

Oak Ridge Reservation

Annual Site

Environmental Report

2012

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**Annual Site
Environmental
Report 2012**

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Acronyms and Abbreviations

AAS	ambient air station
ABC	aluminum beverage can (recycling)
ACHP	Advisory Council on Historic Preservation
ACO	Analytical Chemistry Organization (Y-12 Complex)
ACM	asbestos-containing material
AGL	above ground level
aka	also known as
ALARA	as low as reasonably achievable
AMAD	activity median aerodynamic diameter
ANSI	American National Standards Institute
ANSI/HPS	ANSI Health Physics Society (standard)
AOEC	Agent Operations Eastern Command (NNSA OST)
ARAP	Aquatic Resource Alteration Permit
ARAR	applicable or relevant and appropriate requirement
ARRA	American Recovery and Reinvestment Act
ASER	<i>Oak Ridge Reservation Annual Site Environmental Report</i>
AWQC	ambient water quality criteria
B&W Y-12	Babcock & Wilcox Technical Services Y-12 LLC
BCG	biota concentration guide
BMAP	Biological Monitoring and Abatement Program
BRW	bedrock well
CAA	Clean Air Act
CAP-88	Clean Air Assessment Package (software)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	<i>Code of Federal Regulations</i>
CFTF	Carbon Fiber Technology Facility
CH	contact-handled
CNF	Central Neutralization Facility
CO ₂ e	CO ₂ equivalent
COC	contaminant of concern
CPU	central processing unit
CRK	Clinch River kilometer
CROET	Community Reuse Organization of East Tennessee
CRT	cathode-ray tube
CWA	Clean Water Act
CWTS	Chromium Water Treatment System
CX	categorical exclusion
CY	calendar year
D&D	decontamination and decommissioning
DAC	derived air concentration
DCA	dichloroethane

DCE	dichloroethene
DCG	derived concentration guide
DCS	derived concentration standard
DNAPL	dense nonaqueous phase liquid
DOE	US Department of Energy
DOE ORO	DOE Oak Ridge Office
DVD	digital video disc
EBSR	Environmental Baseline Survey Report
EC&P	Environmental Compliance and Protection
ECD	Environmental Compliance Department (Y-12 Complex)
ECM	energy conservation measure
ED	effective dose
EDTA	ethylenediaminetetraacetic acid
EFK	East Fork Poplar Creek kilometer
EFPC	East Fork Poplar Creek
EISA	Energy Independence and Security Act
EM	Office of Environmental Management (DOE)
EMIP	Energy Modernization Implementation Program
EMMIS	Environmental Monitoring Management Information System (Y-12 Complex)
EMPO	Environmental Management Program Office (ORNL)
EMS	Environmental Management System
EMWMF	Environmental Management Waste Management Facility
EO	executive order
EPA	US Environmental Protection Agency
EPAct	Energy Policy Act
EPCRA	Emergency Planning and Community Right-to-Know Act
EPT	Ephemeroptera, Plecoptera, and Trichoptera (taxa)
EP&WSD	Environmental Protection and Waste Services Division
ES&H	environment, safety, and health
ESPC	Energy Savings Performance Contract
ESS	Environmental Surveillance System
ETTP	East Tennessee Technology Park
EU	exposure unit
FAST	Federal Automotive Statistical Tool
FCK	First Creek kilometer
FEC	Federal Electronics Challenge
FFA	federal facility agreement
FFCA	Federal Facilities Compliance Agreement
FFK	Fifth Creek kilometer
FY	fiscal year
GET	General Employee Training
GHG	greenhouse gas
GI	green infrastructure
HAP	hazardous air pollutant
HCC	Halcyon Commercialization Center

