Department of Energy Air Emissions Annual Report
Oak Ridge Reservation, Oak Ridge, Tennessee
40 Code of Federal Regulations (CFR) 61, Subpart H
Calendar Year 2016

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Prepared by

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For the U.S. Department of Energy under Contract No. DE-NA0001942

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Managed by UT-Battelle, LLC
For the U.S. Department of Energy under Contract No. DE-AC05-00OR22725

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Managed by URS | CH2M Oak Ridge LLC
For the U.S. Department of Energy under Contract No. DE-SC-0004645

Department of Energy
Air Emissions Annual Report
40 Code of Federal Regulations (CFR) 61, Subpart H
Calendar Year 2016

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LIST OF ACRONYMS

ANSI	American National Standards Institute
CAP88PC	Clean Air Act Assessment Package – 1988, Personal Computer
CFR	*Code of Federal Regulations*
CNS	Consolidated Nuclear Security, LLC
DAC	derived air concentration
DCFPAK-2.2	Dose Coefficient Data File Package, Version 2.2
DOE	U.S. Department of Energy
DOE-ORO	Department of Energy Oak Ridge Office
D&D	decontamination and decommissioning
ED	effective dose
EDE	effective dose equivalent
EPA	Environmental Protection Agency
ETTP	East Tennessee Technology Park
FFCA	Federal Facilities Compliance Agreement
HEPA	high-efficiency particulate air
HFIR	High Flux Isotope Reactor
HP	Health Physics
HPS	Health Physics Society
ICP/MS	Inductively Coupled Plasma Mass Spectrometry
LSC	Liquid Scintillation
MEI	maximally exposed individual

NESHAPs	National Emission Standards for Hazardous Air Pollutants
NNSA	DOE/National Nuclear Security Administration
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Office
ORR	Oak Ridge Reservation
Pro2Serve®	Professional Project Services, Inc.
QA	Quality Assurance
REDC	Radiochemical Engineering Development Center
S&T	Science and Technology
SNMs	Special Nuclear Materials
SNS	Spallation Neutron Source
SODAR	Sonic Detection and Ranging
SRDT	Solar Radiation Delta Temperature
STP	Sewage Treatment Plant
TDEC	Tennessee Department of Environment and Conservation
TRU	Transuranic
UCOR	URS | CH2M Oak Ridge LLC
UPF	Uranium Processing Facility
UT-Battelle	UT-Battelle, LLC
Y-12 Complex	Y-12 National Security Complex

EXECUTIVE SUMMARY

The Environmental Protection Agency (EPA) has promulgated national emission standards for emissions of radionuclides other than radon from Department of Energy (DOE) facilities. The final rule can be found in Title 40 of the Code of Federal Regulations (CFR) 61, Subpart H, also incorporated in the Tennessee Air Pollution Control Regulation 1200-3-11-.08: *National Emission Standards for Hazardous Air Pollutants; Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities*. This regulatory standard limits the annual effective dose (ED) that any member of the public can receive from DOE facilities to 10 mrem/yr. As defined in the preamble of the final rule, the entire DOE facility on the Oak Ridge Reservation (ORR) must meet the 10 mrem/yr ED standard.[1] In other words, the combined ED from all radiological air emission sources from Y-12 National Security Complex (Y-12 Complex), Oak Ridge National Laboratory (ORNL), East Tennessee Technology Park (ETTP), Oak Ridge Institute for Science and Education (ORISE) and any other DOE operation on the reservation must meet the 10 mrem/yr standard. Compliance with the standard is demonstrated through emission sampling, monitoring, calculations and radiation dose modeling in accordance with approved EPA methodologies and procedures. DOE estimates the ED to many individuals or receptor points in the vicinity of ORR, but it is the dose to the maximally exposed individual (MEI) that determines compliance with the standard.

The calculated ED to the MEI from all radiological airborne release points on the ORR during 2016 was 0.2 mrem/year (0.002 mSv). Dose contributions to the MEI from the Y-12 Complex, ORNL, and ETTP were 2.2%, 97.8% and 0.004%, respectively. The ORISE demonstrates compliance with the regulations by use of annual possession quantities and therefore contributes zero percent to the MEI dose. The calculated ED to the MEI is well below the National Emission Standards for Hazardous Air Pollutants (NESHAP) standard of 10 mrem and is equal to approximately 0.07% of the roughly 300 mrem that the average individual receives from natural sources of radiation. The MEI for 2016 was an offsite member of the public located outside the ORR about 13,340 m southwest of the Y-12 Complex composite release point; about 5240 m west-southwest of the 7911 stack at ORNL; and about 5710 m south-southeast of the K-1407-AL at ETTP. In accordance with DOE Order 458.1, the collective dose is the sum of the ED to each person within 80 km (50 miles) of the ORR. The population within 80 km (50 miles) of the ORR was estimated to be 1,172,530 and based on 2010 Census Data. For 2016, the calculated collective ED to the entire population within 80 km (50 miles) of the ORR was approximately 6.4 person-rem. This collective dose suggests that the average ED that a member of the public received within 80 km (50 miles) of the ORR was below the DOE Order 458.1 public dose limit of 100 mrem (1 mSv) in a year.

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[1]Environmental Protection Agency, *40 CFR Part 61 National Emission Standards for Hazardous Air Pollutants; Radionuclides; Final Rule and Notice of Reconsideration*, Federal Register Vol. 54, No. 240, December 15, 1989, pg. 51665.

SECTION I. FACILITY INFORMATION

SITE DESCRIPTION: OAK RIDGE RESERVATION (ORR)

The ORR is located within the corporate limits of the city of Oak Ridge in eastern Tennessee and consists of approximately 34,241 acres of federally owned land. The ORR site is predominantly to the west and south of the city of Oak Ridge, which has a population of 29,330.[2] Oak Ridge lies in a valley between the Cumberland and southern Appalachian mountain ranges and is bordered on one side by the Clinch River. The Cumberlands are about 16 km (10 miles) northwest; 113 km (70 miles) to the southeast are the Great Smoky Mountains. Figure 1 is a map of the ORR.

Except for the city of Oak Ridge, the land within 8 km (5 miles) of the ORR is predominantly rural, used largely for residences, small farms, and cattle pasture. Fishing, boating, water skiing, and swimming are recreational activities in the area. The approximate location and population of the towns nearest the ORR are Oliver Springs (population 3,231), 11 km (6.8 miles) to the northwest; Clinton (population 9,841), 16 km (10 miles) to the northeast; Lenoir City (population 8,642), 11 km (6.8 miles) to the southwest; and Harriman (population 6,350), 13 km (8 miles) to the west.[2]   Figure 2 provides a map of the nearby towns and cities. Knoxville, the major metropolitan area nearest Oak Ridge, is located about 20 km (12 miles) to the east and has a population of approximately 178,874.[1] Oak Ridge has a temperate climate of warm, humid summers and cool winters. Spring and fall are usually long. During spring, storm systems bearing significant precipitation frequent the area, but the fall is normally sunny with mild temperatures. Severe storms, such as tornadoes or high-velocity winds, are rare. Oak Ridge is one of the country's calmest wind areas. The daily up-and-down valley winds, however, provide some diurnal exchange. The prevailing winds are northeasterly (down-valley) and southwesterly (up-valley).

During 1991 and 1992, the Department of Energy Oak Ridge Office (DOE-ORO) and EPA Region 4 negotiated a Federal Facilities Compliance Agreement (FFCA), which was used to bring the ORO into full compliance with 40 CFR 61, Subpart H. As required by the FFCA, the *Compliance Plan: National Emission Standards for Hazardous Air Pollutants for Airborne Radionuclides on the Oak Ridge Reservation, Oak Ridge, Tennessee* (*Compliance Plan*), was submitted to EPA Region 4 in December 1991. ORO completed all other obligations under the compliance schedule of the FFCA by December 15, 1992. In September 1993, EPA Region 4 conducted an inspection of the ORR to verify that all requirements of the FFCA were completed. All requirements were found to have been satisfactorily completed, and no deficiencies were

[2]Population data cited here is the 2010 decennial census data reported by the U.S. Census Bureau (www.census.gov).

ORNL-DWG 93M-9616R4

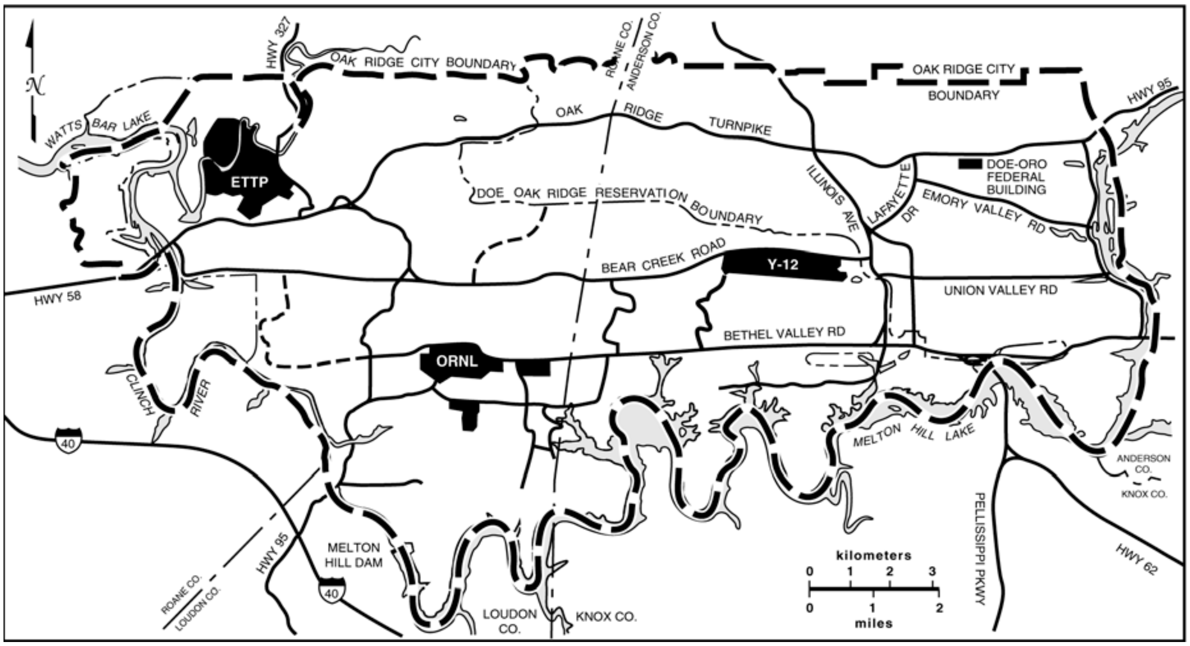

Figure 1: Map of the ORR

ORNL-DWG 87M-7054R14/asb

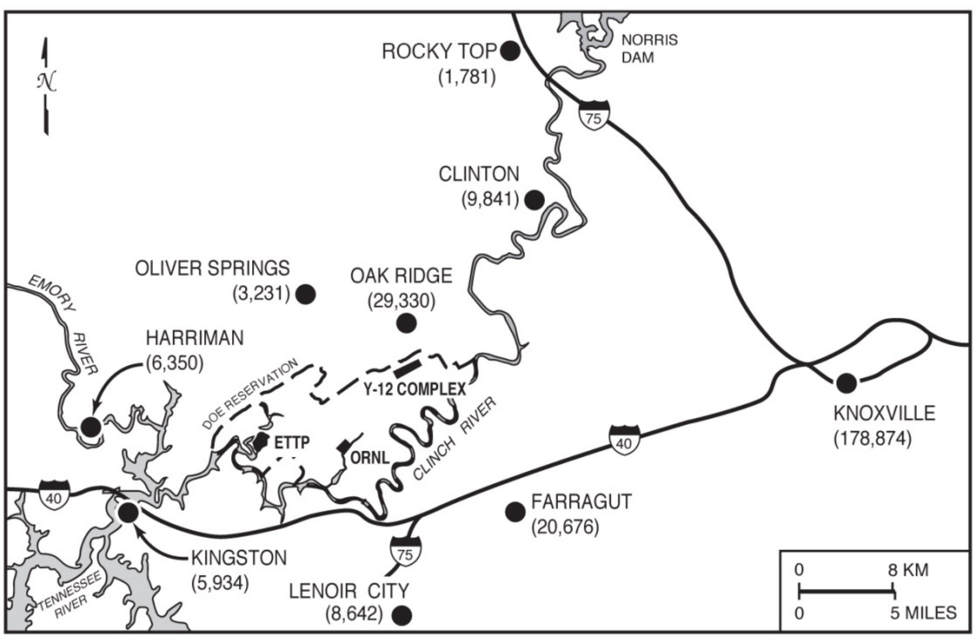

Figure 2: Location of towns and cities near the ORR

noted. In May 1994, the *Compliance Plan* was updated to reflect additional agreements between EPA Region 4 and ORO since the original *Compliance Plan* was submitted in 1991.

In October 2001, EPA Region 4 approved two addendums to the *Compliance Plan*, Addendum C.1, *Monitoring for Fugitive and Diffuse Sources* and Addendum C.2, *Monitoring Plan for Onsite Receptors*. Addendum C.1 formalizes the use of environmental measurements from ambient air monitoring to confirm compliance for fugitive and diffuse sources for the ORR. This compliance approach has been in place since January 1993, and ambient air monitoring results have been included in the ORR Annual Air Emissions Report since the monitoring was implemented in 1993. Addendum C.2 formalizes EPA guidance, in a February 1, 2001, guidance letter, that allows the use of environmental measurements from ambient air monitors in lieu of continuous stack monitoring as an alternative method to demonstrate compliance with 40 CFR 61, Subpart H, for sources that are major when modeled to "onsite" receptors, but minor when modeled to offsite receptors. Ambient air monitoring results for these sources have been included in the ORR Air Emissions Annual Report since the 2002 report. In March 2005, EPA Region 4 approved a third addendum to the *Compliance Plan*, Addendum C.3 ANSI/HPS N13.1-1999 Upgrade Policy, which clarifies when an existing source on the ORR undergoing a modification must be upgraded to meet the new design criteria of the American National Standards Institute (ANSI)/Health Physics Society (HPS) N13.1-1999 Standard in accordance with the September 9, 2002, amendment to 40 CFR 61, Subpart H. During the March 2005 approval cycle, the title page to the *Compliance Plan* was updated with a DOE document number (DOE/ORO/2196), and a revision to Section 2.1 was approved that incorporated updated criteria under 10 CFR Part 835. On April 22, 2013, EPA Region 4 approved Revision 1 of the *Compliance Plan*, DOE/ORO/2196, which changed all references of effective dose equivalent (EDE) to ED and updated operational contractual responsibilities, facility nomenclature and tables used to demonstrate compliance with 40 CFR 61, Subpart H.

SOURCE DESCRIPTION: Y-12 NATIONAL SECURITY COMPLEX

The Y-12 Complex is located in a valley immediately adjacent to the city of Oak Ridge, but separated from it by a 300-foot high ridge. In 2016, the site was managed and operated by Consolidated Nuclear Security, LLC (CNS). The Y-12 Complex's mission is to meet the needs of DOE/National Nuclear Security Administration (NNSA), other government agencies, and private industry through a commitment to excellence in the utilization of a technology-based manufacturing center. Its roles include:

- receipt, storage, and protection of Special Nuclear Materials (SNMs);
- quality evaluation/enhanced surveillance of the nation's nuclear weapon stockpile;
- safe and secure storage of nuclear materials;
- dismantlement of weapon secondaries and disposition of weapon components;
- provision of technical support to the NNSA Defense Nuclear Nonproliferation Program;
- provision of fuel for the nation's naval reactors program;
- transfer of technology to private industry;
- maintenance of DOE capabilities; and
- provision of support to DOE, other federal agencies, and other national priorities.

This mission will be accomplished in a cost-effective manner by integrating manufacturing, engineering, and development technologies, with emphasis on protecting the environment, and the health and safety risks of the public and employees.

The major radionuclide emissions contributing to the dose from the Y-12 Complex are nuclides ^{234}U, ^{235}U, ^{236}U, and ^{238}U, which are emitted as particulates. The particle size and solubility class of the emissions are based on review of the operations and processes served by the exhaust systems to determine the quantity of uranium handled in the operation or process, the physical form of the uranium, and the nature of the operation or process. The four categories of processes or operations that are considered in the total of uranium emissions are those that exhaust through monitored stacks, unmonitored processes for which Appendix D calculations are performed and/or based on historical performance, processes or operations exhausting through laboratory hoods also involving Appendix D calculations, and processes from room exhausts monitored by radiation control equipment.

Continuous sampling systems are used to monitor emissions from a number of process exhaust stacks at the Y-12 Complex. In addition, a probe-cleaning program is in place, and the results from the probe cleaning at each source are incorporated into the respective emission point source term. In 2016, a total of 32 process exhaust stacks were continuously monitored, 24 of which were major stacks, and the remaining 8 being minor stacks (minor sources do not have the potential to cause any member of the public to receive an ED equal to or greater than 0.1 mrem/year (0.001 mSv/year). Processes emitting to Stacks US-044 and US-062 did not operate during 2016. Stack US-128, a minor stack, will not be monitored after 2016. The monitored emission points are listed separately as major and minor point sources in Section II, Table 1.

During 2016, unmonitored uranium emissions at the Y-12 Complex occurred from 31 emission points (stacks/vents) associated with onsite, unmonitored processes and laboratories operated by CNS. Emission estimates for the unmonitored process and laboratory stacks were made using inventory data with emission factors provided in 40 CFR 61, Appendix D, or through historical performance. These emission points are listed as two minor grouped sources in Section II, Table 1. The Y-12 Complex source term includes an estimate of these unmonitored emissions.

Additionally, estimates from room ventilation systems are considered using radiological control data on airborne radioactivity concentrations in the work areas. Where applicable, exhausts from any area where the monthly concentration average exceeds 10 percent of the derived air concentration (DAC) (as defined in the *Compliance Plan)* are included in the annual source term. Annual average concentrations and design ventilation rates are used to arrive at the annual emission estimate for these areas. Five emission points from room ventilation exhausts were identified in 2016 where emissions exceeded 10 percent of the DAC. These emission points fed to monitored stacks and any radionuclide emissions are accounted for as noted above for monitored emission points.

The Y-12 Complex was issued Title V Major Source Operating Permits 554701 and 554594 in 2004. These Permits required compliance implementation beginning April 1, 2005.

Subsequently, a renewal Title V Major Source Operating Permit 562767 was issued to the Y-12 Complex with an effective date of January 9, 2012. Contained in each of the above permits is a site-wide, streamlined alternate emission limit for enriched and depleted uranium process emission units. A limit of 2,000 pounds per year of particulate was set for these sources for the purposes of paying fees. The compliance method defined in the permits is the requirement that annual actual mass emission particulate emissions be generated using the same monitoring methodologies required for Radionuclide NESHAPs compliance.

For calendar year 2016, in accordance with renewal Permit 562767, the total mass radionuclide emission from the Y-12 Complex was approximately 1,500 grams. This value is multiplied by two to conservatively estimate total particulate emissions from these sources (radionuclide + non-radionuclide particulate emissions). Therefore, in 2016 the total particulate emission from these sources was approximately 3,000 grams (<7 lb) which is less than the 2,000-pound permit limit.

Lastly, a Uranium Processing Facility (UPF) is presently being designed. It is intended that this facility house some of the processes that are currently in existing production buildings. The UPF project was issued a Construction Air Permit, No. 967550P, in March 2014. The current strategy, with concurrence from the Tennessee Department of Environment and Conservation (TDEC) Air Division, is to include the UPF into the 2017 update of the Y-12 Site Title V Operating Permit and maintain the facility on the Permit as inactive until operations commence in approximately 2025.

SOURCE DESCRIPTION: OAK RIDGE NATIONAL LABORATORY

ORNL, operated by UT-Battelle, LLC (UT-Battelle), located toward the west end of Bethel Valley, is the largest science and energy national laboratory in the DOE system. ORNL's scientific programs focus on materials, neutron science, energy, high-performance computing, systems biology and national security. ORNL partners with the state of Tennessee, universities, and industries to solve challenges in energy, advanced materials, manufacturing, security and physics. The laboratory's science and technology innovations are translated into applications for economic development and global security. The laboratory is home to several of the world's top supercomputers and is a leading neutron science and nuclear energy research facility that includes the Spallation Neutron Source (SNS) and High Flux Isotope Reactor (HFIR). ORNL's facilities include a nuclear reactor, chemical pilot plants, research laboratories, radioisotope production laboratories, accelerators, fusion test devices, and support facilities.

URS | CH2M Oak Ridge LLC (UCOR) is responsible for the operation of waste management facilities and surveillance and maintenance of facilities slated for environmental restoration or decommissioning at ORNL. These facilities are included in Section II, Table 2 and have a UCOR designation. North Wind Solutions, LLC is the DOE prime contracting manager and operator of the Transuranic (TRU) Waste Processing Center (7880). The 7880 facility has been in operation since 2004 and processes TRU contaminated wastes for disposal. The 7880 facility has a North Wind Solutions, LLC designation in Section II, Table 2.

Radionuclide emissions at ORNL vary because of the diverse range of research activities performed. Sources of radionuclide emissions consist mainly of ventilation from (1) isotope production/handling areas, (2) reactor research, (3) accelerator operations and associated research (4) analytical facilities, (5) small, bench-scale experiments, and (6) out-of-service and decommissioned facilities. These emissions typically consist of particulates, adsorbable gases, nonadsorbable gases (i.e., noble gases), and tritium. For 2016, of the 278 radionuclides released from ORNL operations and evaluated (see Table 4), ^{11}C, ^{234}U, and ^{212}Pb contributed about 34%, 21%, and 18%, respectively, to the offsite dose from ORNL. Carbon-11 emissions result from SNS operations and research activities. Emissions of ^{234}U are associated with a number of sources at ORNL, including 1000, 3000, 4000 and 7000 area laboratory hoods. Emissions of ^{212}Pb result from the radiation decay of legacy material stored onsite and areas containing isotopes of ^{228}Th, ^{232}Th, and ^{232}U. Emissions of ^{212}Pb were from the following stacks: 2026, 3020, 3039, 7503, 7856, 7911, 7935 Glove Box, the Sewage Treatment Plant (STP) Sludge Drier and the 4000 area laboratory hoods.

