ATTACHMENT #1

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ENVIRONMENTAL MONITORING PLAN FOR AIRBORNE RADIOACTIVITY FROM FUGITIVE AND DIFFUSE SOURCES, OAK RIDGE, TENNESSEE

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1. INTRODUCTION

Regulations under 40 CFR 61, Subpart H, require Department of Energy (DOE) facilities to identify and quantify emissions from radionuclide point sources. However, the regulations do not define requirements for reporting and estimating emissions from fugitive and diffuse sources. Further, documented and proven methods that can accurately and selectively estimate emissions from individual fugitive and diffuse sources are not available. Therefore, this document was prepared to outline DOE's plan to use a network of ambient air monitors to confirm that radionuclide emissions from fugitive and diffuse sources, as an aggregate, do not produce off-site atmospheric radionuclide concentrations that significantly contribute to reported radiation doses to the public.

All sources (monitored and unmonitored point sources on the ORR, natural sources, other local industrial and power-producing sources, as well as fugitive and diffuse sources from the ORR) contribute to measured atmospheric radionuclide concentrations at the ambient air monitoring stations. Therefore, use of measured atmospheric concentrations to calculate off-site radiation doses will provide real doses at off-site locations. Historically, doses calculated using point source emissions and atmospheric dispersion models are two to ten times higher than those obtained using measured atmospheric concentrations. Thus, the air monitor results can be used to confirm modeling results and to provide a more realistic estimate of the maximum potential exposure to the most exposed member of the public.

Any fugitive and diffuse radionuclide emissions from ORR will likely be in the form of particulates from resuspension of dust and soil. No significant gaseous source of fugitive radionuclide emissions is known. Therefore, each air sampling station will be equipped to capture particulate radionuclides at 10% or less of the ambient air concentrations listed in 40 CFR Part 61, Appendix E, Table 2. Although not believed to be a significant fugitive source, tritium will also be sampled and analyzed. Continuous ambient air sampling stations are located on the perimeter of ORR in the directions of critical receptors relative to the three operations centers on ORR: Oak Ridge National Laboratory (ORNL), Oak Ridge K-25 Site, and Oak Ridge Y-12 Plant (Fig. 1).

The analytical methods used for the determination of radionuclide concentrations in air, based upon the sampling media, will be consistent with the specifications in 40 CFR Part 61, Appendix B.