HEPA	high-efficiency particulate air
HFIR	High Flux Isotope Reactor
HPSB	high-performance sustainable building
HQ	hazard quotient
HVAC	heating, ventilating, and air-conditioning
IDMS	Integrated Document Management System (UT-Battelle)
I/I	inflow/infiltration
IC ₂₅	inhibition concentration (the concentration of effluent that causes a 25% reduction in survival, reproduction, and/or growth of monitored species)
ICP-MS	inductively coupled plasma–mass spectrometer
ID	identification (number)
ISMS	Integrated Safety Management System
ISO	International Organization for Standardization
Isotek	Isotek Systems LLC
IWC	instream waste concentration
LCD	liquid crystal display
LID	low impact development
LIMS	Laboratory Information Management System (Y-12 Complex)
LLW	low-level waste
M&E	material and equipment
MACT	Maximum Achievable Control Technology
MARSAME	<i>Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual</i>
MARSSIM	<i>Multi-Agency Radiation Survey and Site Investigation Manual</i>
MBK	Mill Branch kilometer
MCK	McCoy Branch kilometer
MCL	maximum contaminant level
MDA	minimum detectable activity
MEI	maximally exposed individual
MEK	Melton Branch kilometer
MIK	Mitchell Branch kilometer
MOA	memorandum of agreement
MT	meteorological tower (when directly followed by a numeral as in “MT2”)
MVSP	Melton Valley Steam Plant (ORNL)
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NIST	National Institute of Standards and Technology
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Site
NOV	notice of violation
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List (EPA)
NPO	NNSA Production Office
NSF-ISR	NSF International Strategic Registrations, Ltd.

NSPS	New Source Performance Standard
NTRC	National Transportation Research Center
ODS	ozone-depleting substance
ORAU	Oak Ridge Associated Universities
OREIS	Oak Ridge Environmental Information System (ORNL)
ORGDP	Oak Ridge Gaseous Diffusion Plant
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
ORPS	Occurrence Reporting and Processing System (Y-12 Complex)
ORR	Oak Ridge Reservation
ORRL	Oak Ridge Reservation Landfill
ORSSAB	Oak Ridge Site Specific Advisory Board
ORSTP	Oak Ridge Science and Technology Park
OST	Office of Secure Transportation (NNSA)
P2	designation for an on-site ORNL wetland
PAM	perimeter air monitoring (station)
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PEMS	Predictive Emissions Monitoring System
PM	particulate matter
PM ₁₀	particulate matter with an aerodynamic diameter less than or equal to 10 µm
PM _{2.5}	fine particulate matter with an aerodynamic diameter less than or equal to 2.5 µm
POTW	publicly owned treatment works
PSD	Prevention of Significant Deterioration
PWTC	Process Waste Treatment Complex
QA	quality assurance
QC	quality control
R&D	research and development
Rad-NESHAPs	National Emission Standards for Hazardous Air Pollutants for Radionuclides
RATA	relative accuracy test audit
RCRA	Resource Conservation and Recovery Act
RDR	remedial design report
REDC	Radiochemical Engineering Development Center
RESRAD	residual radioactivity
RFITS	Radio Frequency Identification Transportation System
RH	remote-handled
RI/FS	remedial investigation/feasibility study
ROD	record of decision
RQ	reportable quantity (CERCLA)
RSI	Restoration Services, Inc.
RSO	radiation safety officer
SAA	satellite accumulation area
SAP	sampling and analysis plan
SARA	Superfund Amendments and Reauthorization Act

SBMS	Standards-Based Management System (UT-Battelle)
SDWA	Safe Drinking Water Act
SEC	SEC Federal Services Corporation
SHPO	State Historical Preservation Office (Tennessee)
SNAP	Significant New Alternatives Program (EPA)
SNM	special nuclear material
SNS	Spallation Neutron Source
SODAR	sonic detection and ranging
SPCC	spill prevention, control, and countermeasures (plan)
SPMD	semipermeable membrane device
SPWTF	Steam Plant Wastewater Treatment Facility
SSP	site sustainability plan
SSPP	Strategic Sustainability Performance Plan (DOE)
STP	sewage treatment plant
SVOC	semivolatile organic compound
SWEIS	sitewide environmental impact statement
SWHISS	Surface Water Hydrological Information Support System (Y-12 Complex)
SWPP	Storm Water Pollution Prevention
SWPPP	Storm Water Pollution Prevention Plan
SWSA	solid waste storage area
TCE	trichloroethene
TDEC	Tennessee Department of Environment and Conservation
TEMA	Tennessee Emergency Management Agency
TOA	Tennessee Oversight Agreement
TP3	Tennessee Pollution Prevention Partnership
TRI	toxic release inventory
TRO	total residual oxidant
TRU	transuranic
TSCA	Toxic Substances Control Act
TVA	Tennessee Valley Authority
TWA	time-weighted average
TWPC	Transuranic Waste Processing Center
TWRA	Tennessee Wildlife Resources Agency
UCOR	URS CH2M Oak Ridge LLC
UMC	unneded materials and chemicals
UMS	Utilities Management System
UNW	unconsolidated well
UPF	Uranium Processing Facility
USACE	US Army Corps of Engineers
USDA	US Department of Agriculture
UST	underground storage tank
UT	University of Tennessee
VEE	Visible Emission Evaluation
VOC	volatile organic compound