Radionuclide emissions from the SNS are discharged through a single emission point, the SNS Central Exhaust Facility stack (8915). The SNS Central Exhaust Facility stack has the potential to emit radionuclides that would result in a dose equal to or greater than 0.1 mrem/year (0.001 mSv/year) to the most exposed member of the public and, therefore, continuous emission sampling or monitoring is required. This requirement is met with an ANSI/HPS N13.1-1999 compliant in-stack radiation detector that monitors radioactive gases flowing through the exhaust stack and provides a continual readout of detected activity using a scintillator probe. The detector is calibrated to correlate with isotopic emissions.

The source term information from the ORNL site is obtained from seven major and a number of minor emission sources. The seven major emission sources (2026, 3020, 3039, 7503, 7880, 7911, and 8915) have the potential to emit radionuclides that would result in a dose equal to or greater than 0.1 mrem/year (0.001 mSv/year) to the most exposed member of the public and require continuous emission sampling. Two minor emission sources (7830 and 7856) that historically have a potential dose below 0.1 mrem/year (0.001 mSv/year) are also continuously sampled. The 7830 and 7856 tanks contain TRU contaminated sludge but have been isolated and inactive for over 15 years. A layer of water has been maintained over the sludge and the head space has a continuous flow of ventilation air. The ventilation air exits through a continuously sampled stack. Data from the continuous samplers in 2016 indicated that the potential dose for both 7830 and 7856 did not exceed 0.1 mrem/year (0.001 mSv/year), and these sources remain categorized as minor sources.

The 3039 Central Off-gas System operations, the 7503 Molten Salt Reactor facility, the 7830 Melton Valley Storage Tanks, and the 7856 Melton Valley Storage Tanks Annex are operated by UCOR. The 7880 TRU Waste Processing Center is designed to process contact handled, remote handled, supernate, and sludge wastes. During 2016, contact and remote handled TRU debris waste was processed for final disposal. TRU waste that was determined to be LLW was either macroencapsulated or shipped for final disposal. Emissions from this operation pass through an extensive pollution control system and then are vented out the 7880 stack. In February 2007, Isotek Systems, LLC, assumed operation of the 3019 Radiochemical Development Facility and the associated 3020 stack. Emissions from all of the major stacks were quantified using continuous sampling systems. In addition, a probe-cleaning program is in place for all monitored stacks except for 8915, and any measurable or statistically significant results from the probe cleaning at each source are incorporated into the respective emission point's source term. A probe cleaning program has not been determined necessary for 8915 since the sample probe is a scintillator probe used to detect radiation and not to extract a sample of stack exhaust emissions. It is not anticipated that contaminant deposits would collect on the scintillator probe. All systems meet the criteria for 40 CFR 61, Subpart H.

A total of 14 minor sources (point and grouped) are located at ORNL. Minor sources do not have the potential to cause any member of the public to receive an ED equal to or greater than 0.1 mrem/year (0.001 mSv/year). Two of the minor sources have emissions from inoperative facilities that are still vented to the atmosphere. These are the Graphite Reactor (3018) and out-of-service laboratory hoods and/or facilities with residual contamination. There are 12 minor sources venting from operational areas. These sources are the Process Waste Treatment Plant (3544), Transuranium Research Laboratory (5505), Liquid Low-Level Waste Solidification Facility (7877), Interim Manipulator Repair Facility (7935), STP Sludge Drier, Nonradiological Wastewater Treatment Facility (3608 Air Stripper and the 3608 Filter Press), Storage Tanks (2099, 7830, 7856, 7966), and laboratory hoods. The 3608 Air Stripper was taken out of service May 16, 2016, and the STP Sludge Drier operated intermittently in 2016 for approximately 69 days. A variety of approved methods are used to evaluate minor source emissions, including in-stack sampling, health physics data, high-efficiency particulate air (HEPA) filter sampling, surrogate emission estimates, and inventory data with emission factors provided in 40 CFR 61, Appendix D. There were no sources added to the ORNL source term in 2016. All other new activities with a potential to release radionuclides were identified as fugitive and diffuse.

EPA Headquarters issued guidance to the EPA Regional Offices February 1, 2001,[3] allowing the use of environmental measurements from high-volume air samplers in lieu of continuous stack monitoring as an alternative method to demonstrate compliance with 40 CFR 61, Subpart H, for DOE's "privatization/reindustrialization" program. In a series of telephone conversations between DOE-ORO and TDEC, it was determined that the construction workers that support construction activities for ORNL's Facilities Revitalization Project would be considered members of the public subject to 40 CFR 61, Subpart H, compliance, since the proposed construction sites were deeded to a non-DOE entity. In light of the February 1, 2001, guidance from EPA, UT-Battelle and DOE requested and obtained approval from EPA Region 4 to use a single transportable high-volume air sampler at the East Campus construction site as an alternative method to demonstrate compliance with 40 CFR 61, Subpart H, due to the transient nature of the construction work force. In October 2001, EPA Region 4 approved Addendum C.2, *Monitoring Plan for Onsite Receptors,* to the *Compliance Plan* which formalizes EPA's

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[3] Memorandum, Frank Marcinowski, Division Director, Radiation Protection Division, Office of Radiation and Indoor Air, EPA, to Regional Radionuclide NESHAPs Coordinators Regions I - X, "Criteria to Determine Whether a Leased Facility at DOE is Subject to Subpart H," February 1, 2001.

February 1, 2001, guidance and allows the use of a single transportable high-volume air sampler at any construction site where the workers are considered members of the public subject to 40 CFR 61, Subpart H. In 2016, there were no construction sites where workers were considered members of the public. Therefore, no ambient air monitors for onsite receptors were used on the ORNL site in 2016.

DOE's national laboratories represent a remarkable collection of scientific facilities, equipment, and researchers that rivals the best in the world. Among DOE's missions is the effort to make the new technologies developed with these unique resources available for national and regional economic growth through technology commercialization. The Oak Ridge Science and Technology (S&T) Park at ORNL facilitates new collaborations with industry and university partners. DOE has leased approximately 12 acres on ORNL's central campus to Halcyon LLC, which will develop the property and then sublease facilities out to private-sector companies who are interested in working with ORNL researchers on critical scientific challenges and to grow new companies. Phase 1 of the S&T Park was completed in 2009 with the construction of the new National Energy Security Center located at 1100 Bethel Valley Road. This facility serves as the corporate headquarters of Professional Project Services, Inc. (Pro2Serve®) and will serve other future tenants supporting DOE's technology transfer mission. In September 2015, the Halcyon Commercialization Center (formerly Building 2033), which had also been a part of the S&T Park was turned back over to DOE for ORNL's use. In accordance with EPA's February 1, 2001, guidance letter, [3] these lessees have been designated as co-located workers and not members of the public for purposes of Subpart H compliance. This determination has been made since these tenants are located on DOE property and wear and use a security badge to access the S&T Park facilities. The S&T Park security badges have been approved by DOE for entry through the Bethel Valley Road Portals and are checked by DOE security guards at the Bethel Valley Road Portals. These badges provide access to the S&T Park facilities and, during regular business hours, the ORNL Conference Center (Building 5200) only. Access to any other ORNL facility requires additional DOE approval.

SOURCE DESCRIPTION: EAST TENNESSEE TECHNOLOGY PARK

ETTP is located on Highway 58 near the intersection of the Clinch River and Poplar Creek. The primary mission at the ETTP is to perform environmental management activities including site remediation, D&D, and waste water treatment operations, as well as to establish a private-sector mixed-use business and industrial park under DOE's Reindustrialization Program. Major activities at ETTP resulting in airborne radionuclide emissions to the environment are: (1) provide waste handling, storage, and waste water treatment capabilities; (2) conduct D&D activities; and (3) conduct site remediation activities.

One method to help accelerate commercialization of the site is via DOE's Reindustrialization Program that leverages the site's underutilized facilities and equipment to attract private businesses to the area. Titles to various buildings and land parcels at ETTP have been transferred, and several other properties are leased. Those companies that locate onsite assume the cost of utilities and surveillance and maintenance, freeing up additional funding for DOE. In addition, once title to a facility has been transferred, it is the property owner's responsibility to demolish the building instead of DOE's. At the close of 2016, there were approximately 16 private companies as well as the city of Oak Ridge Fire Department occupying space at ETTP.

In accordance with the February 2001 EPA Memorandum entitled "Criteria to Determine Whether a Leased Facility at DOE is Subject to Subpart H," from Frank Marcinowski, EPA Headquarters, to all EPA Regional Offices, EPA has established specific criteria for assessing onsite receptor locations with respect to the definition of "public" in conformance with the Radionuclide NESHAPs regulations. These criteria require that employees of a non-DOE entity must be considered members of the public in the Subpart H dose assessment if they do not wear DOE access security badges and there are no DOE security controls, such as a fence that is locked and has an established checkpoint (DOE badge reader or guard) through which the employees must enter. Even if lessees at ETTP wear DOE-issued badges, some are considered "members of the public" because DOE managed site access security controls are not in place at certain lessee business locations.

For 2016, DOE assessed the dose from DOE airborne radionuclide emissions to non-DOE businesses located on the ORR where access is not restricted in the manner described above. This assessment does not include emissions from lessees or private businesses operating under separate Nuclear Regulatory Commission or Agreement State Radiological License. Specifically, dose was assessed to locations where members of the public have unrestricted access to the following locations adjacent to and within the ETTP: ED-1 site located east-north-east of the ETTP site (also known as the Horizon Center), ETTP K-770 area, ETTP Building K-791-B, ETTP K-792-N, ETTP Building K-1006, ETTP Building K-1007 Cafeteria, ETTP Building K-1036, ETTP K-1501 area, ETTP Building K-1515, ETTP Building K-1652, commercial building at 100 Meritus Avenue, Rarity Ridge real estate development community located southwest of the ETTP, and the Tennessee Valley Authority and Oak Ridge Utilities Substations on Blair Road north of the ETTP. Non-DOE workers having unrestricted access to the ETTP site as their place of employment are considered dose receptors under the Radionuclide NESHAPs regulations and subsequently are subject to inclusion in the 2016 ORR dose assessment.

Airborne radionuclide source-term information for ETTP release points was obtained using a variety of methods ranging from continuous sampling, as required by the regulation, to other methods outlined in the *Compliance Plan* and subsequent correspondence between EPA and DOE-ORO. All listed radiological sources were operated under the responsibility of a DOE prime contractor. In August of 2011, UCOR assumed the role and responsibility as the prime contractor for ETTP DOE Office of Environmental Management operations.

Emissions from four minor point sources located at ETTP were estimated during 2016 using one of the following methods: (1) radionuclide inventory (e.g., material balance), and (2) methods outlined in Appendix D to 40 CFR 61. The four UCOR operated minor point sources are the K-1407-AL Chromium Water Treatment System volatile organic compound air stripper, and the K-2500-H Segmentation Shop Stacks B, C, and D. Emissions from the air stripper were estimated following Appendix D methodology. Emissions from K-2500-H Stacks B, C, and D were estimated using a mass inventory tracking method and identified emission control efficiencies. These minor point sources are listed in Section II, Table 3. The K-1200 South Bay and Stack A of the K-2500-H facility are previously reported minor sources that did not operate during 2016.

SOURCE DESCRIPTION: OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

In addition to operations at the three major installations, ORNL's Site Manager is responsible for facilities at ORISE, which handles extremely small quantities of radionuclides for research and training purposes. As indicated in the *Compliance Plan*, compliance with 40 CFR 61, Subpart H, is demonstrated by use of annual possession quantities. Quantities of radionuclides handled at ORISE are well below the annual possession quantities for environmental compliance listed in Appendix E, Table 1 of 40 CFR 61. Therefore, emission estimates from the ORISE operations are not included in this report.

SECTION II. AIR EMISSIONS DATA

Tables 1 – 3 list source parameter data for air emission sources at the Y-12 Complex, ORNL and ETTP, respectively.

Table 1. SOURCE PARAMETER DATA FOR SOURCES - Y-12 COMPLEX

Sources[a]	Type of Control[b]	Efficiency (%)	Stack Height, m	Stack Diameter, m	Exit Gas Velocity, m/s	Exit Gas Temperature, °C	Distance to Receptor (m)		
							Nearest Residence-R School-S Business-B	Source Maximally Exposed Individual	Nearest Farm Dairy - D Beef - B Honey - H Vegetable-V
Major Point Sources									
Central Stack[c]	N/A	N/A	20	NA	NA	Ambient	840-R	2270	5440-H
1[e]	HEPA[d] Filter	99.95				Ambient			
3	Prefilter HEPA Filter	95 99.95				Ambient			
4	Prefilter HEPA Filter	95 99.95				Ambient			
6[e]	Fabric Filter	65				Ambient			
7[e]	No Controls	N/A				Ambient			
11	No Controls	N/A				Ambient			
13	Prefilter HEPA Filter	95 99.95				Ambient			
14	HEPA Filter	99.95				Ambient			
15	Prefilter HEPA Filter	95 99.95				Ambient			
26	Prefilter HEPA Filter	95 99.95				Ambient			
28	Roughing Prefilter HEPA Filter	80 95 99.95				Ambient			

Table 1. (continued)

Sources	Type of Control[b]	Efficiency (%)	Stack Height, m	Stack Diameter, m	Exit Gas Velocity, m/s	Exit Gas Temperature, °C	Distance to Receptor (m)		
							Nearest Residence-R School-S Business-B	Source Maximally Exposed Individual	Nearest Farm Dairy - D Beef - B Honey - H Vegetable-V
33	Roughing Prefilter HEPA Filter	80 95 99.95				Ambient			
38	Prefilter HEPA Filter	95 99.95				Ambient			
40	HEPA Filter	99.95				Ambient			
44[e]	No Controls	N/A				Ambient			
45	Prefilter HEPA Filter	95 99.95				Ambient			
47	No Controls	N/A				Ambient			
48	Prefilter HEPA Filter	95 99.95				Ambient			
60[e]	Prefilter HEPA Filter	95 99.95				Ambient			
61	Baghouse Fabric Filter	85 90				Ambient			
67	Baghouse HEPA Filter	90 99.95				Ambient			
101	HEPA Filter	99.95				Ambient			
109	Prefilter HEPA Filter	55 99.95				Ambient			
110	Prefilter HEPA Filter	55 99.95				Ambient			
112	Primary Secondary Scrubber	50 50 99				Ambient			
113	Scrubber	99				Ambient			
114	HEPA Filter	99.95				Ambient			

Table 1. (continued)

Sources	Type of Control[b]	Efficiency (%)	Stack Height, m	Stack Diameter, m	Exit Gas Velocity, m/s	Exit Gas Temperature, °C	Distance to Receptor (m)		
							Nearest Residence-R School-S Business-B	Source Maximally Exposed Individual	Nearest Farm Dairy - D Beef - B Honey - H Vegetable-V
134	Prefilter HEPA Filter Scrubber	60 99.95 99				Ambient			
143	HEPA Filter	99.95				Ambient			
Minor Point Sources									
8 Remaining Monitored Stacks[f]	Demister Prefilter B-2000 HEPA Filter	60 65-80 95 99.95	20	NA	NA	Ambient	840-R	2270	5440-H
Minor Grouped Sources[g]									
Unmonitored Process Stacks* (3 buildings, 3 emission points)	3 None	NA	20	0.5	NA	Ambient	840-R	2270	5440-H
Unmonitored Laboratory Exhausts* (2 buildings, 28 emission points)	26 None 2 HEPA Filters	NA 99.95	20	0.5	NA	Ambient	840-R	2270	5440-H

[a] The point source number corresponds to the stack radiological monitoring program number.
[b] Some control devices are final controls that serve all processes exhausted to the stack, while other control devices serve individual processes. Not all stacks have a final control device.
[c] Based on guidance from EPA Region 4 (letter from Charles R. Phillips to B. J. Davis, dated January 25, 1985), and as stated in *Compliance Plan* DOE/ORO/2196 revised April 4, 2013, all Y-12 National Security Complex emissions are assumed to come from a single central stack for modeling purposes. A study has been conducted to show that this assumption results in an overestimate of the dose resulting from Y-12 National Security Complex emissions.
[d] High-efficiency particulate air filter.
[e] This stack is temporarily shut down. The process served by this stack is on stand-down status.
[f] Some of these monitored stacks have no emission control. Other stacks have emission control ranging from cyclones to HEPA filtration. The different types of control devices that may be found on these stacks have been listed with their estimated control efficiency.
[g] An asterisk (*) indicates points where the source term is estimated entirely by calculations without any monitoring or sampling data (e.g., Appendix D of 40 CFR 61).

Table 2. SOURCE PARAMETER DATA FOR SOURCES - ORNL

Sources	Type of Control	Efficiency (%)	Stack Height, m	Stack Diameter, m	Exit Gas Velocity, m/s	Exit Gas Temperature, °C	Distance to Receptor (m): Nearest Residence-R School-S Business-B	Distance to Receptor (m): Source Maximally Exposed Individual	Distance to Receptor (m): Nearest Farm Dairy - D Beef - B Vegetable - V
Major Point Sources									
X-2026	HEPA Filters[a] Charcoal Filter	99.95 90[b]	22.9	1.05	7.42	Ambient	3790-R	4820	4270-B
X-3020 (Isotek) [c]	HEPA Filters[a]	99	61	1.22	15.05	Ambient	3930-R	4970	4370-B
X-3039 (UCOR)	HEPA Filters[a] Venturi Scrubber	99.95 98	76.2	2.44	6.39	Ambient	3970-R	5060	4400-B
X-7503 (UCOR)	HEPA Filters[a] Charcoal Filter	99.95 90	30.5	0.91	12.85	Ambient	3590-R	4180	4120-B
X-7880 (North Wind Solutions, LLC)	HEPA Filter	99.95	27.7	1.52	15.62	Ambient	2280-R	3860	2530-B
X-7911	HEPA Filters[a] Packed Bed Scrubber[d] Charcoal Bed	99.95 90 99.98[e]	76.2	1.52	14.38	Ambient	3390-R	4220	3910-B
X-8915	HEPA Filters[a] Charcoal Bed[f]	99.95 99.9	103.98[g]	1.22	6.68	Ambient	2260-R	5420	6470-B
Minor Point Sources									
X-2099 (UCOR)	HEPA Filter	99.95	3.66	0.18	19.03	Ambient	3770-R	4810	4200-B
X-3018 (UCOR)	HEPA Filter	99.95	61.0	4.11	0.95	Ambient	3980-R	5030	4440-B

Table 2. (continued)

Sources	Type of Control	Efficiency (%)	Stack Height, m	Stack Diameter, m	Exit Gas Velocity, m/s	Exit Gas Temperature, °C	Distance to Receptor (m): Nearest Residence-R School-S Business-B	Distance to Receptor (m): Source Maximally Exposed Individual	Distance to Receptor (m): Nearest Farm Dairy - D Beef - B Vegetable - V
X-3544 (UCOR)	HEPA Filter	99.95	9.53	0.28	24.05	Ambient	3660-R	5040	4070-B
X-3608 Air Stripper (UCOR)	None	N/A	10.97	2.44	0.57	Ambient	3740-R	4880	4120-B
X-3608 Filter Press (UCOR)	HEPA Filter	99.95	8.99	0.36	9.27	Ambient	3740-R	4880	4120-B
X-7856 (UCOR)	HEPA Filter[a]	99.95	18.29	0.48	11.05	Ambient	2380-R	3970	2620-B
X-7877 (UCOR)	HEPA Filter	99.95	13.9	0.41	13.56	Ambient	2310-R	2310	2550-B
X-7966 (UCOR)	HEPA Filter	99.95	6.10	0.29	9.62	Ambient	3520-R	3860	4120-B
X-STP Sludge Drier	HEPA Filter	99.95	7.6	0.20	7.39	Ambient	3450-R	5240	3880-B
Minor Grouped Sources									
X-5505 (3 emission points): N and S Duct	HEPA Filter	99.95	11	0.96	17.28	Ambient	4270-R	5560	4660-B
X-5505 (3 emission points): Main Duct			11	0.30	2.54			5560	
X-7830 (UCOR) (4 emission points)	HEPA Filter	99.95	4.6	0.25	7.67	Ambient	2350-R	2350	2600-B
X-7935 (2 emission points): Building Stack	HEPA Filter	99.95	18.29	0.61	26.85	Ambient	3500-R	4230	3980-B
X-7935 (2 emission points): Glovebox Stack			9.14	0.254	4.66			3760	
X-Laboratory Hoods[h] (UT-Battelle and UCOR) (37 points, venting approximately 56 sources)	None[i] HEPA Filter, Roughing Filter	NA 99.95 80	15	NA	NA	Ambient	3300-R (1000) 3810-R (2000) 4000-R (3000) 4130-R (4000) 4040-R (6000) 3400-R (7000)	5580 (1000)[j] 4770(2000) 4950 (3000) 4730 (4000) 5850 (6000) 3770 (7000)	3820-B (1000)[j] 4310-B (2000/3000) 4520-B (4000) 5010-B (6000) 3990-B (7000)
Out of service Laboratory Hoods (UT-Battelle and UCOR) (96 emission points venting 127 sources)	None HEPA Filter	NA 99.95	15	NA	NA	Ambient	4170-R	4700	4570-B

[a] In addition to HEPA filters, other filters are also located at some of the individual sources within buildings. Filter efficiencies at individual sources range from 90 to 99.95 percent. A 90 percent efficiency is used for ^{212}Pb emissions.
[b] Assumed efficiency is based on data from Table 1 of 40 CFR 61, Appendix D, which indicates 90 percent efficiency for iodine gas.
[c] Isotek Systems, LLC.
[d] This scrubber is rated 98 percent efficient for removal of particulates 1 micrometer (μm) or greater in diameter and only serves the exhausts from the cell off-gas and vessel off-gas from the REDC (buildings 7920 and 7930).
[e] Efficiency is based upon measured efficiency tests.
[f] Sulfur-impregnated charcoal adsorber system that consists of a set of eight cylindrical adsorber beds manifolded together in a parallel flow arrangement. Charcoal filters are located in series with HEPA filters in the primary confinement exhaust system. The overall efficiency for the system is 99.9 percent for particulate matter and 99 percent for activated mercury emissions. An additional charcoal adsorber in the mercury off gas system that consists of a single charcoal adsorber bed operated at low temperatures to facilitate adsorption of radioactive noble gas spallation products. The efficiency for this system is 99%.
[g] Stack 8915 is located on Chestnut Ridge above ORNL, ETTP, and Y-12 facilities therefore, the ridge height (79.6 m) and stack height (24.38 m) are included.
[h] Emission points where the source term is estimated entirely by calculations without any monitoring or sampling data (e.g., Appendix D of 40 CFR 61).
[i] The laboratory hoods may go through HEPA filters or roughing filters, or vent directly to the atmosphere depending on the specific hood. These hoods are modeled as six separate sources, depending on geographical grouping.
[j] The number in parentheses represents the building area numbers.