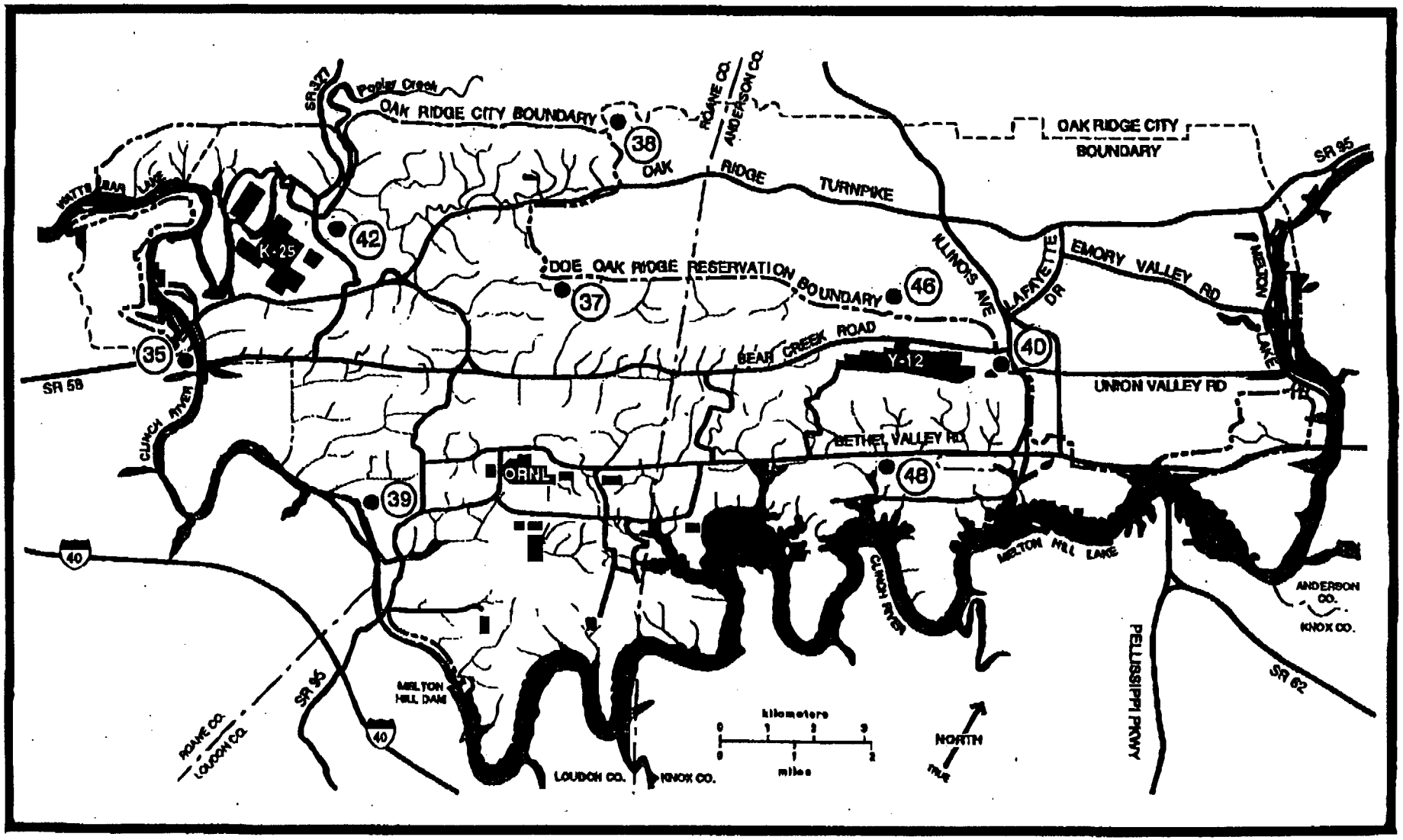

Fig. 1. Map showing locations of ambient air sampling stations for the Oak Ridge Reservation.

2. AIR SAMPLING NETWORK DESIGN

The air sampling network was designed using the Industrial Source Complex (ISC) atmospheric dispersion model to select appropriate sampler locations. The ISC code is employed by EPA to determine the concentrations of materials released from facilities, and is sufficiently flexible to allow numerous potential sampler locations to be analyzed. Although the ISC code does not calculate radioactive dose, the model is useful for determining the atmospheric transport and diffusion of radioactive materials. The model was not run to estimate doses resulting from DOE Oak Ridge Field Office (OR) facilities, but was used as an atmospheric dispersion model to select locations most affected by releases from the Oak Ridge facilities.

2.1 MODEL INPUTS

The terrain of the area was input to the ISC code. As required by the code, terrain above the point of release of materials was assumed to be at the height of release. Numerous model runs were made to estimate the total impact of the Oak Ridge facilities. The rectangular receptor grid option was selected with receptors located at 1-km spacing on a 41- by 41-point grid. An additional 23 receptors located at the residences, businesses, or parks nearest to the sites, were input. For each model run, concentrations at these 1704 receptors were calculated. Release and meteorological data from each site were entered into the code, and the most affected off-site receptors were determined.

The effects of other facility operations on the receptors closest to a given site were estimated. Because the ISC code does not automatically determine the contribution that various sources make to the total concentration predicted for a given receptor location, the effects of releases from the other sites were estimated by entering release information onto the primary site grid using the primary site meteorological data from 1988 and 1989. Because the actual emissions of facilities may vary, the unit emissions rate was employed. This allows the effects of site emissions, and the cumulative effects of overall operations, to be estimated at a consistent set of receptors. The concentration per unit emission ($\mu g/m^3$ per g/s) obtained from the modeling can be multiplied by the actual site emissions of any given material to provide actual estimated impact. In other words, this technique effectively calculates the Chi/Q value for each receptor affected by a facility.

The effects of facility releases on the 1704 receptors were estimated using a ratio technique based on a unit (1 g/s) release from each facility. As an example, the effects of Y-12 Plant releases were estimated using data from the Y-12 Plant E tower, 30-m level as input. These data represent the highest release concentrations for the Y-12 Plant and the ORR, and they determined the receptors most affected by Y-12 Plant operations. The emissions from other OR facilities that might affect receptors near the Y-12 Plant were also taken into account. The effects of K-25 Site emissions on the receptors most affected by Y-12 Plant operations were estimated by inputting the K-25 source location and unit release (1 g/s) into the ISC code, using the Y-12 Plant meteorological data. ORNL effects on the receptors most affected by Y-12 Plant operations were calculated in the same fashion. This procedure was then repeated to calculate dose to receptors from releases at the K-25 Site and ORNL using K-25 Site and ORNL meteorological data, respectively.