WAI	Wastren Advantage, Inc.
WCK	WOC kilometer
WEMA	west end mercury-use area
WET	whole effluent toxicity
WIPP	Waste Isolation Pilot Plant
WOC	White Oak Creek
WOD	White Oak Dam
WQC	water quality criterion
WQPP	water quality protection plan
WRRP	Water Resources Restoration Program
Y-12	Y-12 National Security Complex
Y-12 Complex	Y-12 National Security Complex
ZPR	Zero Power Reactor

Units of Measure and Conversion Factors*

Units of measure and their abbreviations

becquerel	Bq	millicurie	mCi
British thermal unit	Btu	milligram	mg
centimeter	cm	milliliter	mL
curie	Ci	millimeter	mm
day	day	million	M
degrees Celsius	°C	millirad	mrad
degrees Fahrenheit	°F	millirem	mrem
foot	ft	millisievert	mSv
disintegrations per minute	dpm	minute	min
gallon	gal	nanogram	ng
gallons per minute	gal/min	nephelometric turbidity unit	NTU
gram	g	parts per billion	ppb
gross square feet	gsf	parts per million	ppm
hectare	ha	parts per trillion	ppt
hour	h	picocurie	pCi
inch	in.	pound	lb
joule	J	pound mass	lbm
kilogram	kg	pounds per square inch	psi
kilometer	km	pounds per square inch gage	psig
kilowatt	kW	quart	qt
liter	L	rad	rad
megajoule	MJ	roentgen	R
megawatt	MW	roentgen equivalent man	rem
megawatt-hour	MWh	second	s
meter	m	sievert	Sv
metric ton	MT	standard unit (pH)	SU
microcurie	μCi	ton, short (2,000 lb)	ton
microgram	μg	yard	yd
micrometer	μm	year	year

Quantitative prefixes

tera	$\times 10^{12}$	pico	$\times 10^{-12}$
giga	$\times 10^9$	nano	$\times 10^{-9}$
mega	$\times 10^6$	micro	$\times 10^{-6}$
kilo	$\times 10^3$	milli	$\times 10^{-3}$
hecto	$\times 10^2$	centi	$\times 10^{-2}$
deka	$\times 10^1$	deci	$\times 10^{-1}$

* Due to differing permit reporting requirements and instrument capabilities, various units of measurement are used in this report. The provided list of units of measure and conversion factors is intended to help readers convert numeric values presented here as needed for specific calculations and comparisons.

Unit conversions

Unit	Conversion	Equivalent	Unit	Conversion	Equivalent
Length					
in.	× 2.54	cm	cm	× 0.394	in.
ft	× 0.305	m	m	× 3.28	ft
mile	× 1.61	km	km	× 0.621	mile
Area					
acre	× 0.405	ha	ha	× 2.47	acre
ft ²	× 0.093	m ²	m ²	× 10.764	ft ²
mile ²	× 2.59	km ²	km ²	× 0.386	mile ²
Volume					
ft ³	× 0.028	m ³	m ³	× 35.31	ft ³
qt (US liquid)	× 0.946	L	L	× 1.057	qt (US liquid)
gal	× 3.7854118	L	L	× 0.264172051	gal
Concentration					
ppm	× 1	mg/L	mg/L	× 1	ppm
Weight					
lb	× 0.4536	kg	kg	× 2.205	lb
lbm	× 0.45356	kg	kg	× 2.2046226	lbm
ton, short	× 907.1847	kg	kg	× 0.00110231131	ton, short
Temperature					
°C	°F = (9/5) °C + 32	°F	°F	°C = (5/9) (F – 32)	°C
Activity					
Bq	× 2.7 × 10 ⁻¹¹	Ci	Ci	× 3.7 × 10 ¹⁰	Bq
Bq	× 27	pCi	pCi	× 0.037	Bq
mSv	× 100	mrem	mrem	× 0.01	mSv
Sv	× 100	rem	rem	× 0.01	Sv
nCi	× 1,000	pCi	pCi	× 0.001	nCi
mCi/km ²	× 1	nCi/m ²	nCi/m ²	× 1	mCi/km ²
dpm/L	× 0.45 × 10 ⁹	μCi/cm ³	μCi/cm ³	× 2.22 × 10 ⁹	dpm/L
pCi/L	× 10 ⁻⁹	μCi/mL	μCi/mL	× 10 ⁹	pCi/L
pCi/m ³	× 10 ⁻¹²	μCi/cm ³	μCi/cm ³	× 10 ¹²	pCi/m ³

