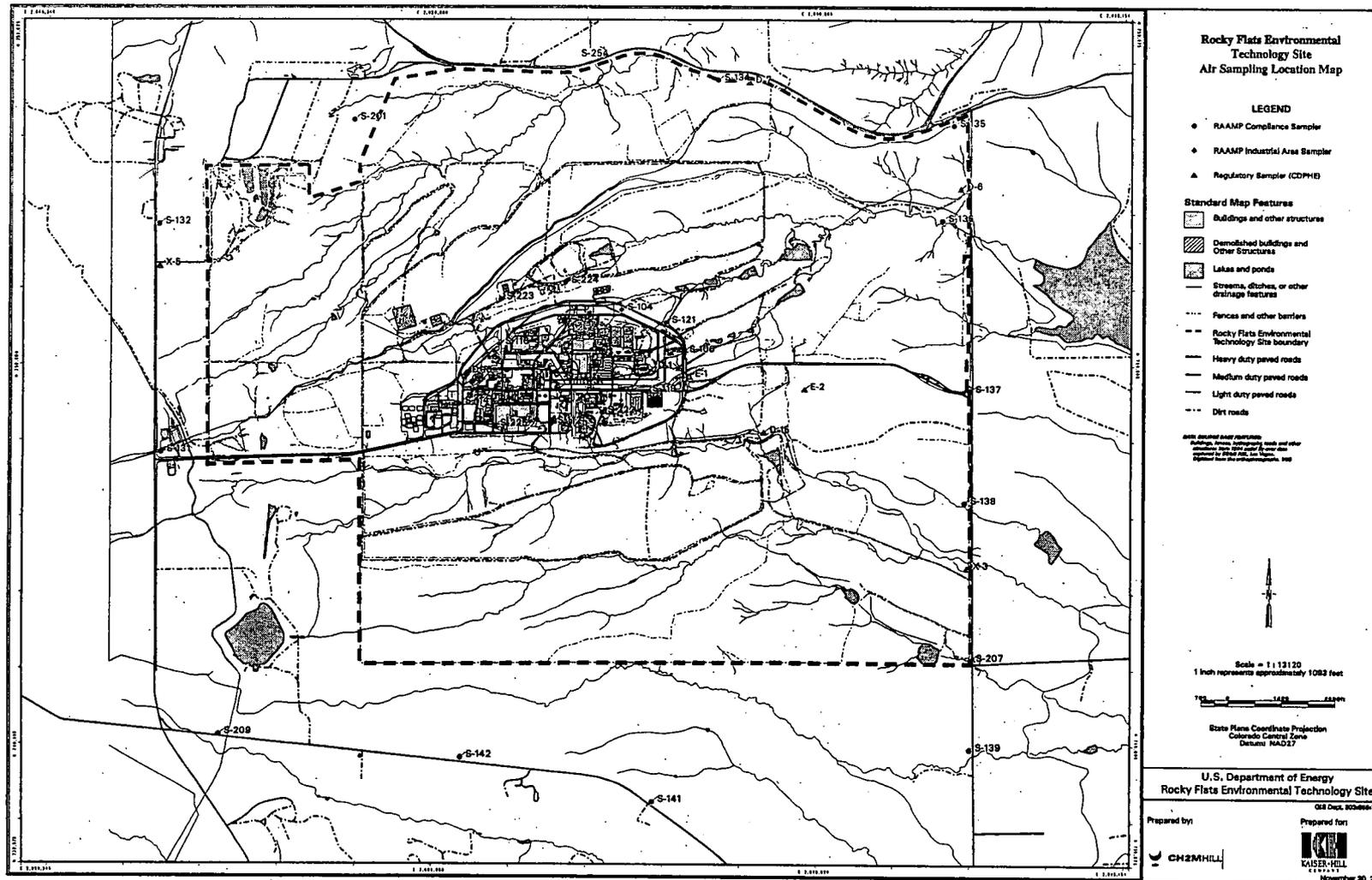


Figure 2. - PLACE HOLDER -Rocky Flats Environmental Technology Site Air Monitoring Locations