2.2 MODEL RESULTS

The highest concentrations affecting residences, businesses, or parks resulting from the Oak Ridge operations were determined by evaluating the model results. Combined impacts from all receptor sites were determined, and sites were ranked according to concentration levels. Based on these analyses, eight receptor locations with the highest summed concentrations were identified. The station numbers are shown on Fig. 1.

Listed below are the station numbers and general locations:

35--TSCA monitoring station near Gallaher Bridge (TSCA Incinerator)
37--west end of Y-12 area nearest Country Club Estates
38--extreme west end of Oak Ridge, north of Highway 95
39--ORNL 0800 Area
40--extreme east end of Y-12
42--Toxic Substances Control Act (TSCA) monitoring station north (TSCA Incinerator)
46--Scarboro monitoring station
48--extreme west end of Bethel Valley Industrial Park

To provide an estimate of background radionuclide concentrations, two additional stations will be added at locations not affected by releases from the DOE Oak Ridge facilities. The remote locations are (52) Loudon Dam and (58) Norris Dam. These stations are shown on Fig. 2.

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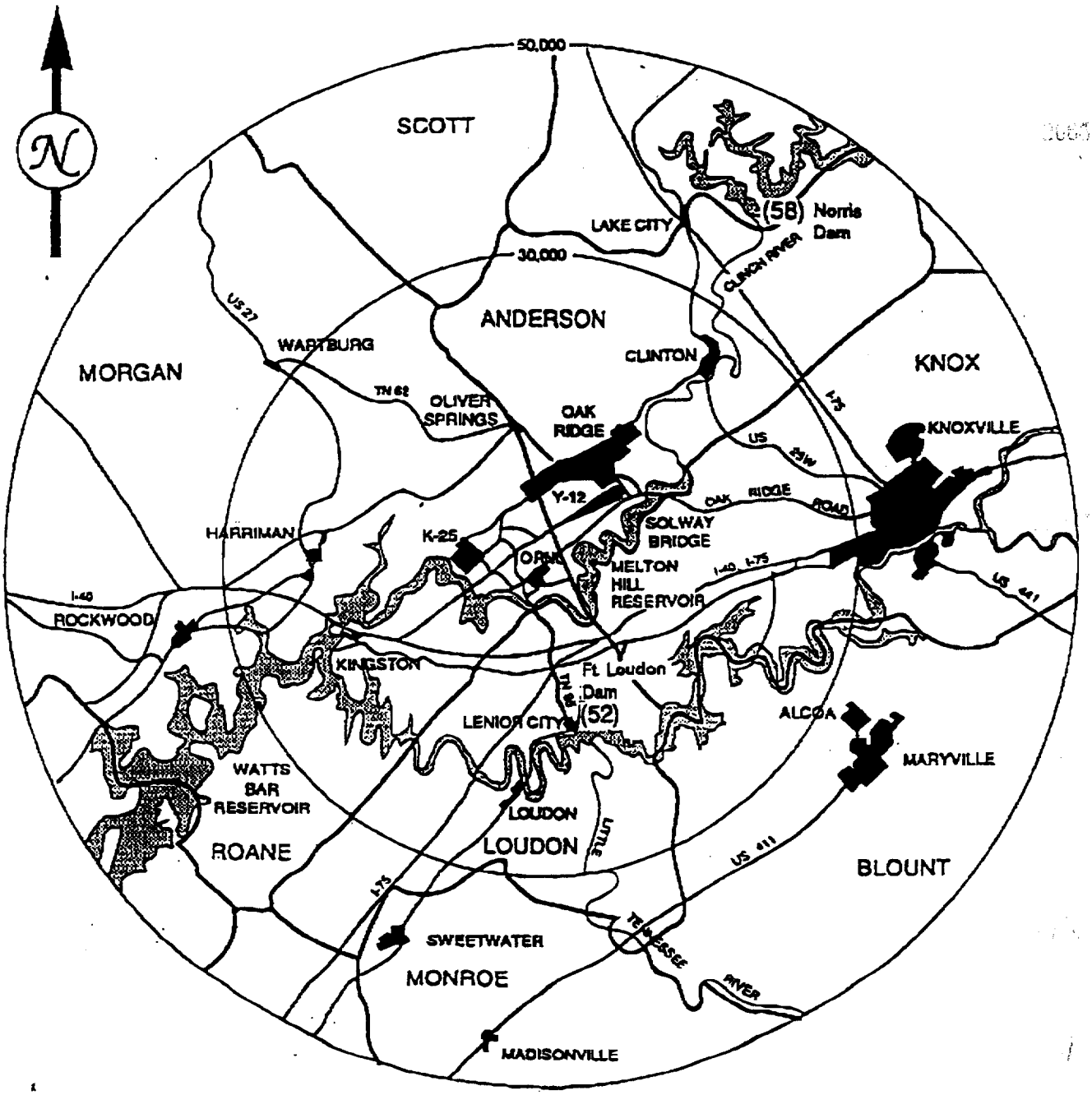