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Executive Summary

Overview

The US Department of Energy's (DOE's) Oak Ridge Reservation (ORR) is located in Roane and Anderson counties in east Tennessee, about 40 km (25 miles) from Knoxville. ORR is one of DOE's most unique and complex sites. It encompasses three major facilities and thousands of employees that perform every mission in the DOE portfolio—energy research, environmental restoration, national security, nuclear fuel supply, reindustrialization, science education, basic and applied research in areas important to US security, and technology transfer. ORR was established in the early 1940s as part of the Manhattan Project for the purposes of enriching uranium and pioneering methods for producing and separating plutonium. Today, scientists at the Oak Ridge National Laboratory (ORNL), DOE's largest multipurpose national laboratory, conduct world-leading research in advanced materials, alternative fuels, climate change, and supercomputing. The Y-12 National Security Complex (Y-12 Complex) is vital in maintaining the safety, security, and effectiveness of the US nuclear weapons stockpile and reducing the global threat posed by nuclear proliferation and terrorism. The East Tennessee Technology Park (ETTP), a former uranium enrichment complex, is being transitioned to a clean, revitalized industrial park.

DOE has established an Integrated Safety Management System (ISMS) to integrate safety into all aspects of work at its facilities. Safety, as defined in ISMS, encompasses protection of the public, the worker, and the environment and includes all safety, health, and environmental disciplines (i.e., radiation protection, fire protection, nuclear safety, environmental protection, waste management, and environmental management). Several contractors, including UT-Battelle, LLC; Babcock & Wilcox Technical Services Y-12, LLC; URS | CH2M Oak Ridge LLC (UCOR); Wastren Advantage, Inc.; Oak Ridge Associated Universities; and Isotek Systems LLC are responsible for carrying out the various DOE missions at the three major ORR facilities. These contractors manage and implement environmental protection programs through Environmental Management Systems (EMSs) that adhere to International Organization for Standardization (ISO) 14001: 2004, *Environmental Management Systems*, and are integrated with ISMS to provide unified strategies for managing resources. An EMS is a continuous cycle of planning, implementing, evaluating, and improving processes and actions undertaken to achieve environmental missions and goals. Routine, external (independent) audits of contractor implemented EMSs on the reservation are typically conducted annually and, if applicable, a triennial recertification is also performed. Detailed information on contractor EMSs is provided in Chapters 3, 4, and 5.

DOE operations on ORR have the potential to release a variety of constituents into the environment via atmospheric, surface water, and groundwater pathways. Some of the constituents, such as particles from diesel engines, are common at many types of facilities, while others, such as radionuclides, are unique to specialized research and production activities like those on ORR. Any releases are highly regulated and carefully monitored. DOE is committed to enhancing environmental stewardship and managing the impacts its operations may have on the environment and encourages the public to participate in matters related to ORR's environmental impact on the community by soliciting citizens' input on matters of significant public interest and through various communications. DOE also provides public access to information on all its Oak Ridge environmental, safety, and health activities.

The *Oak Ridge Reservation Annual Site Environmental Report* (ASER) is prepared for DOE according to requirements of DOE O 231.1 B, *Environment, Safety and Health Reporting*. ASER includes data on the environmental performance of each of the major DOE ORR contractors and describes significant accomplishments in pollution prevention and sustainability programs that serve to reduce all types of waste and pollutant releases to the environment. An environmental report for ORR has been published annually since the mid-1970s and provides consolidated data on overall reservation performance and status. ASER is a key component of the DOE effort to keep the public informed about environmental conditions across DOE/National Nuclear Security Administration sites. The report is

prepared for readability, and frequent reference to other sections, chapters, and reports is made throughout the report to avoid redundancy.