Table 3. SOURCE PARAMETER DATA FOR SOURCES - ETTP

Sources	Type of Control	Efficiency (%)	Stack Height, m	Stack Diameter, m	Exit Gas Velocity, m/s	Exit Gas Temperature, °C	Distance to Receptor (m)		
							Nearest Residence-R School-S Business-B	Source Maximally Exposed Individual	Nearest Farm Dairy - D Beef - B Vegetable - V
Major Point Sources									
None									
Minor Point Sources									
K-1407-AL CWTS Air Stripper (UCOR)[a]	None	0	2.74	0.15	5.43	Ambient	250-B	460	4530-B
K-2500-H Stack B (UCOR)[a]	HEPA[b]	99	8.23	0.61	12.9	Ambient	550-B	820	4260-B
K-2500-H Stack C (UCOR)[a]	HEPA[b]	99	8.23	0.61	12.9	Ambient	550-B	810	4250-B
K-2500-H Stack D (UCOR)[a]	HEPA[b]	99	8.23	0.914	12.9	Ambient	520-B	800	4260-B
Minor Grouped Sources									
None									

[a] Source term estimated entirely by calculations without monitoring or sampling data (e.g., Appendix D of 40 CFR 61).
[b] Abatement efficiencies from Table 1 of Appendix D of 40 CFR 61 conservatively used to calculate source terms. However, actual efficiencies are typically higher (i.e., HEPA filters are rated at 99.97 percent).

ORR 2016 RADIONUCLIDE EMISSIONS[4] FROM POINT SOURCES

Table 4 shows total radionuclide emissions from point sources on the ORR. Also shown are the assumed lung clearance type and activity median aerodynamic diameters (AMADs) used in the Clean Air Act Assessment Package – 1988, Personal Computer (CAP88PC), Version 4 dose assessment code. The designation of F, M, and S refers to the lung clearance type for particulate emissions -- Fast (F), Moderate (M), and Slow (S) for the given radionuclide. If the emissions are not of particulate form, the isotope was handled as gaseous (G), vapor (V), or blank, unspecified form (B). The default AMAD of 1.0 μm was used for modeling particulates. In most cases the chemical form is known (e.g., particulate, gas, vapor) and available in CAP88PC, Version 4. When the chemical form is unknown, it is designated as unspecified.

[4]Emissions are shown in Curies (1 Curie = 3.7E+10 Becquerels).

Table 4. ORR RADIONUCLIDE EMISSIONS - 2016

				Facility			
				Y-12 Complex	ORNL	ETTP	ORR
Nuclide	**Solubility**	**AMAD**	**Chemical Form**	**Activity Ci/Year**	**Activity Ci/Year**	**Activity Ci/Year**	**Activity Ci/Year**
^{225}Ac	M	1	particulate		3.04E-04		3.04E-04
^{226}Ac	M	1	particulate		5.63E-08		5.63E-08
^{227}Ac	M	1	particulate		6.48E-09		6.48E-09
^{228}Ac	M	1	particulate		2.34E-05		2.34E-05
^{109m}Ag	B	0	unspecified		1.25E-14		1.25E-14
^{110m}Ag	M	1	particulate		1.15E-09		1.15E-09
^{111}Ag	M	1	particulate		8.52E-06		8.52E-06
^{112}Ag	M	1	particulate		2.45E-08		2.45E-08
^{26}Al	M	1	particulate		6.85E-14		6.85E-14
^{241}Am	M	1	particulate	3.50E-09	1.01E-05		1.01E-05
^{241}Am	F	1	particulate		1.17E-06		1.17E-06
^{243}Am	M	1	particulate	3.50E-09	8.74E-09		1.22E-08
^{37}Ar	B	0	unspecified		9.75E-11		9.75E-11
^{39}Ar	B	0	unspecified		7.25E-10		7.25E-10
^{41}Ar	B	0	unspecified		5.22E+02		5.22E+02
^{42}Ar	B	0	unspecified		2.04E-14		2.04E-14
^{133}Ba	M	1	particulate		2.14E-09		2.14E-09
^{137m}Ba	B	0	unspecified		3.13E-11		3.13E-11
^{139}Ba	M	1	particulate		1.99E-01		1.99E-01
^{140}Ba	M	1	particulate		3.84E-04		3.84E-04
^{7}Be	M	1	particulate		7.94E-06		7.94E-06
^{7}Be	S	1	particulate		7.43E-06		7.43E-06
^{206}Bi	M	1	particulate		3.80E-07		3.80E-07
^{211}Bi	B	0	unspecified		5.82E-11		5.82E-11
^{212}Bi	M	1	particulate		1.70E-07		1.70E-07

Table 4. (continued)

				Facility			
				Y-12 Complex	ORNL	ETTP	ORR
Nuclide	**Solubility**	**AMAD**	**Chemical Form**	**Activity Ci/Year**	**Activity Ci/Year**	**Activity Ci/Year**	**Activity Ci/Year**
^{213}Bi	M	1	particulate		2.76E-04		2.76E-04
^{249}Bk	M	1	particulate		7.00E-11		7.00E-11
^{82}Br	M	1	particulate		8.99E-08		8.99E-08
^{11}C	G	0	dioxide		4.00E+04		4.00E+04
^{14}C	M	1	particulate		7.11E-08		7.11E-08
^{14}C	G	0	dioxide		3.00E-02		3.00E-02
^{41}Ca	M	1	particulate		1.13E-10		1.13E-10
^{45}Ca	M	1	particulate		9.70E-08		9.70E-08
^{47}Ca	M	1	particulate		1.10E-10		1.10E-10
^{109}Cd	M	1	particulate		1.25E-14		1.25E-14
^{113m}Cd	M	1	particulate		2.66E-14		2.66E-14
^{115}Cd	M	1	particulate		3.55E-06		3.55E-06
^{139}Ce	M	1	particulate		3.69E-08		3.69E-08
^{141}Ce	M	1	particulate		2.06E-06		2.06E-06
^{143}Ce	M	1	particulate		4.36E-07		4.36E-07
^{144}Ce	M	1	particulate		5.17E-07		5.17E-07
^{249}Cf	M	1	particulate		1.06E-08		1.06E-08
^{250}Cf	M	1	particulate		2.91E-07		2.91E-07
^{251}Cf	M	1	particulate		2.50E-09		2.50E-09
^{252}Cf	M	1	particulate		2.33E-06		2.33E-06
^{36}Cl	M	1	particulate		3.90E-10		3.90E-10
^{242}Cm	F	1	particulate		6.61E-07		6.61E-07
^{242}Cm	M	1	particulate		4.32E-13		4.32E-13
^{243}Cm	M	1	particulate		1.26E-07		1.26E-07
^{243}Cm	F	1	particulate		4.62E-07		4.62E-07

Table 4. (continued)

				Facility			
				Y-12 Complex	ORNL	ETTP	ORR
Nuclide	Solubility	AMAD	Chemical Form	Activity Ci/Year	Activity Ci/Year	Activity Ci/Year	Activity Ci/Year
^{244}Cm	M	1	particulate		3.71E-06		3.71E-06
^{244}Cm	F	1	particulate		4.62E-07		4.62E-07
^{245}Cm	M	1	particulate		3.74E-10		3.74E-10
^{246}Cm	M	1	particulate		2.26E-14		2.26E-14
^{248}Cm	M	1	particulate		6.80E-14		6.80E-14
^{56}Co	M	1	particulate		1.58E-13		1.58E-13
^{57}Co	M	1	particulate	6.95E-10	4.13E-09		4.83E-09
^{57}Co	S	1	particulate		7.85E-07		7.85E-07
^{58}Co	M	1	particulate	6.20E-12	9.91E-09		9.92E-09
^{60}Co	M	1	particulate	9.29E-07	2.79E-05		2.89E-05
^{60}Co	S	1	particulate		2.06E-06		2.06E-06
^{60m}Co	M	1	particulate		1.05E-13		1.05E-13
^{51}Cr	S	1	particulate		1.99E-05		1.99E-05
^{51}Cr	M	1	particulate		2.18E-04		2.18E-04
^{134}Cs	F	1	particulate	5.56E-08	3.61E-07		4.17E-07
^{136}Cs	F	1	particulate		1.02E-06		1.02E-06
^{137}Cs	F	1	particulate	6.25E-06	4.93E-04		4.99E-04
^{137}Cs	S	1	particulate		1.12E-04		1.12E-04
^{138}Cs	F	1	particulate		2.05E+02		2.05E+02
^{64}Cu	M	1	particulate		3.70E-07		3.70E-07
^{66}Cu	B	0	unspecified		1.93E-13		1.93E-13
^{67}Cu	M	1	particulate		4.35E-09		4.35E-09
^{169}Er	M	1	particulate		2.41E-19		2.41E-19
^{152}Eu	M	1	particulate	2.63E-08	2.58E-04		2.58E-04
^{154}Eu	M	1	particulate	3.33E-08	4.86E-05		4.86E-05

Table 4. (continued)

				Facility			
				Y-12 Complex	ORNL	ETTP	ORR
Nuclide	Solubility	AMAD	Chemical Form	Activity Ci/Year	Activity Ci/Year	Activity Ci/Year	Activity Ci/Year
^{155}Eu	M	1	particulate	9.52E-07	5.09E-06		6.04E-06
^{156}Eu	M	1	particulate		6.58E-15		6.58E-15
^{55}Fe	M	1	particulate		1.91E-05		1.91E-05
^{59}Fe	M	1	particulate		1.93E-06		1.93E-06
^{60}Fe	M	1	particulate		1.05E-13		1.05E-13
^{221}Fr	B	0	unspecified		3.00E-04		3.00E-04
^{72}Ga	M	1	particulate		4.69E-12		4.69E-12
^{151}Gd	M	1	particulate		2.64E-14		2.64E-14
^{153}Gd	M	1	particulate		2.19E-08		2.19E-08
^{71}Ge	M	1	particulate		6.53E-09		6.53E-09
^{3}H	V	0	vapor	6.88E-03	1.09E+03		1.09E+03
^{175}Hf	M	1	particulate		1.45E-08		1.45E-08
^{178m}Hf	M	1	particulate		4.01E-11		4.01E-11
^{181}Hf	M	1	particulate		3.23E-07		3.23E-07
^{203}Hg	M	1	inorganic		3.66E-11		3.66E-11
^{166m}Ho	M	1	particulate		1.90E-12		1.90E-12
^{124}I	F	1	particulate		2.73E-07		2.73E-07
^{124}I	V	0	vapor		5.08E-16		5.08E-16
^{125}I	V	0	vapor		7.96E-10		7.96E-10
^{126}I	F	1	particulate		2.48E-07		2.48E-07
^{126}I	V	0	vapor		5.82E-10		5.82E-10
^{129}I	F	1	particulate		1.86E-05		1.86E-05
^{129}I	V	0	vapor		1.94E-06		1.94E-06
^{130}I	V	0	vapor		3.24E-32		3.24E-32
^{131}I	F	1	particulate		3.24E-02		3.24E-02

Table 4. (continued)

				Facility			
				Y-12 Complex	ORNL	ETTP	ORR
Nuclide	Solubility	AMAD	Chemical Form	Activity Ci/Year	Activity Ci/Year	Activity Ci/Year	Activity Ci/Year
^{131}I	V	0	vapor		8.86E-06		8.86E-06
^{132}I	F	1	particulate		4.09E-01		4.09E-01
^{133}I	F	1	particulate		1.82E-01		1.82E-01
^{133}I	V	0	vapor		2.45E-35		2.45E-35
^{134}I	F	1	particulate		8.25E-01		8.25E-01
^{135}I	F	1	particulate		6.18E-01		6.18E-01
^{113m}In	M	1	particulate		7.11E-10		7.11E-10
^{114}In	B	0	unspecified		8.67E-12		8.67E-12
^{114m}In	M	1	particulate		1.37E-10		1.37E-10
^{192}Ir	M	1	particulate		1.82E-13		1.82E-13
^{40}K	M	1	particulate		7.99E-05		7.99E-05
^{42}K	M	1	particulate		2.04E-14		2.04E-14
^{79}Kr	B	0	unspecified		2.27E-29		2.27E-29
^{81}Kr	B	0	unspecified		5.82E-12		5.82E-12
^{85}Kr	B	0	unspecified		6.63E+02		6.63E+02
^{85m}Kr	B	0	unspecified		5.06E+00		5.06E+00
^{87}Kr	B	0	unspecified		3.21E+01		3.21E+01
^{88}Kr	B	0	unspecified		8.55E+01		8.55E+01
^{89}Kr	B	0	unspecified		2.91E+01		2.91E+01
^{140}La	M	1	particulate		3.62E-04		3.62E-04
^{177}Lu	M	1	particulate		9.28E-11		9.28E-11
^{177m}Lu	M	1	particulate		2.20E-12		2.20E-12
^{54}Mn	M	1	particulate		4.23E-07		4.23E-07
^{56}Mn	M	1	particulate		2.04E-21		2.04E-21
^{93}Mo	M	1	particulate		2.96E-12		2.96E-12

Table 4. (continued)

				Facility			
				Y-12 Complex	ORNL	ETTP	ORR
Nuclide	Solubility	AMAD	Chemical Form	Activity Ci/Year	Activity Ci/Year	Activity Ci/Year	Activity Ci/Year
^{99}Mo	M	1	particulate		3.97E-06		3.97E-06
^{13}N	B	0	unspecified		8.80E+02		8.80E+02
^{22}Na	M	1	particulate		4.27E-11		4.27E-11
^{24}Na	M	1	particulate		9.52E-08		9.52E-08
^{91m}Nb	B	0	unspecified		1.62E-11		1.62E-11
^{92m}Nb	B	0	unspecified		1.83E-17		1.83E-17
^{93m}Nb	M	1	particulate		1.63E-13		1.63E-13
^{94}Nb	M	1	particulate		1.37E-12		1.37E-12
^{95}Nb	M	1	particulate		4.20E-07		4.20E-07
^{95m}Nb	M	1	particulate		1.76E-13		1.76E-13
^{96}Nb	M	1	particulate		4.59E-09		4.59E-09
^{97}Nb	M	1	particulate		2.15E-09		2.15E-09
^{147}Nd	M	1	particulate		6.37E-07		6.37E-07
^{59}Ni	M	1	particulate		4.94E-09		4.94E-09
^{63}Ni	M	1	particulate		6.58E-03		6.58E-03
^{65}Ni	M	1	particulate		2.81E-24		2.81E-24
^{66}Ni	M	1	particulate		1.92E-13		1.92E-13
^{237}Np	M	1	particulate	1.61E-08	8.94E-08		1.06E-07
^{237}Np	F	1	particulate			1.65E-10	1.65E-10
^{239}Np	M	1	particulate		1.90E-09		1.90E-09
^{191}Os	M	1	particulate		7.03E-10		7.03E-10
^{32}P	M	1	particulate		6.38E-09		6.38E-09
^{33}P	M	1	particulate		3.85E-12		3.85E-12
^{228}Pa	M	1	particulate		2.48E-09		2.48E-09
^{230}Pa	M	1	particulate		6.62E-07		6.62E-07

Table 4. (continued)

				Facility			
				Y-12 Complex	ORNL	ETTP	ORR
Nuclide	**Solubility**	**AMAD**	**Chemical Form**	**Activity Ci/Year**	**Activity Ci/Year**	**Activity Ci/Year**	**Activity Ci/Year**
^{232}Pa	M	1	particulate		8.44E-09		8.44E-09
^{233}Pa	M	1	particulate		1.53E-07		1.53E-07
^{234m}Pa	B	0	unspecified		2.11E-09		2.11E-09
^{210}Pb	M	1	particulate		4.06E-12		4.06E-12
^{212}Pb	M	1	particulate	5.41E-07	7.86E-01		7.86E-01
^{212}Pb	S	1	particulate		1.24E+00		1.24E+00
^{214}Pb	M	1	particulate		6.08E-14		6.08E-14
^{147}Pm	M	1	particulate		7.80E-11		7.80E-11
^{148m}Pm	M	1	particulate		1.53E-07		1.53E-07
^{210}Po	B	0	inorganic		5.17E-12		5.17E-12
^{143}Pr	M	1	particulate		2.86E-15		2.86E-15
^{144}Pr	M	1	particulate		6.32E-11		6.32E-11
^{193}Pt	M	1	particulate		5.40E-10		5.40E-10
^{236}Pu	M	1	particulate	5.33E-09			5.33E-09
^{238}Pu	M	1	particulate	1.31E-08	2.33E-05		2.33E-05
^{238}Pu	F	1	particulate		1.03E-06		1.03E-06
^{239}Pu	M	1	particulate	4.95E-08	6.08E-07		6.58E-07
^{239}Pu	F	1	particulate		7.40E-07		7.40E-07
^{240}Pu	M	1	particulate		1.62E-07		1.62E-07
^{240}Pu	F	1	particulate		7.40E-07		7.40E-07
^{241}Pu	M	1	particulate		2.16E-06		2.16E-06
^{242}Pu	M	1	particulate	1.56E-08	3.96E-09		1.96E-08
^{223}Ra	M	1	particulate		3.17E-06		3.17E-06
^{224}Ra	M	1	particulate		9.54E-07		9.54E-07
^{225}Ra	M	1	particulate		2.34E-12		2.34E-12

Table 4. (continued)

				Facility			
				Y-12 Complex	ORNL	ETTP	ORR
Nuclide	**Solubility**	**AMAD**	**Chemical Form**	**Activity Ci/Year**	**Activity Ci/Year**	**Activity Ci/Year**	**Activity Ci/Year**
^{226}Ra	M	1	particulate		1.20E-07		1.20E-07
^{228}Ra	M	1	particulate		2.34E-05		2.34E-05
^{88}Rb	M	1	particulate		2.56E-15		2.56E-15
^{186}Re	M	1	particulate		3.58E-10		3.58E-10
^{188}Re	M	1	particulate		6.21E+01		6.21E+01
^{189}Re	M	1	particulate		3.04E-11		3.04E-11
^{105}Rh	M	1	particulate		2.17E-06		2.17E-06
^{106}Rh	B	0	unspecified		1.09E-11		1.09E-11
^{219}Rn	B	0	unspecified		3.80E-11		3.80E-11
^{220}Rn	B	0	unspecified		1.70E-07		1.70E-07
^{103}Ru	M	1	particulate		3.17E-06		3.17E-06
^{106}Ru	M	1	particulate		1.20E-06		1.20E-06
^{35}S	M	1	particulate		1.21E-07		1.21E-07
^{120m}Sb	M	1	particulate		1.50E-07		1.50E-07
^{122}Sb	M	1	particulate		5.59E-07		5.59E-07
^{124}Sb	M	1	particulate		4.94E-07		4.94E-07
^{125}Sb	M	1	particulate		1.26E-07		1.26E-07
^{126}Sb	M	1	particulate		1.19E-06		1.19E-06
^{127}Sb	M	1	particulate		4.14E-07		4.14E-07
^{44}Sc	M	1	particulate		3.75E-22		3.75E-22
^{46}Sc	M	1	particulate		3.46E-08		3.46E-08
^{47}Sc	M	1	particulate		5.01E-08		5.01E-08
^{48}Sc	M	1	particulate		2.93E-08		2.93E-08
^{75}Se	S	1	particulate		3.75E-03		3.75E-03
^{75}Se	F	1	particulate		1.39E-11		1.39E-11

Table 4. (continued)

				Facility			
				Y-12 Complex	ORNL	ETTP	ORR
Nuclide	Solubility	AMAD	Chemical Form	Activity Ci/Year	Activity Ci/Year	Activity Ci/Year	Activity Ci/Year
^{31}Si	M	1	particulate		1.51E-23		1.51E-23
^{32}Si	M	1	particulate		1.17E-13		1.17E-13
^{145}Sm	M	1	particulate		2.91E-10		2.91E-10
^{151}Sm	M	1	particulate		2.54E-12		2.54E-12
^{113}Sn	M	1	particulate		1.60E-09		1.60E-09
^{117m}Sn	M	1	particulate		1.44E-07		1.44E-07
^{119m}Sn	M	1	particulate		4.58E-10		4.58E-10
^{121}Sn	M	1	particulate		3.42E-10		3.42E-10
^{121m}Sn	M	1	particulate		7.24E-12		7.24E-12
^{123}Sn	M	1	particulate		5.94E-12		5.94E-12
^{125}Sn	M	1	particulate		1.08E-06		1.08E-06
^{85}Sr	M	1	particulate		5.17E-11		5.17E-11
^{89}Sr	M	1	particulate		3.21E-04		3.21E-04
^{89}Sr	S	1	particulate		2.83E-05		2.83E-05
^{90}Sr	M	1	particulate	2.14E-06	4.23E-04		4.25E-04
^{90}Sr	S	1	particulate		3.43E-05		3.43E-05
^{182}Ta	M	1	particulate		2.49E-08		2.49E-08
^{183}Ta	M	1	particulate		2.96E-06		2.96E-06
^{184}Ta	M	1	particulate		4.08E-14		4.08E-14
^{160}Tb	M	1	particulate		1.06E-10		1.06E-10
^{161}Tb	M	1	particulate		9.36E-22		9.36E-22
^{96}Tc	M	1	particulate		1.84E-08		1.84E-08
^{99}Tc	M	1	particulate	1.00E-03	3.47E-06		1.00E-03
^{99}Tc	S	1	particulate		6.88E-06	1.17E-05	1.86E-05
^{121}Te	M	1	particulate		1.95E-07		1.95E-07

Table 4. (continued)