Fig. 2. Map showing locations of background ambient air sampling stations for the Oak Ridge Reservation.

3. AIR SAMPLING STATION DESIGN

The proposed sampling system was designed in accordance with the recommendations of the publication, "Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance," DOE/EH-0173T (Regulatory Guide). The nominal sampling period will range from 1 to 2 weeks, depending upon sample loading. The system reliability criterion is 80% sample production per year.

The air sampling stations will capture ambient concentrations of radionuclides that have historically been major contributors to the point source emissions of ORR. Radionuclides to be monitored include ^{3}H, ^{228}Th, ^{234}U, ^{235}U, ^{238}U, ^{90}Sr, ^{238}Pu, ^{239}Pu, and ^{240}Pu. A gamma scan will be conducted for any detectable gamma emitter such as ^{137}Cs. The tritium will be trapped with silica gel; the remaining isotopes will be collected on a particulate filter. In addition, the design for the subject monitors specifies a minimum sample flow rate of 20 ft^3/min for particulates and 0.1 L/min for tritium. The sample flow rates may be adjusted, if necessary, to increase system sensitivity or to optimize performance and reliability. As an example, the sampling rate for particulate may be increased to ensure that the linear velocity across the particulate filter matrix is maintained within the appropriate range to ensure proper particulate capture, per criteria of the Regulatory Guide.

To ensure a constant flow rate throughout the sample period, a flow controller will be used. The sample flow rate and volume will be continuously measured throughout the sampling interval using a mass flow meter and flow totalizer. The flow meter readings and flow totalizer output will be read and recorded by sampling personnel at the beginning and conclusion of each sampling interval. The inclusion of a mass flow meter and flow totalizer in the station design ensures that an accurate measurement of total sample volume can be made and used in calculations of average ambient radionuclide concentration. Based on the performance of commercially available flow controllers, a maximum flow variance of 30% throughout the sampling period is anticipated; however, actual variations cannot be determined until the sampling system is operated under field conditions.

The sampling rates and sampling media, combined with the analytical methods in Sect. 4, will provide data at or below 10% of the radionuclide ambient air concentrations provided in Table 2, Appendix E of 40 CFR 61, for all the radionuclides listed above.

Tritium will be sampled as tritiated water vapor in accordance with standard practices for tritium sampling in ambient air.

3.1 PARTICULATE SAMPLING

Sample flow rate	20-40 ft^3/min*
Sample volume	5,700 m^3 per week minimum; sample will be composited every 4 weeks
Sample media	Whatman GF/A filter
Flow measurement	Mass flow meter with totalizer and controller

Design calculations:

Design based on ^{228}Th, which has the lowest concentration in air in Table 2:
3.1×10^{-15} Ci/m^3 for ^{228}Th, from 40 CFR 61, Appendix E, Table 2
Sample volume = 22,800 m^3 (for a 4-week composite)
Detection limit = 0.001 total Bq for a 24-h count, from Sect. 4
Minimum detectable concentration (MDC) = detection limit/sample volume
MDC = 0.001 Bq/2.3 X 10^4 m^3 = 4.3×10^{-8} Bq/m^3 = 1.2×10^{-18} Ci/m^3
MDC = <1% of the Table 2 value

3.2 TRITIUM

Sample flow rate	0.1 L/min
Sample volume	1.0 m^3 per week sample will be composited every 4 weeks
Sample media	Indicating silica gel
Flow measurement	Mass flow meter with totalizer and controller

Design calculations:

1.5×10^{-9} Ci/m^3 for ^3H, from 40 CFR 61, Appendix E, Table 2
Sample volume = 4.0 m^3 (for a 4-week composite)
Detection limit = 0.4 total Bq for a 30-min count
Minimum detectable concentration (MDC) = detection limit/sample volume
MDC = 0.4 Bq/4.0 m^3 = 0.1 Bq/m^3 = 2.7×10^{-12} Ci/m^3
MDC = <1% of the Table 2 value

3.3 DUPLICATE PARTICULATE SAMPLING

A duplicate ambient-air-modified high-volume sampler will be operated at a minimum of one sampling site for quality assurance purposes. This duplicate sampler will be collocated with one of the sampling sites and will be completely independent of the operation of the permanent sampling system. The duplicate sampling train will be periodically relocated among the sampling sites and will be operated on a schedule identical to that of the other ambient air monitoring stations.

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*Sample flow rate will be adjusted on the basis of sample filter loading over a 1-week period.

4. ANALYTICAL METHODS

4.1 RADIOCHEMICAL ANALYSIS FOR URANIUM ON AIR FILTERS

This method is consistent with EPA Method A-1, Radiochemistry-Alpha Spectrometry.

Uranium-232 tracer is added to the dissolved air filter solution and equilibrated with the uranium in the sample. Plutonium and thorium are separated by adsorption on anion-exchange resin under conditions that allow uranium to remain in the effluent. Repeated liquid-liquid extractions with methyl isobutyl ketone are used to purify the uranium. The final extract is dried on a stainless steel plate, and the determination of uranium isotopes is made by alpha spectrometric measurements using a silicon surface-barrier detector to count the plate.

Detection limit: 0.001 Bq based on a 24-h count.

4.2 RADIOCHEMICAL ANALYSIS FOR THORIUM ON AIR FILTERS

This method is consistent with EPA Method A-1, Radiochemistry-Alpha Spectrometry.

Thorium-234 tracer (a beta-gamma emitter) is equilibrated with the thorium isotopes in the dissolved air filter solution. The thorium isotopes are adsorbed on an anion-exchange resin, eluted with strong HCl, and coprecipitated with praseodymium as the hydroxide and fluoride. The thorium is finally purified by extracting with thenoyltrifluoroacetone (TTA)-xylene. The TTA extract is dried on a stainless steel disc; the chemical yield is determined by measuring ^{234}Th by beta counting; the alpha-emitting thorium isotopes are determined by alpha pulse-height analysis.

Detection limit: 0.001 Bq based on a 24-h count.

4.3 RADIOCHEMICAL ANALYSIS FOR PLUTONIUM ON AIR FILTERS

This method is consistent with EPA Method A-1, Radiochemistry-Alpha Spectrometry.

Plutonium-242 tracer is added to the dissolved air filter solution, and valence adjustment steps are taken to equilibrate the tracer with the plutonium in the sample. The plutonium is adsorbed onto an ion-exchange resin and then selectively eluted from the resin. The plutonium is precipitated as a hydroxide and then extracted into TTA-xylene. The TTA extract is dried on a stainless steel disc; the chemical yield is determined by measuring ^{242}Pu by pulse-height analysis. ^{238}Pu and ^{239}Pu are determined by alpha pulse-height analysis.

Detection limit: 0.001 Bq based on a 24-h count.

4.4 RADIOCHEMICAL ANALYSIS FOR STRONTIUM ON AIR FILTERS

Strontium carrier is equilibrated with the dissolved filter solution; afterward, the strontium is separated from calcium and magnesium by repeated nitrate precipitations. Additional purification is made by removing rare earths and other radionuclides by hydroxide scavenging and by removing barium and radium as chromates. Strontium is finally precipitated as the oxalate, which is mounted for beta counting and counted on a low-background beta counter.

Detection limit: 0.074 Bq based on 30-min count.

4.5 ANALYSIS OF TRITIUM ON SILICA GEL

This method is consistent with EPA Method B-5, Liquid Scintillation Spectrometry.

Silica gel is transferred to a distillation flask and heated with a heating mantle. The tritium is distilled with the water from the silica gel and collected in an appropriate container. The total volume of water is measured and an aliquot taken. The aliquot of the distillate is transferred to a polyethylene vial and mixed with a liquid scintillation cocktail. The sample is allowed to sit in the dark for approximately 30 min and is then counted in a liquid scintillation counting system for tritium beta particle activity. The tritium is reported as total becquerel for the volume of water removed. The efficiency of the system is determined by the use of prepared tritiated water standards having the same density and color as the sample.

Detection limit: 0.4 Bq total based on 30-min count.