				Facility			
				Y-12 Complex	ORNL	ETTP	ORR
Nuclide	Solubility	AMAD	Chemical Form	Activity Ci/Year	Activity Ci/Year	Activity Ci/Year	Activity Ci/Year
^{121m}Te	M	1	particulate		7.64E-09		7.64E-09
^{123m}Te	M	1	particulate		4.90E-09		4.90E-09
^{125m}Te	M	1	particulate		2.12E-08		2.12E-08
^{127}Te	M	1	particulate		3.60E-13		3.60E-13
^{127m}Te	M	1	particulate		3.68E-13		3.68E-13
^{131m}Te	M	1	particulate		2.74E-07		2.74E-07
^{132}Te	M	1	particulate		1.24E-06		1.24E-06
^{227}Th	S	1	particulate		4.03E-06		4.03E-06
^{228}Th	S	1	particulate	8.23E-12	4.56E-07		4.56E-07
^{229}Th	S	1	particulate	3.50E-09	7.61E-09		1.11E-08
^{230}Th	S	1	particulate	2.35E-08	8.42E-08		1.08E-07
^{230}Th	F	1	particulate		1.81E-08		1.81E-08
^{232}Th	S	1	particulate	8.77E-09	8.49E-06		8.50E-06
^{232}Th	F	1	particulate		1.10E-08		1.10E-08
^{45}Ti	M	1	particulate		2.06E-24		2.06E-24
^{202}Tl	M	1	particulate		3.98E-12		3.98E-12
^{204}Tl	M	1	particulate		3.46E-13		3.46E-13
^{208}Tl	B	0	unspecified		3.17E-06		3.17E-06
^{170}Tm	M	1	particulate		1.25E-09		1.25E-09
^{171}Tm	M	1	particulate		5.66E-10		5.66E-10
^{232}U	M	1	particulate		1.70E-07		1.70E-07
^{233}U	M	1	particulate		1.78E-04		1.78E-04
^{233}U	S	1	particulate	8.51E-06	3.81E-06		1.23E-05
^{234}U	M	1	particulate	5.33E-04	2.43E-02		2.49E-02
^{234}U	S	1	particulate	3.63E-03	3.81E-06	3.31E-06	3.64E-03

Table 4. (continued)

				Facility			
				Y-12 Complex	ORNL	ETTP	ORR
Nuclide	Solubility	AMAD	Chemical Form	Activity Ci/Year	Activity Ci/Year	Activity Ci/Year	Activity Ci/Year
^{234}U	F	1	particulate	4.24E-04			4.24E-04
^{235}U	M	1	particulate	1.65E-05	1.20E-03		1.22E-03
^{235}U	S	1	particulate	1.19E-04	1.56E-06	1.74E-07	1.21E-04
^{235}U	F	1	particulate	1.32E-05			1.32E-05
^{236}U	S	1	particulate	1.60E-05	2.37E-07	2.31E-08	1.63E-05
^{236}U	M	1	particulate	2.21E-06	8.17E-05		8.39E-05
^{236}U	F	1	particulate	1.76E-06			1.76E-06
^{238}U	M	1	particulate	1.49E-07	4.89E-03		4.89E-03
^{238}U	S	1	particulate	4.42E-04	2.06E-06	1.18E-06	4.46E-04
^{238}U	F	1	particulate	1.19E-07			1.19E-07
^{49}V	M	1	particulate		2.08E-09		2.08E-09
^{181}W	M	1	particulate		1.27E-11		1.27E-11
^{185}W	M	1	particulate		6.06E-09		6.06E-09
^{187}W	M	1	particulate		5.29E-03		5.29E-03
^{188}W	M	1	particulate		6.18E-04		6.18E-04
^{127}Xe	B	0	unspecified		8.11E+02		8.11E+02
^{129m}Xe	B	0	unspecified		1.31E-10		1.31E-10
^{131m}Xe	B	0	unspecified		1.46E+02		1.46E+02
^{133}Xe	B	0	unspecified		5.13E+00		5.13E+00
^{133m}Xe	B	0	unspecified		2.13E+01		2.13E+01
^{135}Xe	B	0	unspecified		1.53E+01		1.53E+01
^{135m}Xe	B	0	unspecified		6.73E+00		6.73E+00
^{137}Xe	B	0	unspecified		3.16E+01		3.16E+01
^{138}Xe	B	0	unspecified		4.31E+01		4.31E+01
^{87}Y	M	1	particulate		1.18E-08		1.18E-08

Table 4. (continued)

				Facility			
				Y-12 Complex	ORNL	ETTP	ORR
Nuclide	**Solubility**	**AMAD**	**Chemical Form**	**Activity Ci/Year**	**Activity Ci/Year**	**Activity Ci/Year**	**Activity Ci/Year**
^{88}Y	M	1	particulate		6.23E-11		6.23E-11
^{88}Y	F	1	particulate		1.35E-06		1.35E-06
^{90}Y	M	1	particulate		1.36E-10		1.36E-10
^{91}Y	M	1	particulate		4.00E-11		4.00E-11
^{65}Zn	M	1	particulate		1.96E-05		1.96E-05
^{69}Zn	M	1	particulate		2.76E-09		2.76E-09
^{69m}Zn	M	1	particulate		1.84E-09		1.84E-09
^{95}Zr	M	1	particulate		1.00E-06		1.00E-06
^{97}Zr	M	1	particulate		1.14E-07		1.14E-07
Totals				**1.31E-02**	**4.47E+04**	**1.64E-05**	**4.47E+04**

Table 5 lists the potential fugitive and diffuse sources on the ORR for 2016.

Table 5. POTENTIAL FUGITIVE AND DIFFUSE SOURCES ON THE ORR[a]

Y-12 Complex:	▪ Disposal Area Remedial Action Solid Storage Facilities (Building 9720-60) ▪ Environmental Management Waste Management Facility Landfill ▪ Low-level liquid tanks and associated valves and piping, outside storage, and waste storage ▪ Cleanup of outdoor storage areas and demolition of inactive buildings ▪ Overall decontamination and maintenance activities
ORNL:	▪ Bethel Valley and Melton Valley restoration projects (2101 Excavation and remediation project) ▪ Solid Waste Storage Areas 3, 4, 5, and 6 ▪ Surface impoundments/retention basins [2544 (Sewage Holding Pond), 3513, 7905, 7906, 7907, 7908, and White Oak Lake] ▪ 7822B (Fissile Disposal Wells); 7822C (Low Range Silos); 7822D (High Range Silos); 7822H (Asbestos Silos) ▪ 7841 (Contaminated Equipment Storage Yard) ▪ 7853 (Liquid and Gaseous Waste Operations Storage Building) ▪ Hazardous Waste Storage Facilities: 7572, 7574, 7651, 7652, 7653, 7654 and 7879 ▪ 7880 Area: Drum Venting Building, Contact Handled Marshalling Building, Container Staging Area, Multi-Purpose Building, Drum Aging Criteria Area, and Contact Handling Storage Area ▪ Low-level liquid waste tanks and associated valve pits and piping ▪ Decontamination and maintenance activities
ETTP:	▪ K-1070-B Burial Ground ▪ K-1203 Sewage Sludge Drying Beds ▪ Low-level liquid tanks and associated valves and piping, inactive buildings, outside storage, waste storage, general decontamination activities of active and inactive facilities, and demolition of inactive buildings ▪ Specific examples of building demolition/decontamination and soil removal/remediation locations are: K-27, K-25/27 non-process line removal and the K-25/27 process line removal.

[a] This list identifies the largest areas on the ORR with the most significant potential for fugitive and diffuse emissions. Environmental measurements are used to demonstrate that total emissions (point, diffuse, and fugitive) from the ORR result in a dose less than 10 mrem/year (0.1 mSv/year). See Section III, Dose Assessments.

SECTION III. DOSE ASSESSMENTS

DESCRIPTION OF DOSE MODEL

The radiation dose calculations were performed using the CAP88PC Version 4. CAP88PC is a set of computer programs, databases and associated utility programs for estimation of dose and risk from radionuclide emissions to air. CAP88 is composed of modified versions of AIRDOS-EPA and DARTAB. The AIRDOS-EPA computer code implements a steady-state, Gaussian plume, atmospheric dispersion model to calculate environmental concentrations of released radionuclides and then food chain models are used to calculate human exposures, both internal and external, to the environmental concentrations.

CAP88PC Version 4 incorporates dose and risk factors from the Dose Coefficient Data File Package, Version 2.2 (DCFPAK-2.2). There were three significant changes in CAP88PC Version 4 compared to Version 3: Age-dependent radionuclide dose and risk factors for ingestion and inhalation, additional radionuclides included in database and changes in the file management system. Adult dose coefficients were used to estimate doses. The dose factors are used to calculate effective doses, which are the weighted sum of equivalent doses over specified tissues or organs. The ED uses tissue weighting factors for twelve tissues or organs (as well as one for remainder organs and tissues).

SUMMARY OF INPUT PARAMETERS

Except for those given below in Table 6, all important input parameter values used are the default values provided with the CAP88 computer codes and databases. Default radionuclide inhalation types were used unless otherwise requested. Physical source parameters are provided and utilized in the CAP88 computer model. This year the ridge and stack height were used for the ORNL source X-8915 dose calculations to take into account that it is located on Chestnut Ridge above other ORR facilities.

Table 6. FOOD CONSUMPTION DATA

The sources of foodstuffs consumed by exposed persons are the CAP-88 rural area default values:

Foodstuff	Fraction grown		
	In local area	Within 50-mile radius	Beyond 50-miles radius
Vegetables and produce	0.70	0.30	0.00
Meat	0.44	0.56	0.00
Milk	0.40	0.60	0.00

Dose evaluated at business locations:

DOE estimates doses to individuals located at businesses in the vicinity of the ORR using the same methodology as for the residential exposure scenario [i.e., assuming full occupancy (8,760 hours/year) and the rural food source scenario in CAP88], but divides the resulting dose in half. The resulting estimated business dose more accurately represents the time of exposure a single person would be exposed to airborne radionuclide emissions (4,380 hours/year), which is more than double the normal work year of 2,080 hours.

METEOROLOGICAL DATA

Table 7 is a summary of the meteorological data used in the dose assessment. Figures 3 through 20 show the 2016 annual wind roses for each tower. Figure 21 shows the locations of meteorological towers on the ORR. The 2016 meteorological data summarized in Table 7 were deemed acceptable for use during 2016 in assessing radiation doses from the indicated sources. All meteorological data were reviewed by an onsite air quality meteorologist and, based on the judgment of the meteorologist, data acquired from stations with low recovery rates were corrected with other onsite meteorological data as necessary. All meteorological data used here have been corrected through profiling and substitution along with consideration of ambient meteorological measurements and synoptic weather by the site meteorologist. For the ORNL towers (MT2, MT3, and MT4), a transition to the use of Sigma Phi for stability measurement [in place of the Solar Radiation Delta Temperature (SRDT) method] is in process; however, the SRDT method continues to be used until sufficient roughness length calculations are obtained from Tower “D.”

Table 7. METEOROLOGICAL DATA SUMMARY

Tower:	**MT1 (K1208)[a]**		**MT2 (Tow D)**			**MT3 (Tow B)**		**MT4 (Tow A)**		**MT6 (West Y12)**	**MT7 (K1209)**	
Station:	**10-m**	**60-m**	**15-m**	**35-m**	**60-m**	**15-m**	**30-m**	**15-m**	**30-m**	**30-m/60-m[b]**	**10-m**	**30-m**
Wind – Percent Minimum Quarterly Data Recovery corrected/ (uncorrected):	100.0 (99.7)	100.0 (99.7)	100.0 (99.6)	100.0 (99.9)	100.0 (98.9)	100.0 (99.8)	100.0 (97.6)	100.0 (98.1)	100.0 (93.9)	100.0 (99.5)	100.0 (99.9)	100.0 (99.9)
Wind – Percent Annual Data Recovery corrected/ (uncorrected):	100.0 (99.8)	100.0 (99.8)	100.0 (99.8)	100.0 (99.9)	100.0 (99.7)	100.0 (99.9)	100.0 (99.3)	100.0 (99.4)	100.0 (98.4)	100.0 (99.9)	100.0 (99.9)	100.0 (99.9)
Temperature /RH – Percent Minimum Quarterly Data Recovery Corrected/ (uncorrected)	100.0 (99.7)	100.0 (99.7)	100.0 (99.9)	100.0 (99.9)	100.0 (99.9)	100.0 (99.8)	100.0 (99.8)	100.0 (99.4)	100.0 (98.4)	100.0 (99.9)	100.0 (100.0)	100.0 (100.0)
Temperature / RH – Percent Annual Data Recovery Corrected/ (uncorrected)	100.0 (99.9)	100.0 (99.9)	100.0 (99.9)	100.0 (99.9)	100.0 (99.9)	100.0 (99.9)	100.0 (99.9)	100.0 (99.8)	100.0 (99.6)	100.0 (99.9)	100.0 (100.0)	100.0 (100.0)
Absolute Humidity (g/m^3):	9.77	9.77	9.75	9.75	9.75	9.75	9.75	9.82	9.82	9.75	9.77	9.77
Rainfall Rate (cm/year):	118.0	118.0	108.4	108.4	108.4	110.4	110.4	115.6	115.6	113.9	119.8	119.8
Average Air Temperature (°C):	15.8	16.0	15.6	15.8	16.0	15.3	15.5	15.5	15.8	16.0/15.9	15.5	15.7
Average Mixing Depth (m):	919.3	919.3	919.4	919.4	919.4	919.4	919.4	919.4	919.4	899.0	919.3	919.3

Tower:	MT1 (K1208)[a]		MT2 (Tow D)			MT3 (Tow B)		MT4 (Tow A)		MT6 (West Y12)	MT7 (K1209)	
Station:	**10-m**	**60-m**	**15-m**	**35-m**	**60-m**	**15-m**	**30-m**	**15-m**	**30-m**	**30-m/60-m[b]**	**10-m**	**30-m**
Annual Stability Class Distribution – Percent (determined NRC-enhanced by SRDT method):	A - 6.3; B - 14.6; C - 4.5; D - 20.2; E – 18.7; F - 24.4; G – 11.3		A -6.3; B - 14.4; C - 5.9; D - 17.8; E - 14.1; F - 32.1; G – 9.5			A – 6.7; B – 14.3; C - 5.6; D - 19.2; E – 12.3; F - 32.4; G - 9.6		A - 5.5; B – 14.5; C - 6.3; D – 20.3; E - 12.4; F - 31.4; G - 9.5		A - 5.2; B - 13.3; C -8.0; D - 23.5; E – 18.3; F – 29.0; G - 2.7	A - 5.1; B - 14.1; C - 6.2; D – 23.1; E – 15.9; F - 24.3; G - 11.3	
Emission sources:			X-2099 X-2523 X3544 X-3608FP X-3608AS STP X-Decon Hoods, X-Hoods: 1000, 2000, 3000, 4000 Areas	X-2026	X-3018 X-3020 X-3039	X-5505 X-Hoods: 6000 Area		X-7830 Grp X7966 X-7935 Glove Box X-7877 X-Hoods: 7000 Area	X-7503 X-7856-CIP X-7880 X-7911 X-7935 Bldg	All Y-12 Complex sources, labeled as Y-.... X8915 SNS	K-1407-AL CWTS K-2500-H Stacks B, C and D	

[a]All ETTP sources that utilized tower MT1 (K1208) for dose modeling have been permanently shut down.
[b]At Tower MT-6, 30-m is used for Y-12 and 60-m is used for SNS.

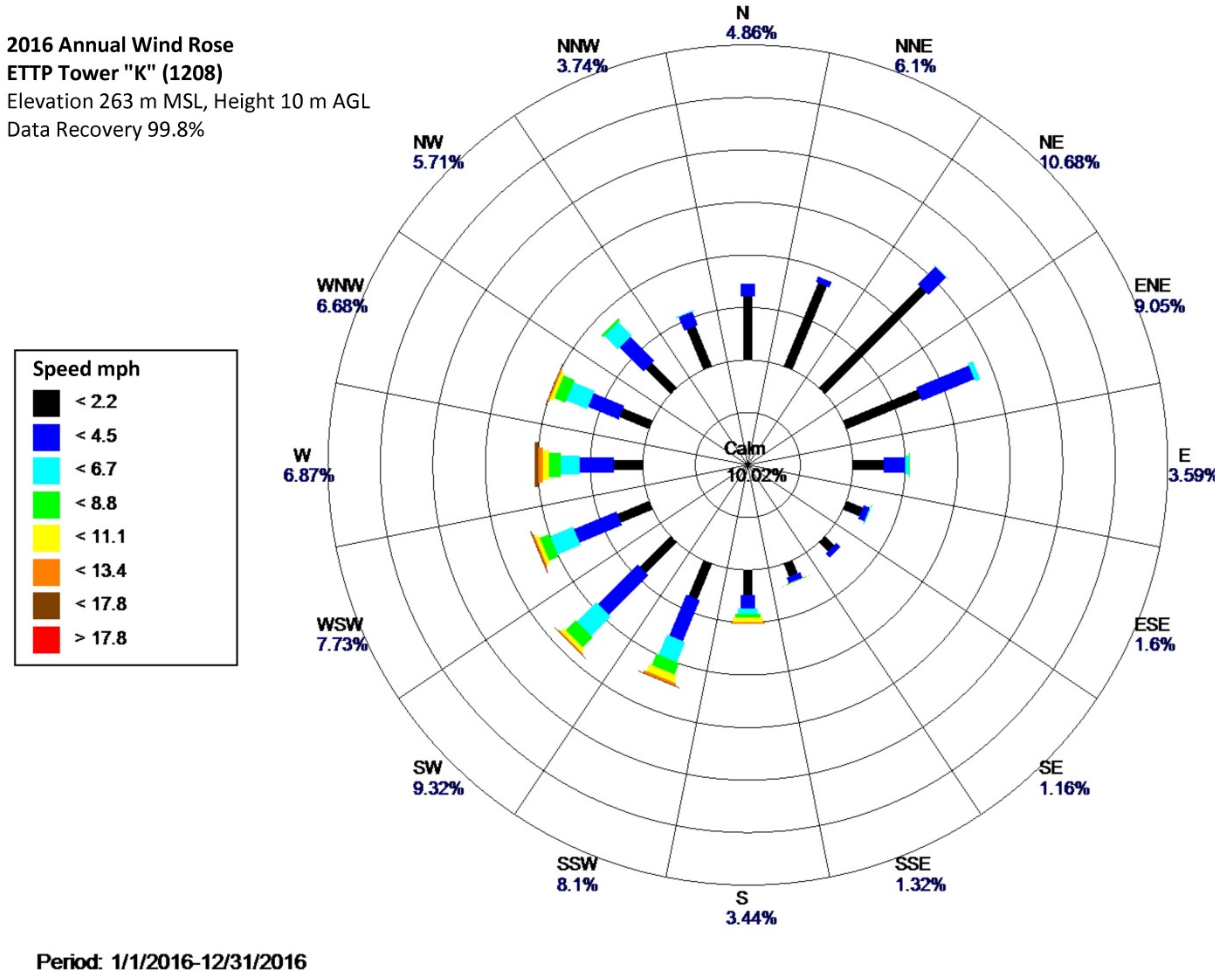

Figure 3: ETTP Met Tower MT1 (“K” 1208) 2016 Annual Wind Rose – 10 meters

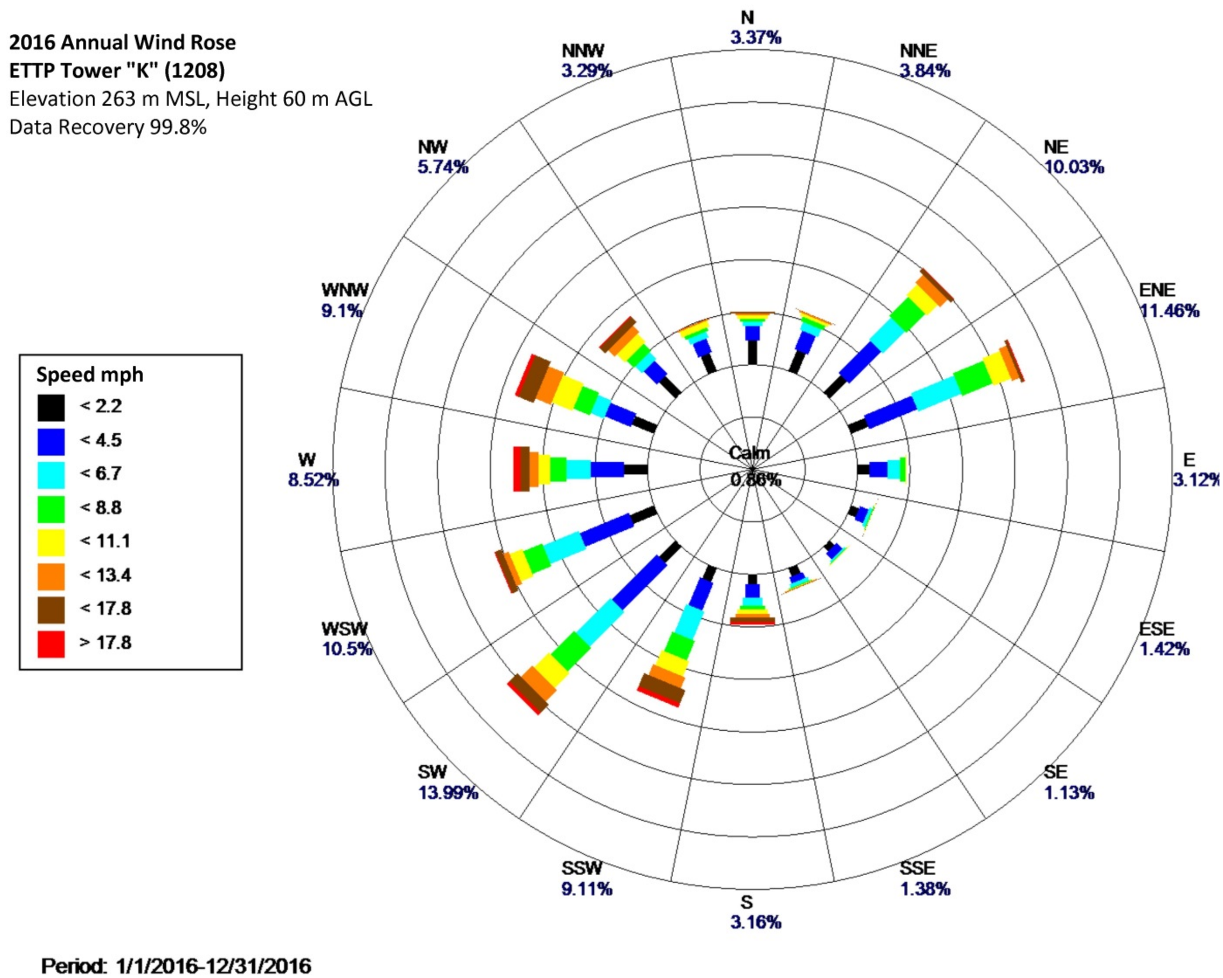

Figure 4: ETTP Met Tower MT1 (“K” 1208) 2016 Annual Wind Rose – 60 meters

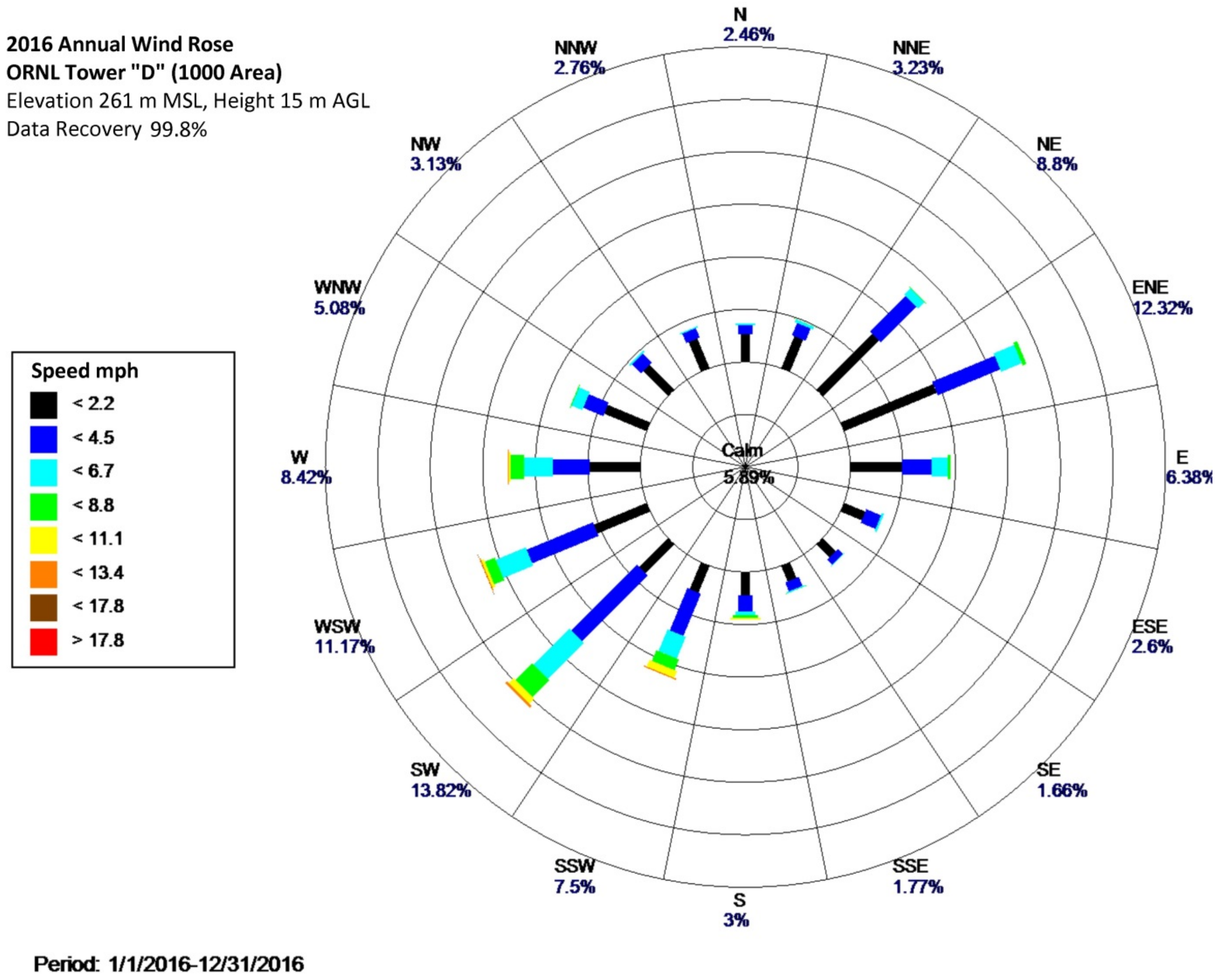

Figure 5: ORNL Met Tower MT2 ("D") 2016 Annual Wind Rose – 15 meters

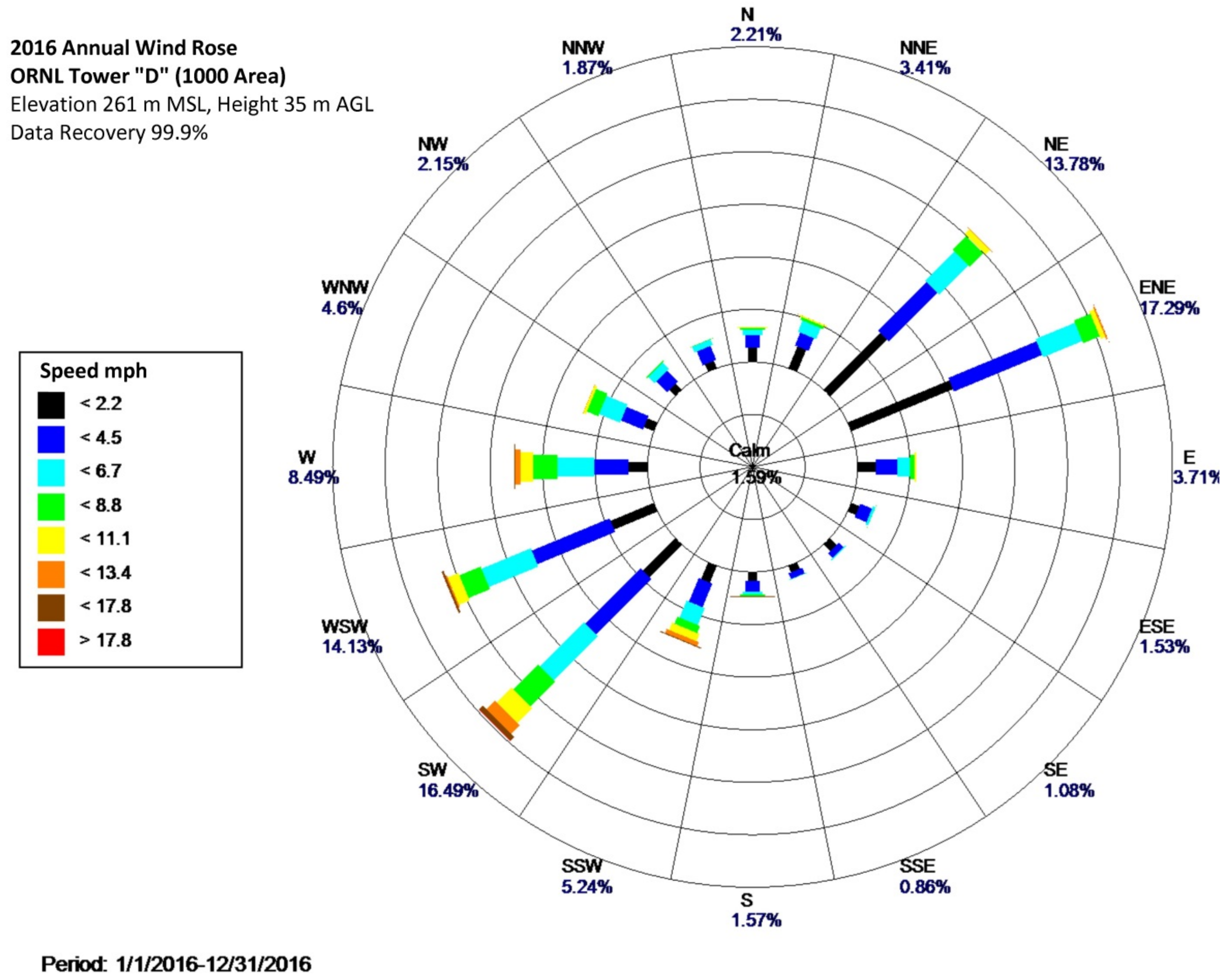

Figure 6: ORNL Met Tower MT2 (“D”) 2016 Annual Wind Rose – 35 meters

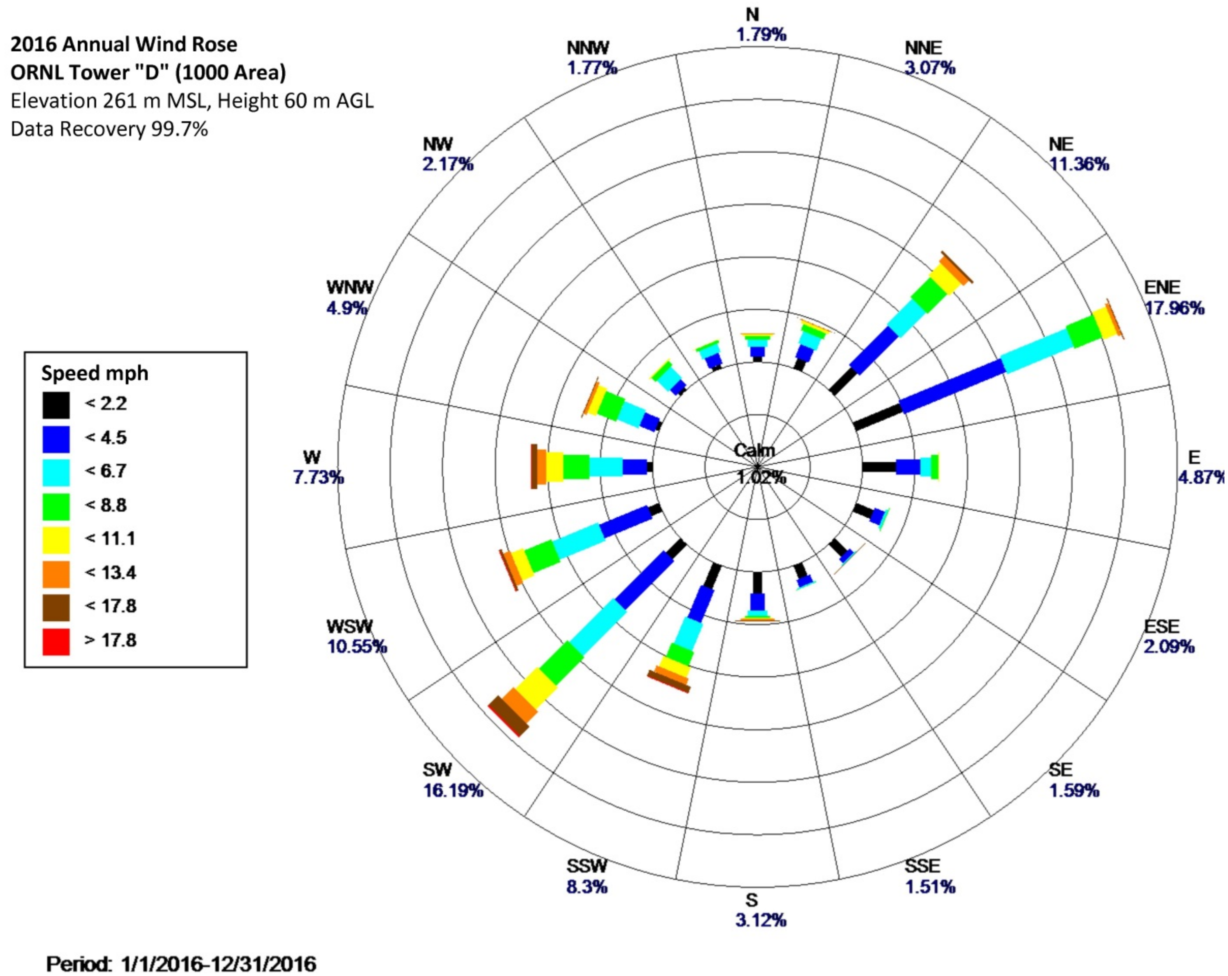

Figure 7: ORNL Met Tower MT2 ("D") 2016 Annual Wind Rose – 60 meters

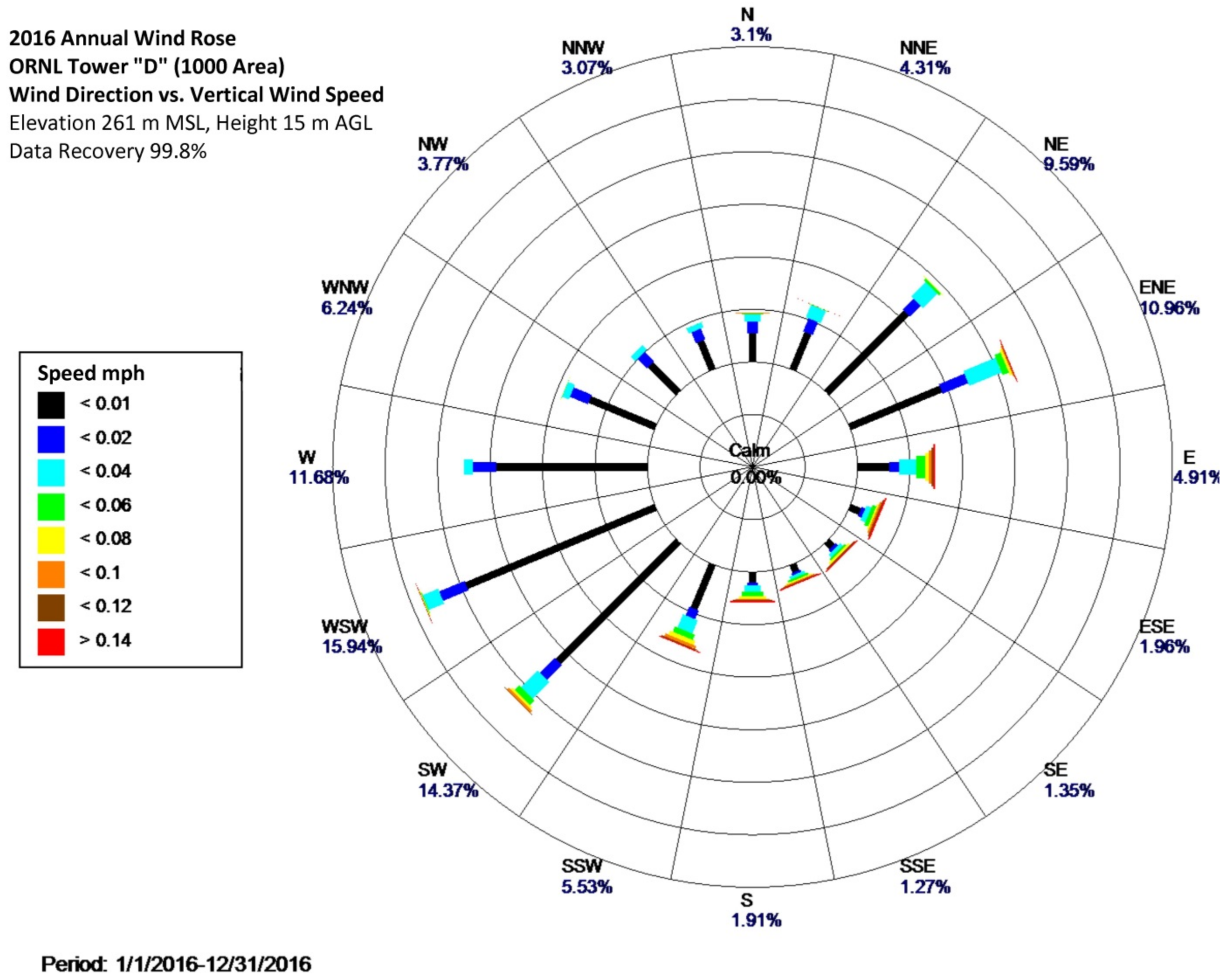

Figure 8: ORNL Met Tower MT2 ("D") 2016 Annual Vertical Wind Speed vs. Wind Direction Rose – 15 meters

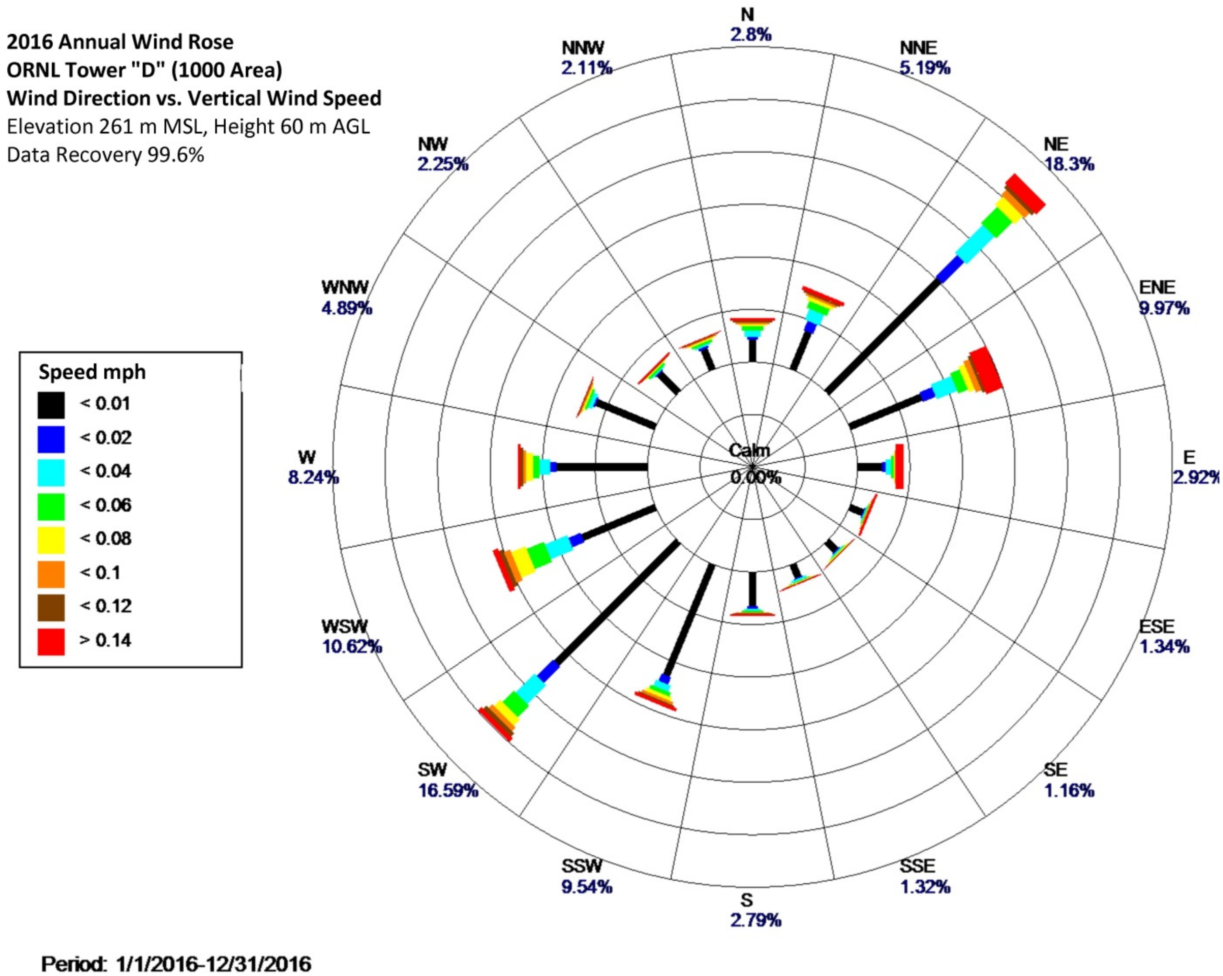

Figure 9: ORNL Met Tower MT2 ("D") 2016 Annual Vertical Wind Speed vs. Wind Direction Rose – 60 meters