5. QUALITY ASSURANCE/QUALITY CONTROL

A Quality Assurance Program has been developed which includes all components of the ambient air program — responsibilities, monitoring, instrumentation, analytical, quality control, and data management and reporting. Elements of the program are included in the following documents:

1. DOE/HQ Order 5700.6C Quality Assurance
2. Energy Systems Policy GP-7, Quality
3. Energy Systems Environmental Surveillance Procedures Quality Control Program
4. ORNL Quality Assurance Manual
5. Quality Assurance Plan for the Office of Environmental Compliance and Documentation, QAP-S-90-EHP/ECHP-0000
6. Environmental Surveillance and Protection Sampling and Instrumentation QA Plan, QAP-X-91-ESHC/ESP-001
7. Environmental Surveillance and Protection Information and Integration and Analysis QA Plan, QAP-X-91-ESHC/ESP-002
8. Chain of Custody, SOP-ESP-003.002
9. Ambient Air Sampling, SOP-ESP-003.038
10. Sampling Document Control, SOP-ESP-003.014
11. Analytical Chemistry Quality Assurance Manual, ORNL/M-806
12. Oak Ridge Field Office Environmental Monitoring Plan for the Oak Ridge Reservation, September 1992

To prevent tampering with monitoring equipment at each of the proposed ambient air monitoring locations, each station is enclosed within a 6-ft-high fence that surrounds the station. Each station is equipped with a locked entry, which remains closed and locked at all times other than when authorized personnel are at the station performing required duties.

6. IMPLEMENTATION SCHEDULE

Implementation of the ambient air monitoring network on ORR will consist of eight continuous air sampling stations at the locations shown in Fig. 1 and described in Sect. 2. The implementation schedule for the ambient air monitoring network is given below:

- Complete Modification 10/30/92
- Ambient Monitoring Network Operational 10/30/92

beta, and total fluorides. The monitors are incapable of producing results from which off-site doses due to PGDP radionuclide emissions can be accurately determined. It is reiterated that PGDP extrapolated data from ambient monitoring results simply because there is no DOE or EPA guidance on estimation of off-site dose resulting from diffuse and fugitive sources at PGDP.

PGDP intends to upgrade its ambient air monitoring network to be capable of isotope specific analysis. The present schedule indicates that the monitors will be installed and prepared for operation by November 1993. After EPA and DOE issue guidance for estimation of fugitive and diffuse emissions, PGDP will determine whether the new ambient monitors or another method will be used to assess fugitive emissions.

According to the March 24 correspondence, sources of diffuse and fugitive emissions include evaporation ponds, breathing of buildings, cooling tower drift equipment, and contaminated soil. These sources are addressed as follows:

1. PGDP has no evaporation ponds.

2. Emissions from building ventilation were included as a grouped minor source in the 1991 annual NESHAP report.

3. PGDP's recirculating cooling water (RCW) system is separated from the diffusion cascade by a chlorofluorocarbon-114 (CFC-114) cooling system. The cooling tower drift contains no radionuclides due to the fact that the cascade operates below atmospheric pressure and substantially below the operating pressure of the adjacent CFC-114 system, which is approximately 90 pounds per square inch (gauge). Therefore, any leakage in the system will result in and in-leakage of CFC-114 into the process gas stream, rather than process gas into the CFC-114.

4. Resuspension of contaminated soil can occur from vehicular traffic during remediation activities and contaminated scrap storage. Vehicular traffic in contaminated scrap areas is very minimal, and usually results from the hauling and deposit or movement of large pieces of scrap metal. During 1991 the only remediation activities which could have resulted in the resuspension of soil were drilling activities associated with the establishment of sampling wells and removal of two leaking underground fuel storage tanks. PGDP has no methods or guidance for estimation of emissions from such activities and requests a determination from EPA as to whether these activities actually consistute a fugitive or diffuse source.

The March 24 correspondence stated that sources of diffuse emissions included the above. It can be inferred that these sources do not comprise the total list of potential fugitive or diffuse sources. Until such a list is determined by EPA, PGDP cannot determine whether such sources exist at PGDP.

Finally, in telephone conversations between Doug W. Jones of the PGDP Air and Water Compliance Department and Jon Richards of EPA Region IV, it was agreed that PGDP's

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DRAKE	McNEAL	RICHARDS	BEALS
~~GAILLARD~~	~~SPAGG~~	~~LOVETT~~	~~CREW~~
~~HARPER~~			

bc: Jon Richards, Region IV - Office of Radiation

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