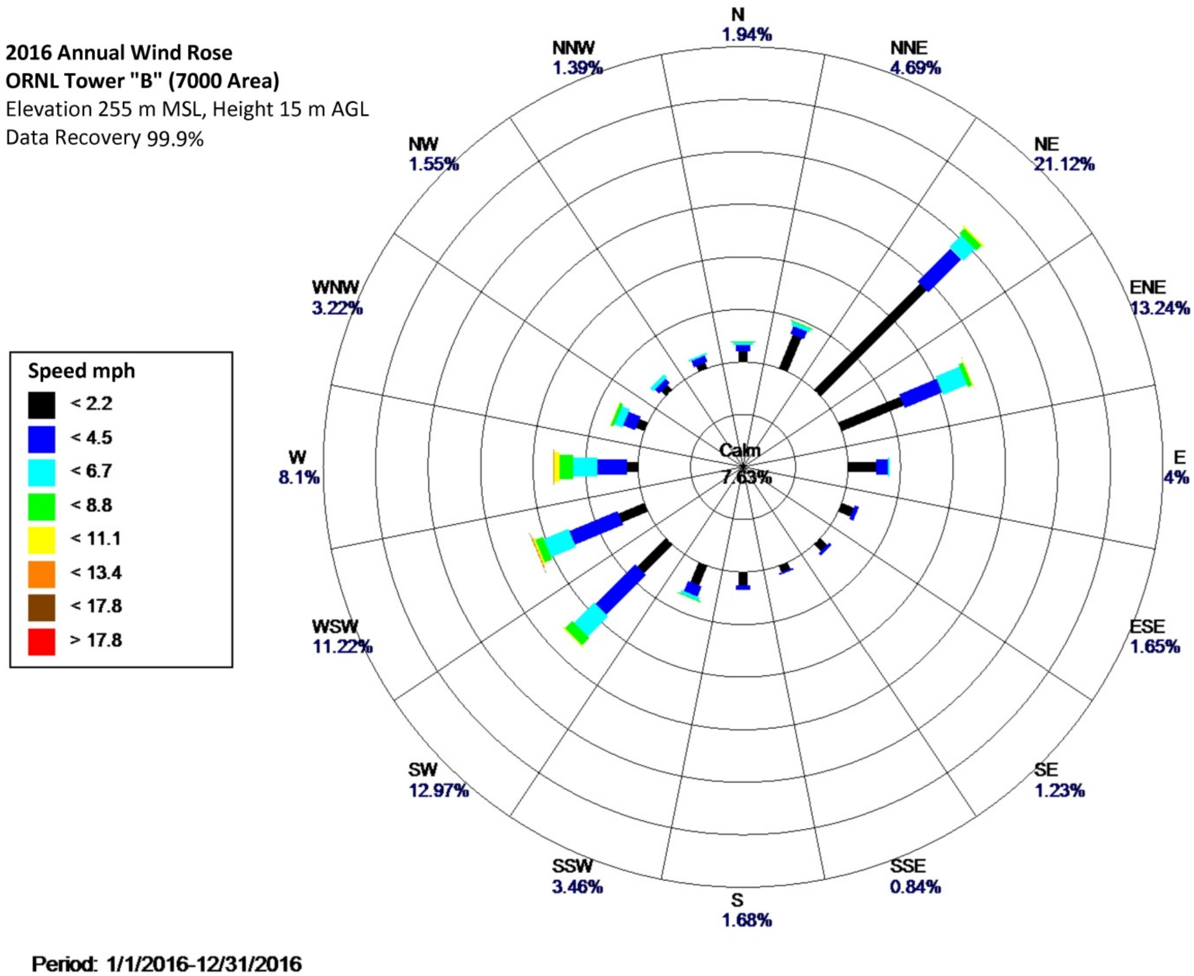

Figure 10: ORNL Met Tower MT3 (“B”) 2016 Annual Wind Rose – 15 meters

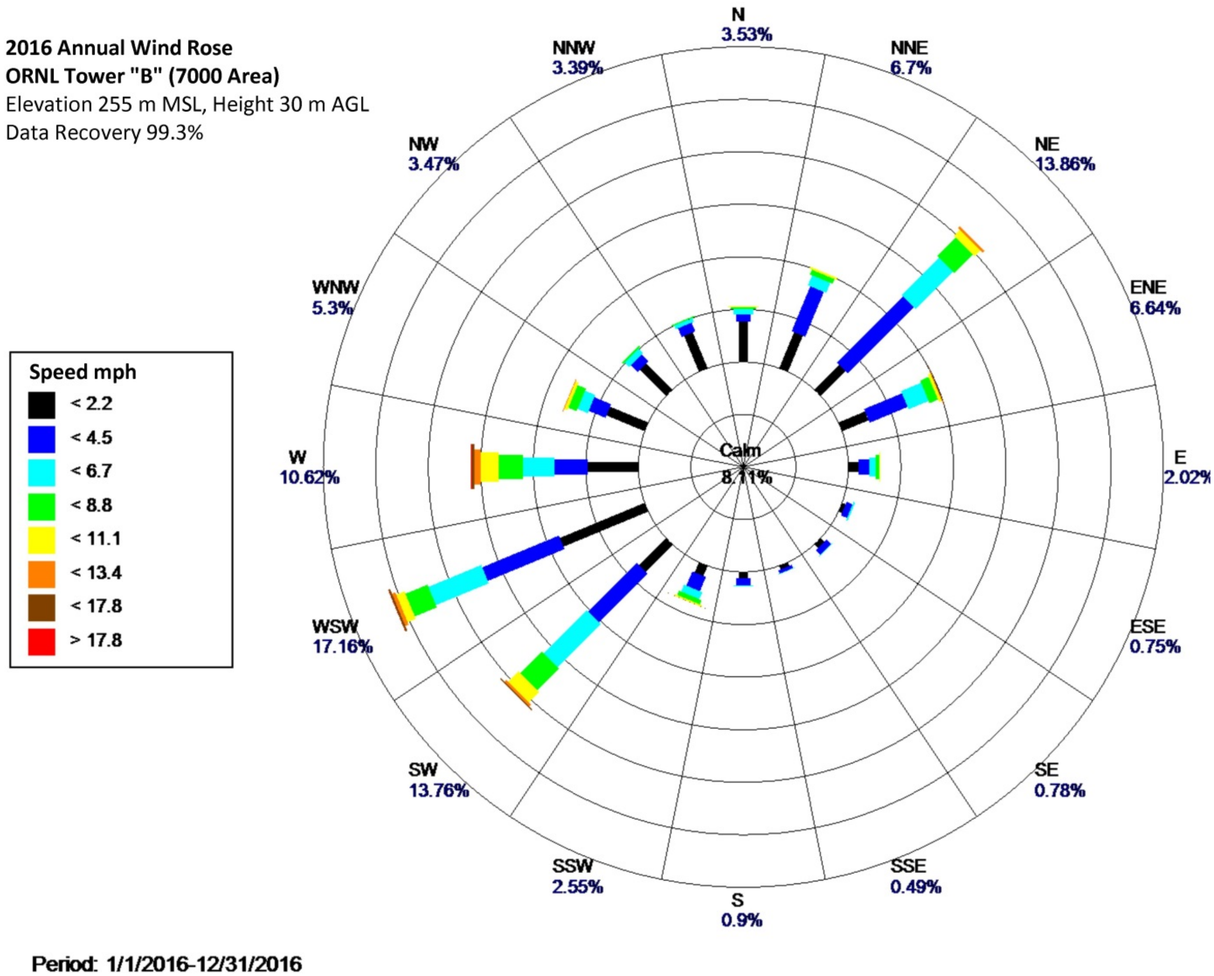

Figure 11: ORNL Met Tower MT3 ("B") 2016 Annual Wind Rose – 30 meters

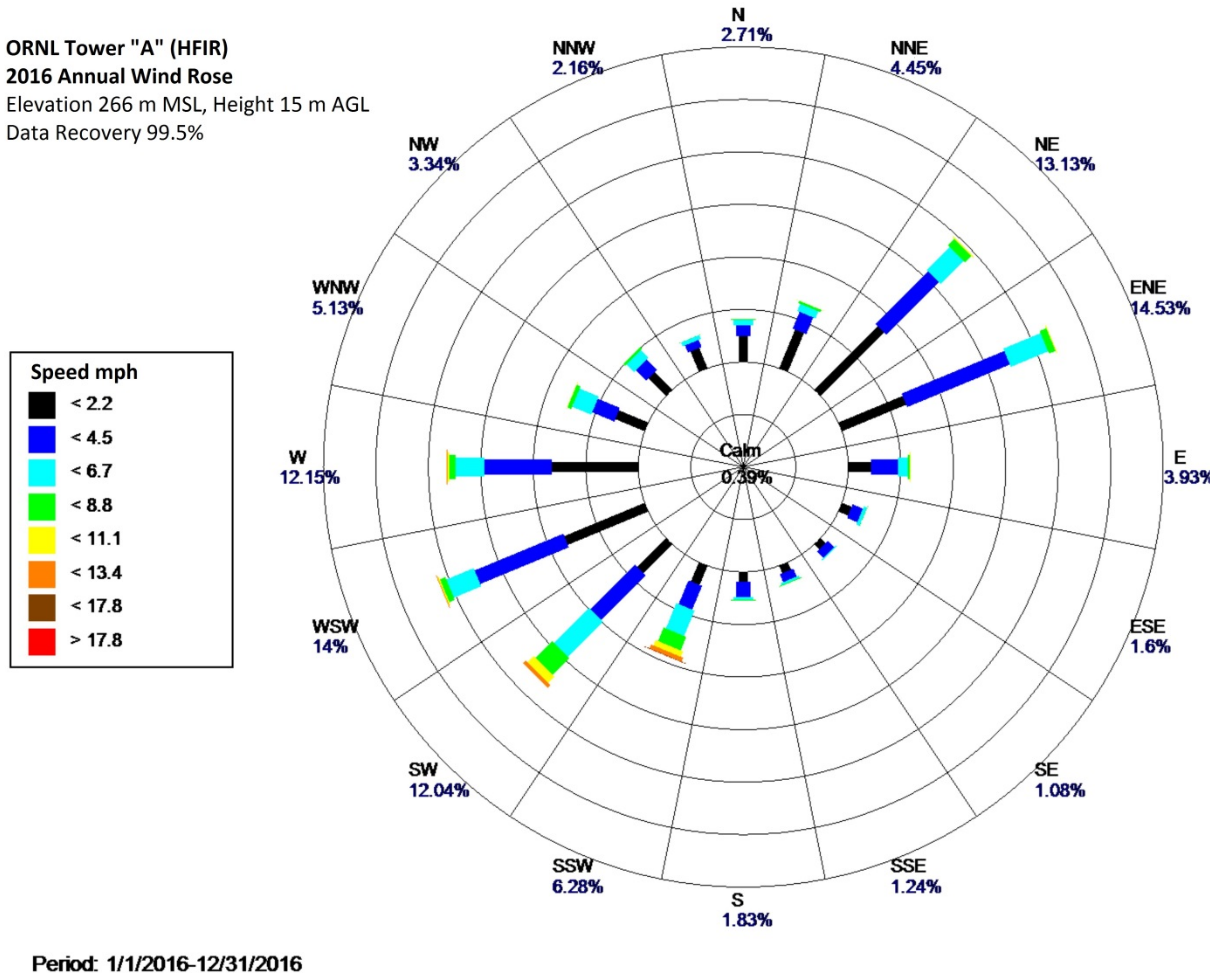

Figure 12: ORNL Met Tower MT4 ("A") 2016 Annual Wind Rose – 15 meters

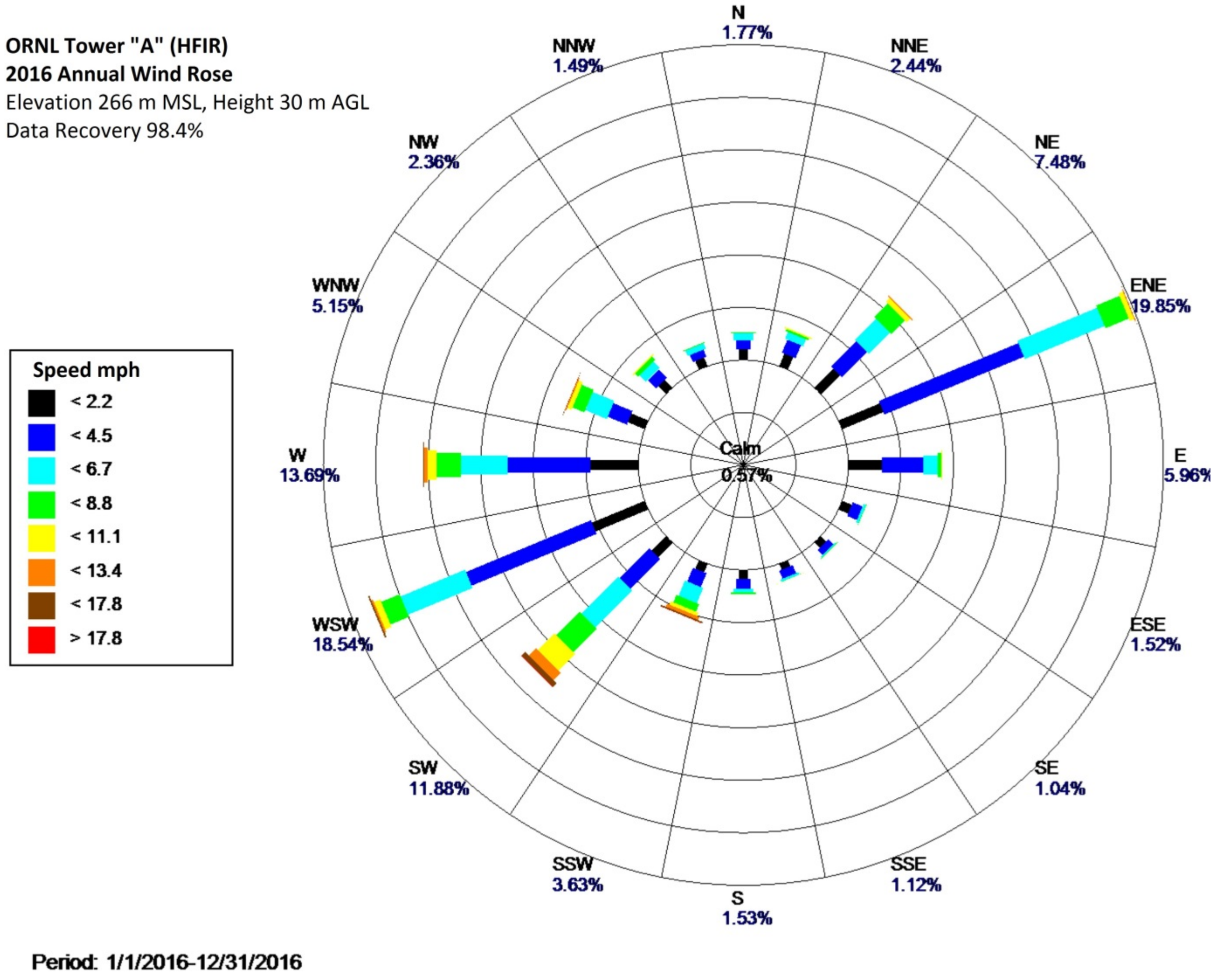

Figure 13: ORNL Met Tower MT4 ("A") 2016 Annual Wind Rose – 30 meters

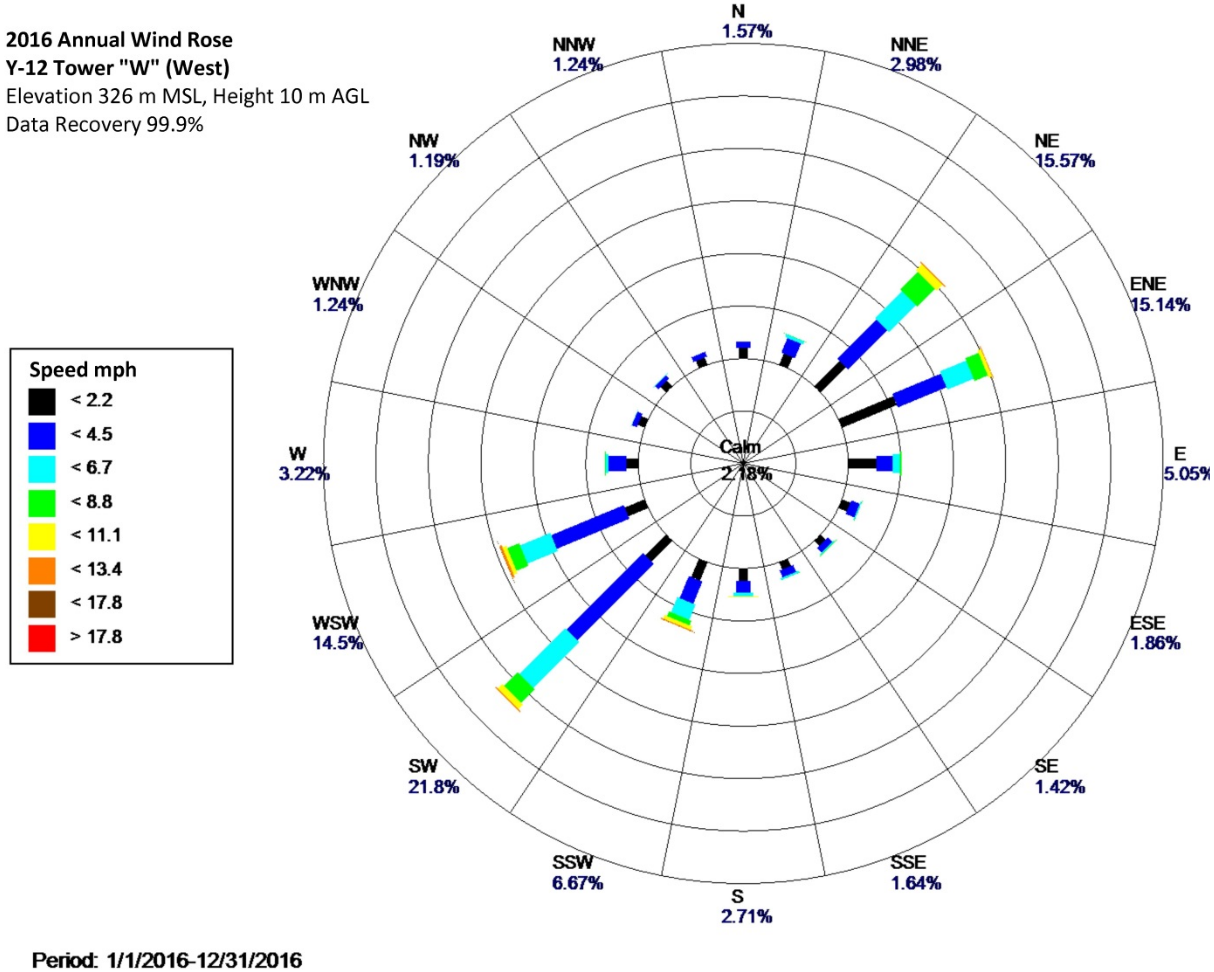

Figure 14: Y-12 Met Tower MT6 ("West") 2016 Annual Wind Rose – 10 meters

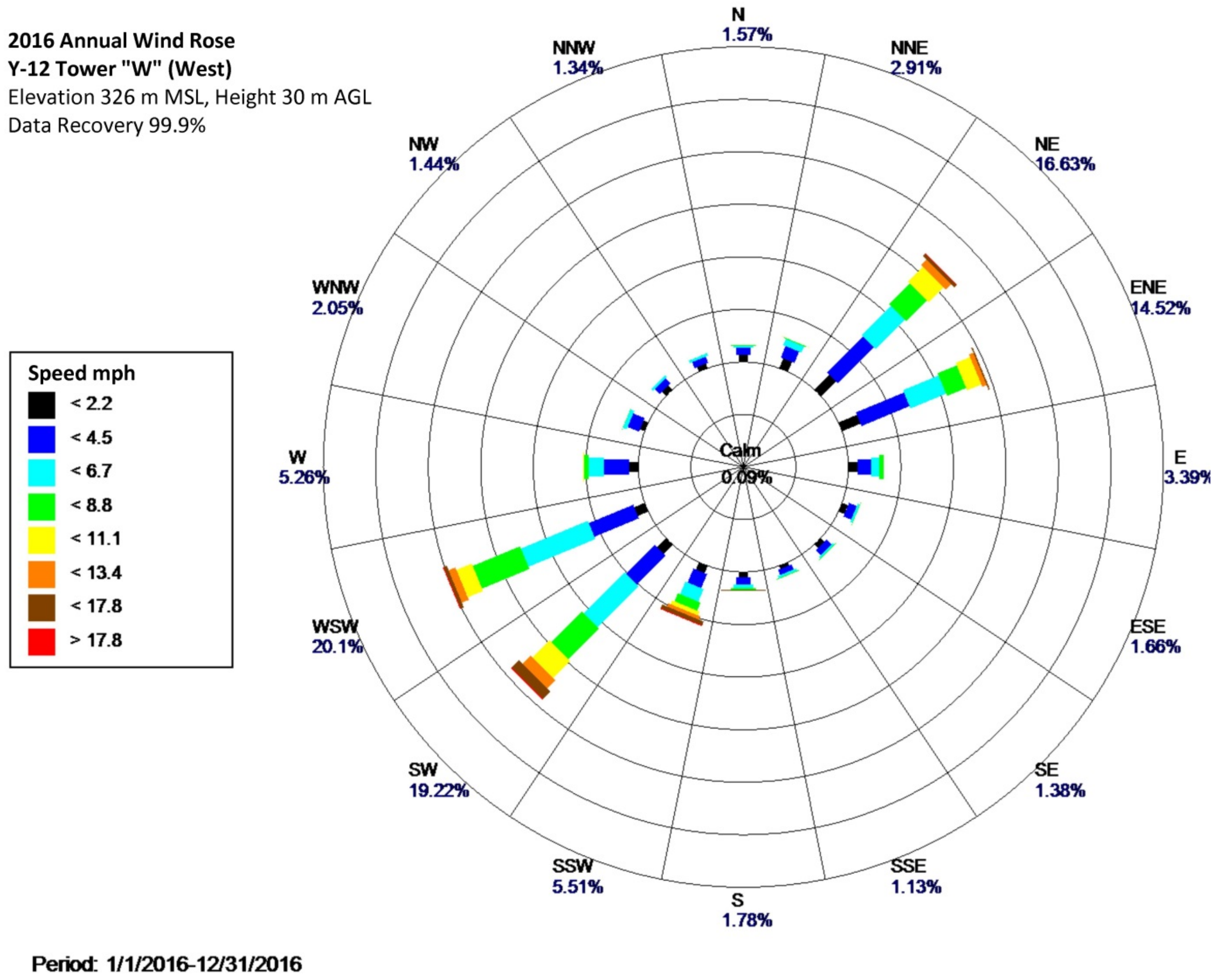

Figure 15: Y-12 Met Tower MT6 ("West") 2016 Annual Wind Rose – 30 meters

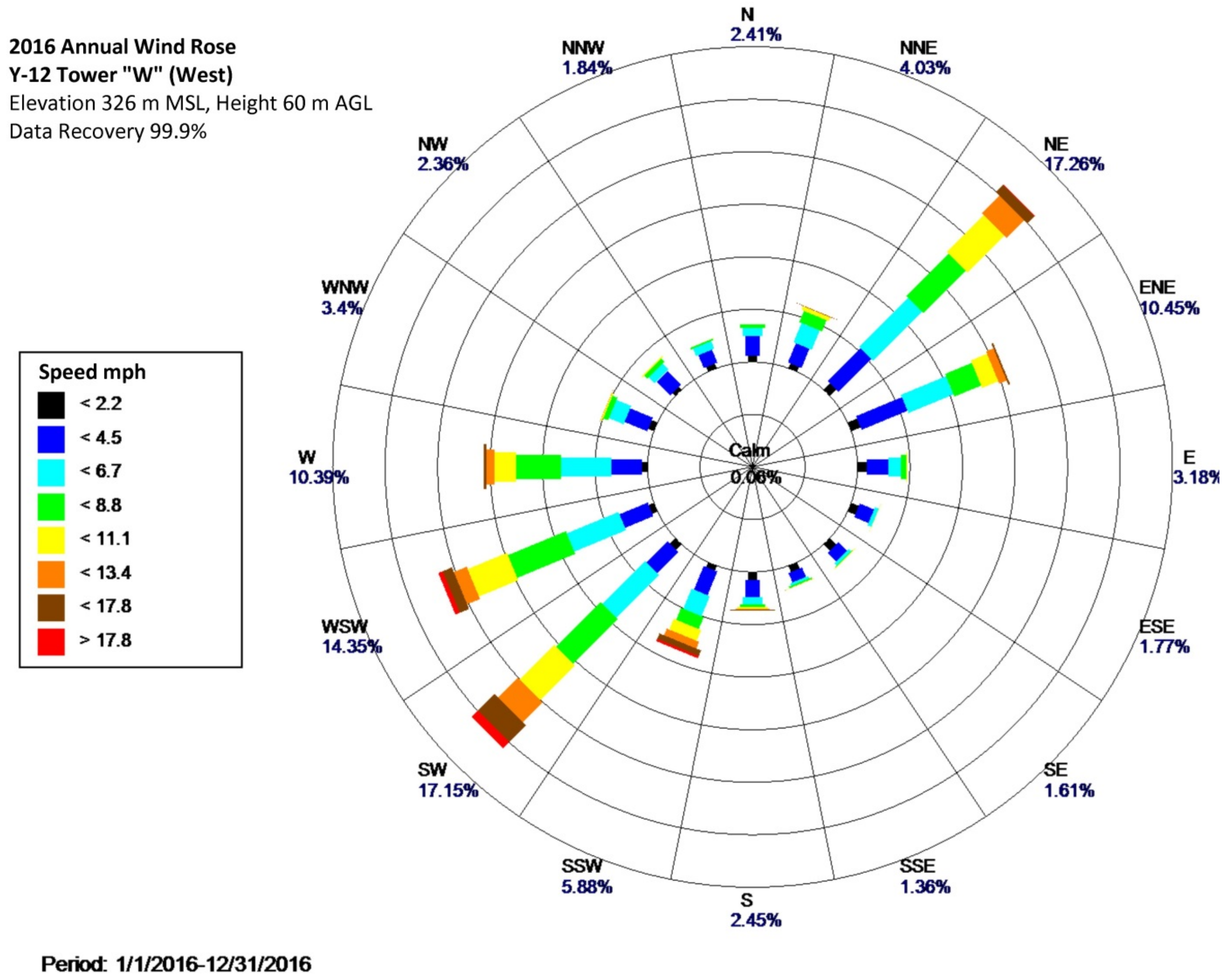

Figure 16: Y-12 Met Tower MT6 ("West") 2016 Annual Wind Rose – 60 meters

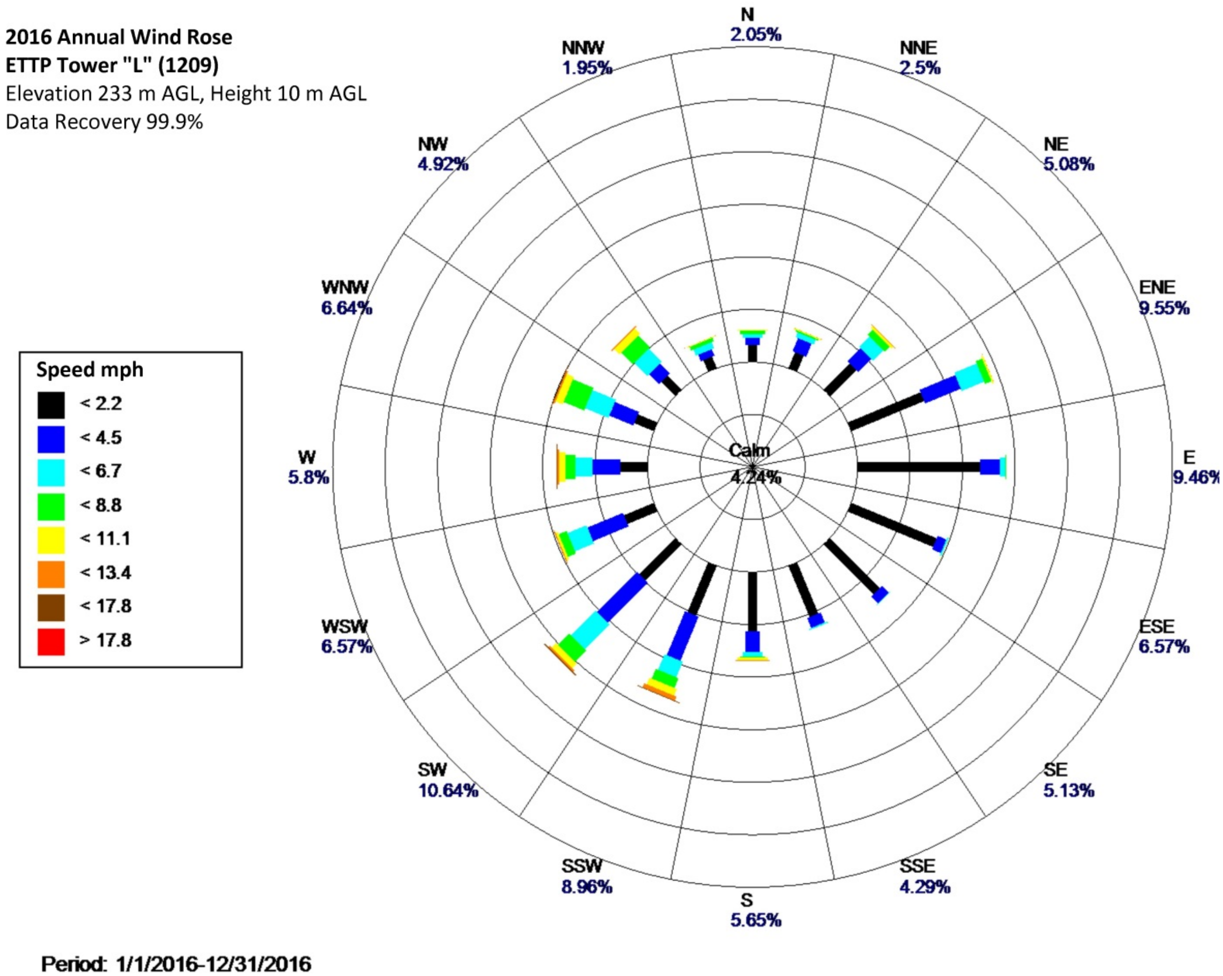

Figure 17: ETTP Met Tower MT7 ("L" 1209) 2016 Annual Wind Rose – 10 meters

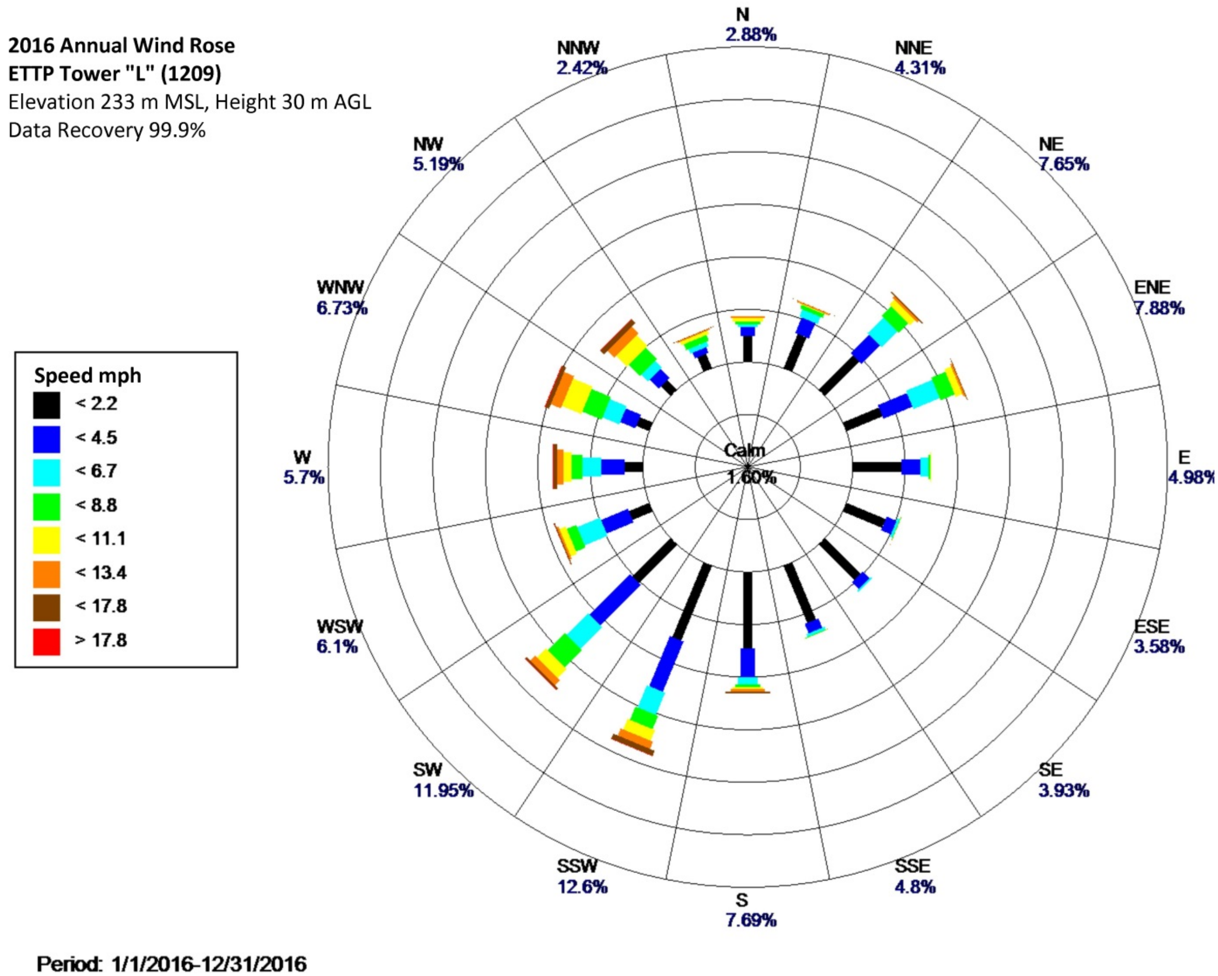

Figure 18: ETTP Met Tower MT7 ("L" 1209) 2016 Annual Wind Rose – 30 meters

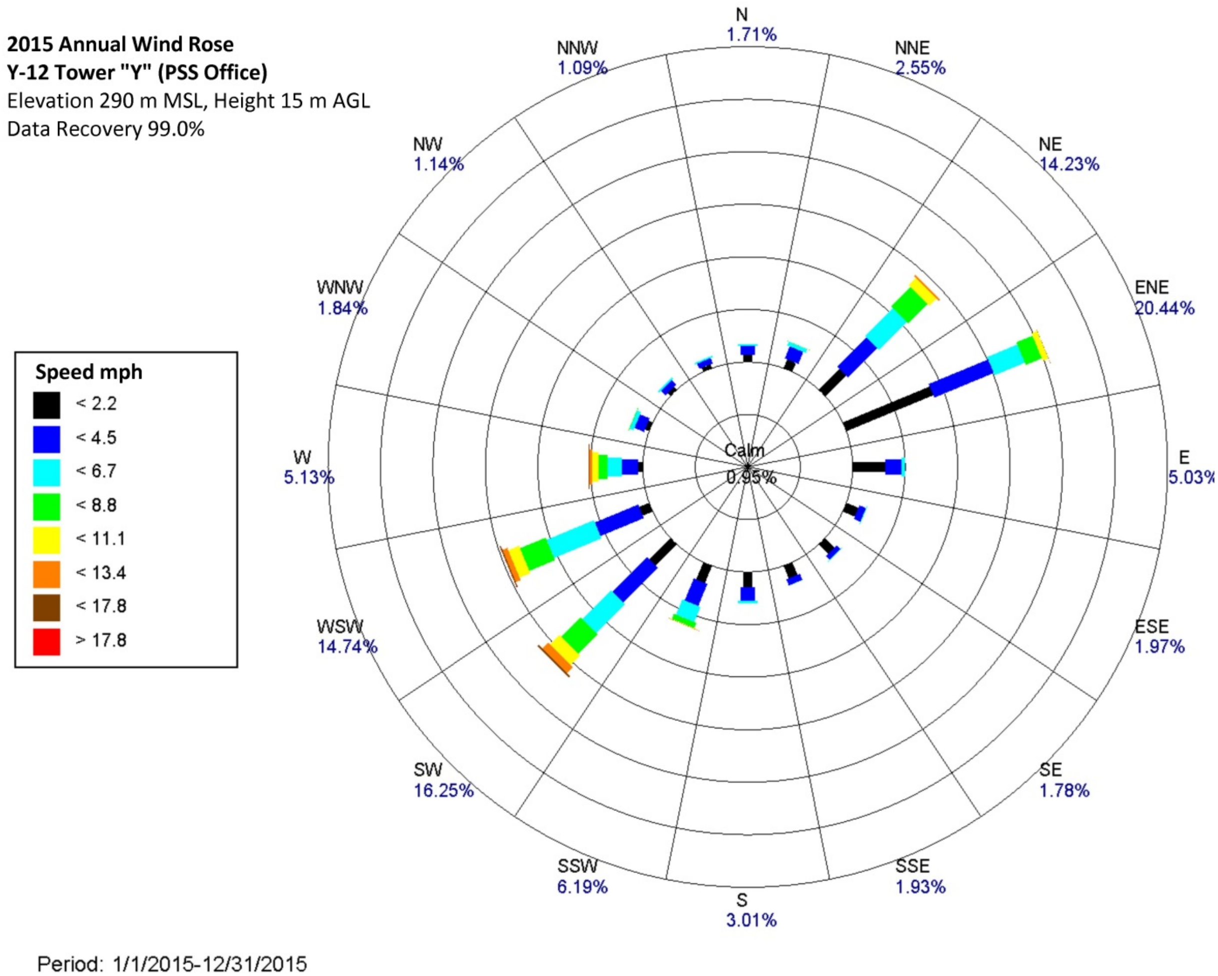

Figure 19: Y-12 Met Tower MT9 ("Y") 2016 Annual Wind Rose – 15 meters

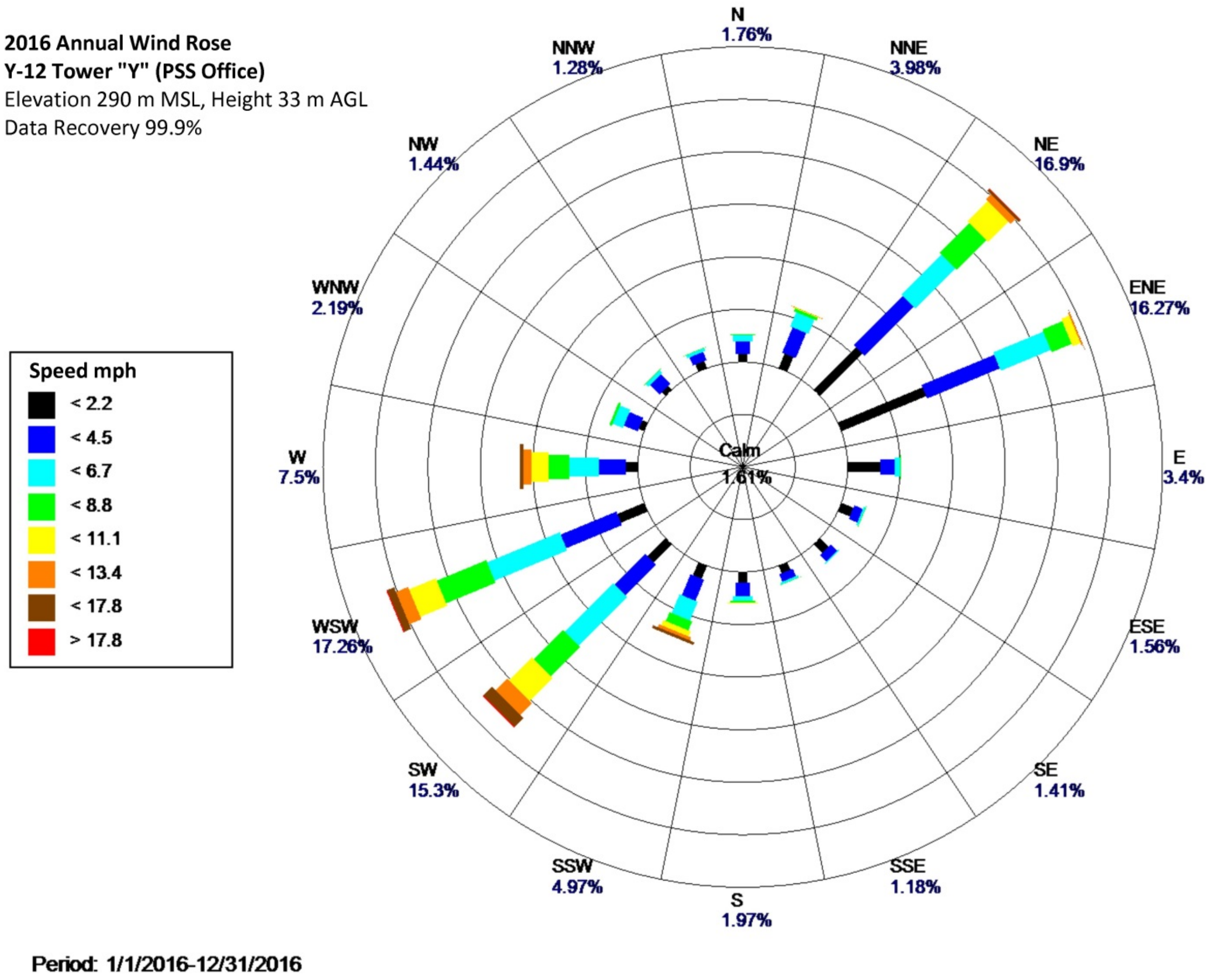

Figure 20: Y-12 Met Tower MT9 ("Y") 2016 Annual Wind Rose – 33 meters

ORR COMPLIANCE ASSESSMENT

The calculated ED to the MEI from all radiological airborne release points on the ORR during 2016 was 0.2 mrem/year (0.002 mSv/year). Dose contributions to the MEI from the Y-12 Complex, ORNL, and ETTP were 2.2%, 97.8% and 0.0045%, respectively. The ORISE demonstrates compliance with the regulations by use of annual possession quantities and, therefore, contributes zero percent to the MEI dose. The calculated ED to the MEI is well below the NESHAP standard of 10 mrem and is approximately 0.07% of the roughly 300 mrem that the average individual receives from natural sources of radiation. The MEI for 2016 was an offsite member of the public located outside the ORR about 13,340 m southwest of the Y-12 Complex composite release point; about 5240 m west-southwest of the 7911 stack at ORNL; and about 5710 m south-southeast of the K-1407-AL at ETTP, as shown in Figure 21. No surrogate radionuclides were used in 2016 since CAP88PC Version 4 includes all radionuclides.

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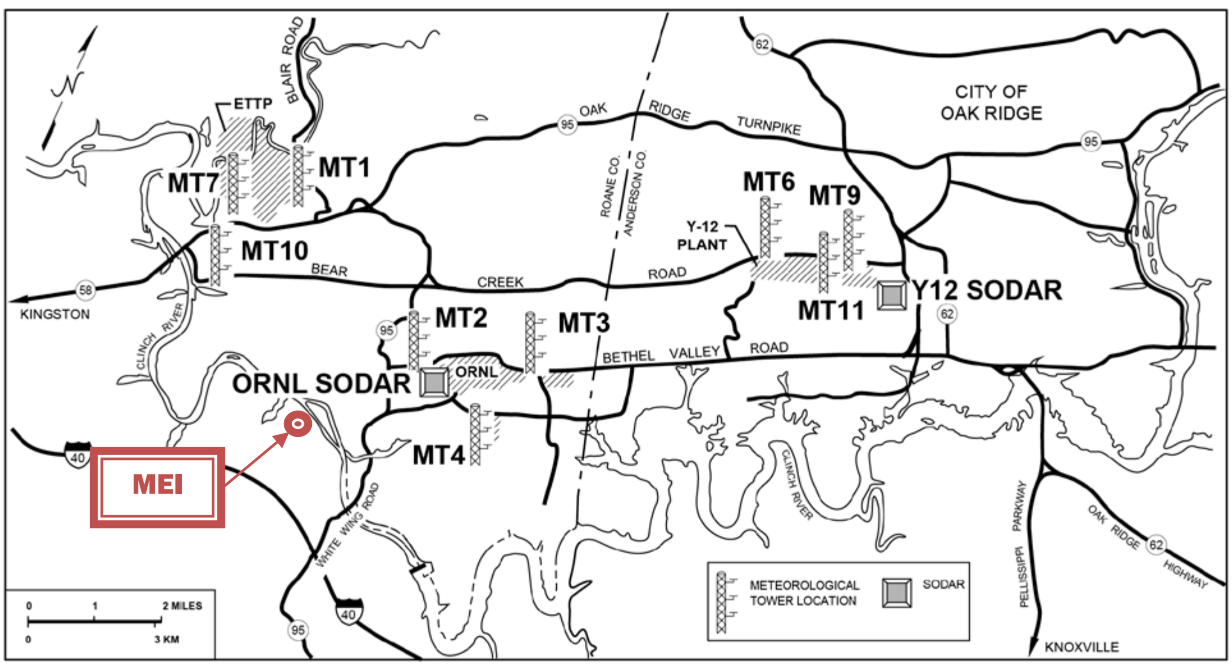

Figure 21: Locations of meteorological towers on the ORR and the 2016 MEI

DIFFUSE/FUGITIVE EMISSIONS

Diffuse/fugitive sources include any source that is spatially distributed, diffuse in nature, or not emitted with forced air from a stack, vent, or other confined conduit. Diffuse/fugitive sources also include emissions from sources where forced air is not used to transport the radionuclides to the atmosphere. In this case, radionuclides are transported entirely by diffusion and/or thermally driven air currents. Typical examples of diffuse/fugitive sources include emissions from building breathing; resuspension of contaminated soils, debris, or other materials; unventilated tanks; ponds, lakes, and streams; wastewater treatment systems; outdoor storage and processing areas; and leaks in piping, valves, or other process equipment. Table 5 provides a list of potential fugitive/diffuse sources on the ORR. However, this list is not intended to include all areas with potential emissions because most of the manufacturing and research areas on the ORR have handled radioactive materials in the past.

EPA has not defined requirements for reporting and estimating emissions for fugitive and diffuse sources in 40 CFR 61, Subpart H. However, a guidance letter from Winston A. Smith, EPA Region 4, to R. R. Nelson, DOE-ORO, on March 24, 1992,[5] allowed the use of environmental measurements such as ambient air monitoring to confirm compliance for fugitive and diffuse sources as long as this methodology was "coordinated between DOE and EPA." In response to the March 24, 1992, letter and an EPA visit to the ORR in April 1992, a plan was developed by DOE-ORO to confirm compliance for fugitive and diffuse sources by measuring atmospheric concentrations of radionuclides at critical receptor locations using a network of ambient air monitors around the ORR. This plan was submitted to EPA Headquarters October 28, 1992,[6] and was implemented January 1993. Doses calculated from the ambient air monitoring results have been provided to EPA as supplementary information in the ORR Annual Radionuclide Air Emissions Report since 1992 consistent with the Memorandum of Understanding between DOE and EPA Headquarters.[7, 8] In October 2001, EPA Region 4 approved Addendum C.1,

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[5]Letter, Winston A. Smith, Director, Air, Pesticides and Toxics Management Division, EPA Region 4, to R. R. Nelson, DOE-ORO, "Fugitive Radionuclides Air Emissions From DOE Facilities," March 24, 1992.

[6]Letter, R. R. Nelson of DOE to Winston A Smith of EPA, "Fugitive Radioactive Air Emissions from DOE Facilities," with Attachment, "Environmental Monitoring Plan For Airborne Radioactivity from Fugitive and Diffuse Sources, Oak Ridge, Tennessee," October 28, 1992.

[7]Memorandum with Attachment, Peter J. Gross to DOE site Managers and Directors, June 20, 1995, Attachment, "MOU Between the U.S. Environmental Protection Agency and the U.S. Department of Energy Concerning the Clean Air Act Emission Standards for Radionuclides 40 CFR 61 Including Subparts H, I, Q & T," April 5, 1995.

[8]The April 5, 1995, MOU between EPA and DOE was in draft form in 1992, which included an agreement to include data on fugitive and diffuse emissions as supplementary information in the annual air emissions report.

Monitoring for Fugitive and Diffuse Sources, to the *Compliance Plan*, which formalized the use of environmental measurements from ambient air monitoring to confirm compliance for fugitive and diffuse sources for the ORR.

Table 8 contains the estimated doses at each ambient air monitoring station calculated using measured ambient air concentrations of radionuclides. Figure 22 provides the location of each perimeter air monitoring station and ORNL ambient air monitor 1 (AAM1). Doses calculated at the ORR stations ranged between 0.007 and 0.04 mrem/year (0.00007 and 0.0004 mSv/year) and the calculated dose at the background station was about 0.008 mrem/year (0.00008 mSv/year). Dose and air concentration ratios were determined using CAP88PC Version 4. For ambient air monitors representing offsite members of the public, doses were estimated assuming EPA's local food source scenario. This approach removed the potential bias that one particular source would primarily contribute to the dose at a given ambient air monitoring station, since multiple sources may contribute to the dose, and the sources may change over the years. These doses do not include contributions of naturally occurring ^{40}K and ^{7}Be. The highest estimated dose 0.04 mrem/year (0.0004 mSv/year) was recorded at Station 42. At Stations 37, 38, 39, 40, 42, 48, and 49 ^{99}Tc was the primary dose contributor (55%-91%) with ^{3}H (AAM1, 35, 39, 46, and 49), ^{234}U and ^{238}U contributing the remaining dose. At Station 42, ^{99}Tc and ^{234}U were the primary dose contributors (approximately 55% and 36%, respectively). At Station 52, the background location, Tc-99 was the primary contributor (91%).

The annual doses calculated at the Perimeter Air Monitoring stations and the local ORNL ambient air monitor AAM1 using CAP88PC Version 4 and source emission data ranged from 0.01 mrem (0.0001 Sv) (at Stations 38 and 40) to 0.2 mrem (0.002 Sv) (at AAM1 and Stations 39 and 48). PAM 39 was the nearest ambient air monitoring station to the estimated MEI receptor location. The estimated dose at PAM 39, using source emission data, was 0.2 mrem. Whereas, as shown in Table 8, the doses calculated using air monitoring data was lower than the estimated MEI dose using emission data, the dose calculated using emission data at the background station was about 0.009 mrem/year (0.00009 mSv/year). All calculated doses based on the ambient air monitoring data were less than doses calculated using source emission data.

Table 8. ESTIMATED DOSES AT THE ORR PERIMETER AIR MONITORING STATIONS AND LOCAL ORNL AMBIENT AIR MONITOR 1 (AAM1) - 2016

Ambient air station number	Effective Dose (mrem/year)[a, b]
AAM1	0.02
35	0.02
37	0.007
38	0.009
39	0.02
40	0.01
42	0.04
46	0.02
48	0.009
49	0.01
Fort Loudon Dam (Background)	0.008

[a] 100 mrem = 1 mSv.
[b] Doses exclude contributions from ^{7}Be and ^{40}K radionuclides.

ORNL-DWG 16-G00540R/chj

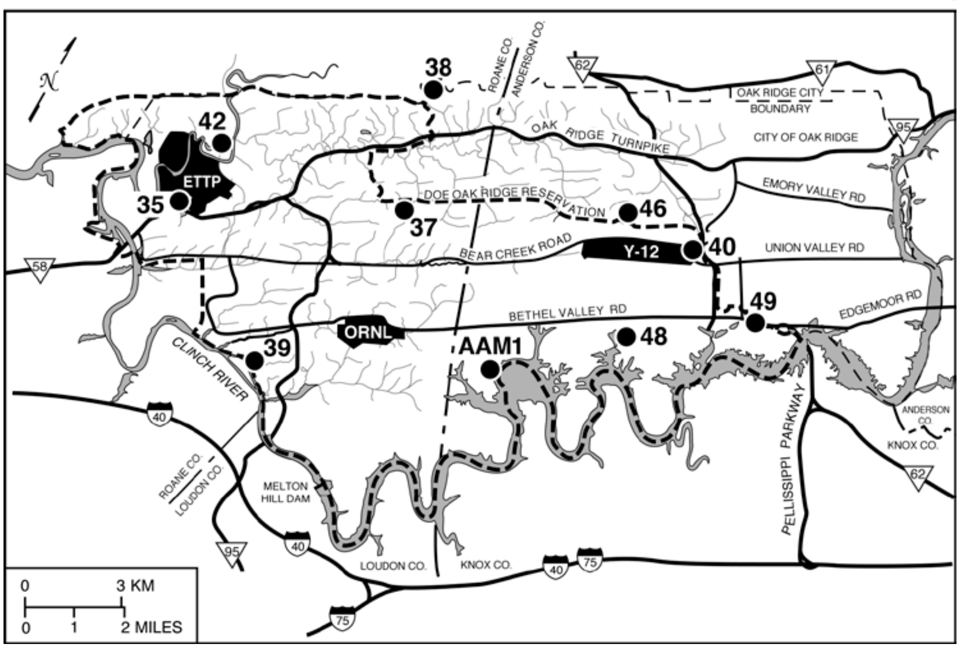

Figure 22: Approximate locations of ORR perimeter air monitors and ORNL local ambient air monitor 1 (AAM1) 2016

FACILITIES REVITALIZATION CONSTRUCTION PROJECT AMBIENT AIR RESULTS

There were no facilities revitalization construction projects in 2016 where the construction workers were considered members of the public. Therefore, no ambient air monitors were used to determine the ED from such activities.

ETTP AMBIENT AIR NETWORK

The ETTP operates a separate ambient air monitoring network with stations located specifically to measure air contaminants emanating from this site. Figure 23 provides the location of each ETTP station. Two of the ETTP stations (K2 and K6) are located in the prevailing upwind and downwind sectors with respect to the plant, but within the ORR boundary. Additionally, the downwind location is in the region of the modeled annual maximum impact location with respect to all ETTP sources. Two supplemental stations (K11 and K12) operated during this reporting period. Station K11 is adjacent to Building K-1036 that is an onsite business receptor location. K12 is positioned to conservatively represent the impact on occupants' located onsite at 100 Meritus Avenue. These locations serve to measure the impact during the demolition of radionuclide contaminated buildings. Analyses of samples collected by the ETTP ambient air monitoring network during 2016 were performed to assess the presence of the primary airborne dose contributors for ^{99}Tc and the isotopes of uranium.

The annual dose impact at ETTP ambient air sampling locations has been historically based on quarterly composites prepared from the collection of weekly sampling periods. The ETTP ambient air radionuclide data presented in Table 9 have been calculated using quarterly composited sampling results. Data was reviewed such that any analytical result reported as negative was assumed to be zero. The analytical results were not corrected for naturally occurring background levels, blank filter background levels, measurement uncertainties, or detection limits.

During 2016, the analytical method used for ^{99}Tc was changed from Liquid Scintillation (LSC) to Inductively Coupled Plasma Mass Spectrometry (ICP/MS). This change was initiated for the fourth quarter composite analyses to avoid analytical interference issues for this isotope. The analytical method change was based on the results split sample analyses of archived exposed filter material and unexposed filter blanks using both methods. The results demonstrated improved consistency of results and therefore ICP/MS will be the method of choice for ^{99}Tc analyses.

Table 10 summarizes the estimated doses at the ETTP air monitoring stations. The doses associated with air monitoring stations K2 and K6 were about 0.05 mrem and for K11 and K12 the estimate doses were 0.03 mrem and 0.07 mrem, respectively. Stations K11 and K12 are near onsite businesses, therefore the estimated doses for residential exposures were divided by 2 to account for occupational exposures following approved procedures as identified in the *Compliance Plan*. The isotopic details measured at the ambient air monitoring stations show that the most significant dose contributor was ^{99}Tc with the percent contribution ranging between 75.2 % (K12) to 98.1% (K2). The remainder of the dose contribution was attributed to ^{234}U, ^{235}U, and ^{238}U. Data show that all measurements are well below the 10 mrem annual dose limit.

Table 9. ETTP AMBIENT AIR ANNUAL CONCENTRATION RESULTS - 2016

Isotope	Concentration, (µCi/mL)[a]			
	K2	K6	K11	K12
^{99}Tc	1.78E-15	1.53E-15	2.27E-15	4.19E-15
^{234}U	4.11E-18	4.22E-17	5.42E-17	1.55E-16
^{235}U	6.92E-19	2.35E-18	4.93E-18	1.10E-17
^{238}U	4.59E-20	3.46E-18	8.49E-18	2.76E-17

a All isotopic-U results by Alpha Spectroscopy; ^{99}Tc results by LCS for the first three quarters and ICP/MS for the 4th quarter of 2016.

Table 10. ESTIMATED DOSES AT THE ETTP AIR MONITORING STATIONS - 2016

Ambient air station number	Effective Dose (mrem/year)[a, b, c]
K2	0.05
K6	0.05
K11	0.03
K12	0.07

a 100 mrem = 1 mSv.

b Doses exclude contributions from ^{7}Be and ^{40}K radionuclides.

c K2 and K6 results represent a residential exposure. K11 and K12 represent an onsite business exposure equivalent to ½ of a yearly exposure at this location.

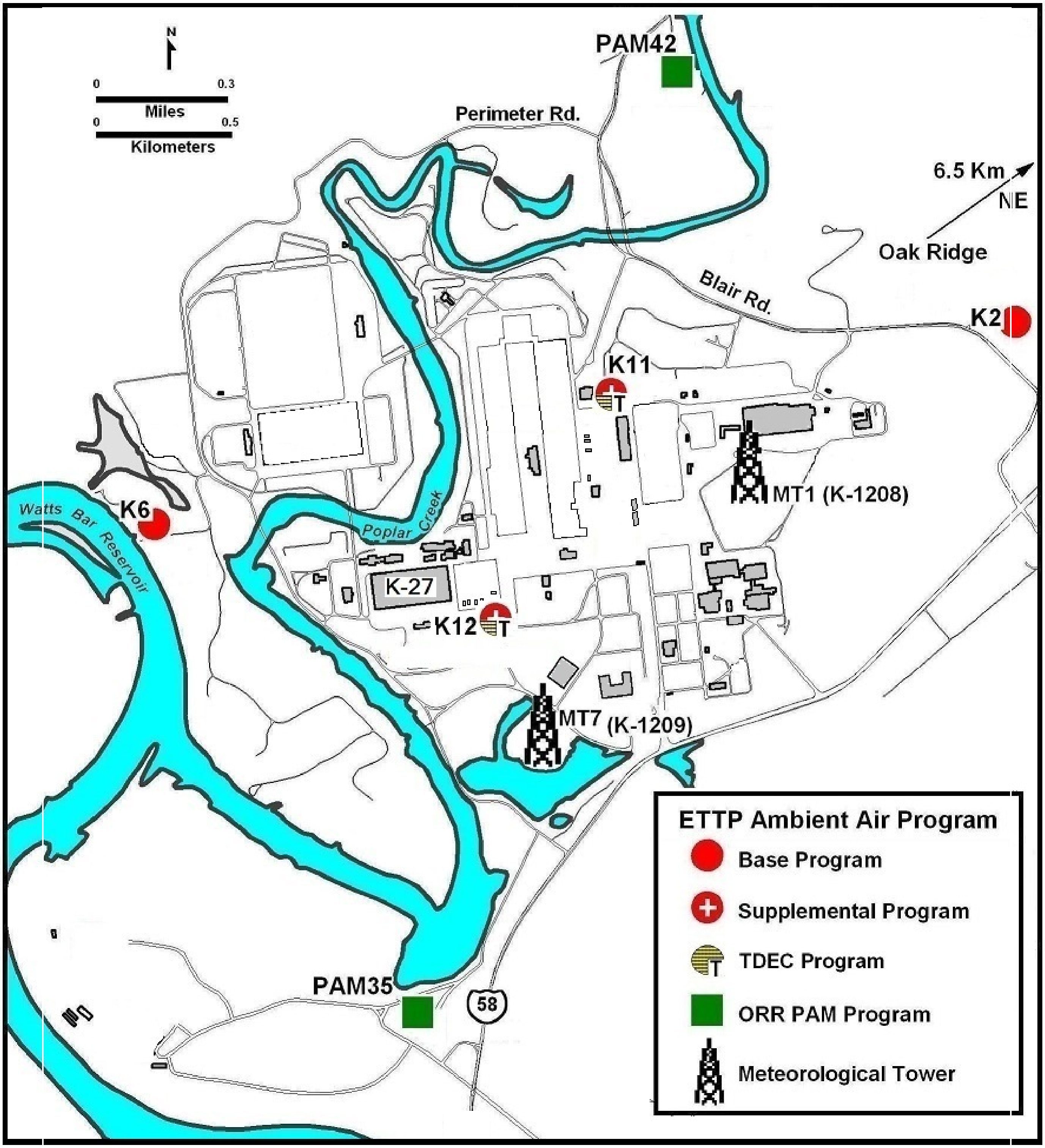

Figure 23: Approximate locations of ETTP ambient air monitors during 2016

CERTIFICATIONS

Separate certification statements are provided for the purpose of clarifying the roles and responsibilities of the government entities with respect to the facilities herein and shall not be construed as altering or limiting the certification.

CERTIFICATION FOR THE Y-12 NATIONAL SECURITY COMPLEX

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein; based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (See 18 U.S.C. 1001.)

____ ____________________________

Susan D. Morris, DOE-NNSA Date
Manager for Environment, Safety, Health & Quality
NNSA Production Office, NPO-60

The National Nuclear Security Administration Production Office Assistant Manager for Environment, Safety, Health & Quality has been delegated authority to sign this certification from the public official in charge of the Y-12 National Security Complex. Thus, the certification signed for the National Nuclear Security Administration Production Office relates only to Y-12 National Security Complex information for which National Nuclear Security Administration has operational responsibility.

CERTIFICATION FOR OAK RIDGE NATIONAL LABORATORY AND OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein; based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (See 18 U.S.C. 1001.)

____ ________________________

Johnny O. Moore, DOE-Office of Science — Date
Manager, ORNL Site Office

The Manager for the Oak Ridge National Laboratory Site Office signed this certification as the public official in charge of the Oak Ridge National Laboratory and the Oak Ridge Institute for Science and Education. Thus, the certification signed for the Oak Ridge National Laboratory Site Office relates only to Oak Ridge National Laboratory and Oak Ridge Institute for Science and Education information for which the Office of Science has operational responsibility.

CERTIFICATION FOR EAST TENNESSEE TECHNOLOGY PARK AND ENVIRONMENTAL MANAGEMENT PROGRAM ACTIVITES ON THE OAK RIDGE RESERVATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein; based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (See 18 U.S.C. 1001.)

____ ____________________________

John A. Mullis II, Acting Manager Date
Oak Ridge Office of Environmental Management

The Manager for the Oak Ridge Office of Environmental Management signed this certification as the public official in charge of East Tennessee Technology Park and Environmental Management program activities on the Oak Ridge Reservation. Thus, this certification relates only to East Tennessee Technology Park and Environmental Management program information for which the Oak Ridge Office of Environmental Management has operational responsibility.

SECTION IV. ADDITIONAL INFORMATION

NEW/MODIFIED SOURCES COMPLETED IN 2016

Y-12 Complex: There were no new or modified sources.

ORNL: There were no new or modified sources.

ETTP: There were no new or modified sources.

UNPLANNED RELEASES

Y-12 Complex: No unplanned releases in 2016.

ORNL: No unplanned releases in 2016.

ETTP: No unplanned releases in 2016.

SECTION V. SUPPLEMENTAL INFORMATION

COLLECTIVE DOSE

In accordance with DOE Order 458.1, the collective (or population) dose is the sum of the ED to each person within 80 km (50 miles) of the ORR. The collective dose was calculated using population data that was based on 2010 Census Data. The population within 80 km (50 miles) of the ORR was estimated to be 1,172,530[2]. Table 11 summarizes the results. The ORR collective dose suggests that the average ED to a member of the public was well below the DOE Order 458.1 public dose limit of 100 mrem (1 mSv) in a year. CAP88PC Version 4 was used in 2016 to calculate both individual and collective doses.

Table 11. COLLECTIVE ED (PERSON-REM/YEAR) - 50-MILE RADIUS

Installation	Total[a]
Y-12 Complex	0.7
ORNL	5.7
ETTP	0.0003
ORR	6.4

[a] The summation of numbers may differ because of rounding and use of significant figures.

COMPLIANCE WITH SUBPARTS Q AND T OF 40 CFR 61

Not applicable.

RADON EMISSIONS (^{220}Rn, ^{222}Rn)

Y-12 Complex: The radionuclide content of materials shipped to the Y-12 Complex for processing, as well as the material streams in process at any time, are measured and controlled by technical specification. Based on the historical and current radionuclide content of the material streams processed at the Y-12 Complex, and the presence of any progeny of ^{220}Rn, and ^{222}Rn due to these streams or from plant laboratory activities, there are no measureable effects relative to Y-12’s dose contribution to the ORR.

ORNL: In accordance with supplementary information guidelines,[9] the presence of ^{220}Rn in effluent streams located in Bethel and Melton Valley has been verified. Thorium-232, ^{228}Ra, ^{228}Th, and ^{232}U are progenitors of ^{220}Rn and these radionuclides are present onsite. Radon-220 was emitted from the 4000 laboratory hood area, and ^{212}Pb a decay product of ^{220}Rn, was emitted from five facilities in Bethel Valley and four facilities in Melton Valley. Based on these emissions, the ORR dose from ^{220}Rn and its progeny (i.e., ^{212}Pb emissions the major dose contributor from ^{220}Rn) should not exceed 0.1 mrem/year to the public and contributed less than 5% of the dose to the public.

Uranium-238 was present in the effluent streams in both Bethel and Melton Valley. Ra-226 (a progenitor of ^{222}Rn) was reported in an effluent stream in Bethel Valley. Lead-210, and ^{214}Pb (decay products of ^{222}Rn) were reported in one Melton Valley effluent stream. Based on these emissions, the ORR dose from ^{222}Rn and its progeny (i.e., from ^{210}Pb, ^{214}Bi, and ^{214}Pb emissions) should be less than 0. 001 mrem/year to the public and contribute less than 0.001% of the dose to the public.

ETTP: There are no known sources of ^{220}Rn or ^{222}Rn at the ETTP. Although trace quantities of ^{234}U are found at the ETTP, the long half-life and the small quantities present indicate that it is very unlikely that ^{222}Rn is present in significant amounts.

STATUS OF COMPLIANCE WITH NESHAPS MONITORING REQUIREMENTS OF SUBPART H

Y-12 Complex: Thirty two emission points included in the Y-12 Complex Title V Air Permit were equipped with continuous emission monitoring equipment. Each of these emission points complies with the regulatory requirements of 40 CFR 61.93 (b).

ORNL: Seven emission points were subject to the continuous emission monitoring requirements of 40 CFR 61.93(b). Each of these emission points complies with the regulatory requirements. In addition, there were two other sources that were continuously monitored to ensure compliance in the event of an increase in the potential dose.

ETTP: There are no emission points that would be subject to the continuous emission monitoring requirements of 40 CFR 61.93(b).

MINOR SOURCES: The periodic confirmatory measurement plan for minor sources is outlined in detail in the *Compliance Plan* which was originally submitted to EPA on December 27, 1991, and has been updated in subsequent years. In addition, the specific methods used for each minor and/or grouped source were provided to EPA Region 4 by June 15, 1992, for the

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[9]Section IV. Supplemental Information, DOE Oak Ridge Operations to M.E. Mitchell from P.J. Gross, 1990 National Emissions Standards for Hazardous Air Pollutants Annual Reports for the Oak Ridge Reservation, Paducah Gaseous Diffusion Plant, and Portsmouth Gaseous Diffusion Plant, 40 CFR 61, Subpart H Annual Reports, January 30, 1991.

Y-12 Complex and ORNL and by September 15, 1992, for the ETTP. Methods allowed for periodic confirmatory measurements include (1) radionuclide inventory (e.g., mass balance), (2) health physics data and building ventilation flow rates, (3) modified Method 5 sampling, and (4) various other engineering calculations.

STATUS OF QUALITY ASSURANCE PLANS

Each of the major ORR installations has prepared a Quality Assurance (QA) Plan in accordance with 40 CFR 61, Appendix B, Method 114. The final plans were submitted to EPA by June 15, 1992, in accordance with the ORR FFCA. ORISE has obtained a waiver from EPA for developing a QA plan because the quantities of radionuclides used are less than the quantities identified in 40 CFR 61, Appendix E. The ORNL QA Plan was updated in December 2010 to reflect organizational and procedural changes. The ETTP NESHAP QA Plan was updated in December 2015 to address both administrative and operational changes and enhance roles and responsibilities. The Y-12 Complex's Environmental Compliance Department revised the NESHAPs QA Plan in December 2010 to reflect changes in organizational structures and procedural updates.

ERRATA

In the 2015, DOE Air Emissions Annual Report Executive Summary, the dose contributions by site were incorrectly reported. Dose contributions to the MEI from the Y-12 Complex, ORNL, and ETTP for 2015 were 1.6%, 98.4% and 0.003%, respectively.

In addition, during a review of selected sources, it was determined that a 2015 radionuclide source term had been submitted twice. Revision of the source term resulted in no change in the 2015 annual ORR MEI dose (0.4 mrem/year) but a reduction in the ORNL collective dose to 8.8 person-rem/year (from 9.4 person-rem/year) and a reduction in the ORR collective dose to 10.2 person-rem/year (from 10.8 person-rem/year).

For previous Air Emissions Annual Reports, the release height for ORR sources did not include the elevation of the source and only the stack heights into the CAP88 code. The release height is a major factor in the air dispersion transport model affecting the location of the MEI and the dose impact of the source on the MEI. In particular, ORNL source X-8915 sits on a ridge and is thus elevated approximately 79 m above all of the other ORR Rad NESHAP sources. It was determined that for the 2016 annual report that the release height for ORNL source X-8915 would include the Chestnut Ridge elevation. DOE is currently accessing whether modified release heights for all sources on the ORR significantly impact the ORR dose and MEI for previous years, and will report the updated values in the 2017 report if warranted.