2012 Impacts

DOE ORR operations in 2012 continued to result in minimal impact to the public and the environment. Discharges to air and water were well below regulatory standards, and potential radiation doses to the public from activities on the reservation were significantly less than the 100 mrem standard established for DOE sites in DOE O 458.1, *Radiation Protection of the Public and the Environment*.

The maximum radiation dose that a hypothetical off-site individual could have received from DOE activities on ORR in 2012 was estimated to be 0.3 mrem from air pathways, 0.2 mrem from water pathways (drinking water, fish consumption, swimming, recreation, and other uses), and 2.0 mrem from consumption of wildlife harvested on ORR. This is less than 3% of the DOE 100 mrem standard for all pathways and is significantly less than the 300 mrem natural annual average radiation dose to people in the United States. The 2012 maximum hypothetical dose is consistent with those calculated for the previous 5 years (2007–2011), which have ranged from 3 to 5 mrem.

Environmental Monitoring

Extensive environmental monitoring is conducted across ORR each year. Site-specific environmental protection programs are carried out at ORNL, the Y-12 Complex, and ETP, and ORR-wide environmental surveillance programs, which include locations and media on and off the reservation, are conducted to enhance and supplement data from site-specific efforts. In 2012, thousands of samples and measurements of air, water, direct radiation, vegetation, fish, and wildlife collected from across the reservation were analyzed for both radioactive and nonradioactive contaminants. Sample media, locations, frequencies, and parameters were selected based on environmental regulations and standards, public and environmental exposure pathways, public concerns, and measurement capabilities. Chapters 2 to 7 of this report provide detailed summaries of the environmental protection and surveillance programs on ORR. These extensive sampling and monitoring efforts demonstrate DOE's commitment to safety; protecting human health; complying with regulations, standards, DOE orders, and "as low as reasonably achievable" principles; reducing the risks associated with past, present, and future operations; and improving cost-effectiveness.

Compliance with Environmental Regulations

Federal, state, and local government agencies, including the US Environmental Protection Agency (EPA) and the State of Tennessee, monitor ORR and enforce compliance with applicable environmental regulations. These agencies issue permits, review compliance reports, participate in joint monitoring programs, inspect facilities and operations, and/or oversee compliance with regulations. Compliance with environmental regulations and DOE orders related to environmental protection provides assurance that on-site processes do not impact the public or the environment adversely.

During 2012, there were only a few instances of noncompliance with regulations, permits, and DOE orders, which were promptly addressed to ensure that no adverse environmental or public health effects resulted. In 2012, there was one notice of violation (NOV), which was associated with the failure to conduct a preoperational evaluation at a permitted stack emission point; an alleged violation for storage of investigative-derived waste for more than 1 year from date of generation; and an NOV for a past-due line tightness test for an underground storage tank. Compliance with National Pollutant Discharge Elimination System permits across ORR was greater than 99% for 2012. Chapter 2 provides a detailed summary of ORR environmental compliance during 2012 and Chapters 3, 4, and 5 discuss each facility's compliance status for the year.

Pollution Prevention and Site Sustainability

Numerous pollution prevention and sustainability programs across ORR embody efforts to achieve enduring sustainability in facilities, operations, and organizational culture. These programs promote

energy and water conservation, building efficiency, sustainable landscaping, green transportation, environmental-preferable purchasing, and waste minimization, which in turn reduce life-cycle costs of programs and projects and reduce risks to the environment. During 2012, ORR contractors were recognized for excellence in pollution prevention and sustainability programs with the following awards.

ETTP Awards

- EPA Federal Electronics Challenge (FEC) Platinum-Level Award for electronic assets-management achievements (DOE EM's first award at this level).
- Six internal (UCOR) awards representing 17.7 million lb of construction debris being diverted from landfills at a cost savings of \$447,000.

Y-12 Complex Awards

- Two DOE Sustainability Awards—one for sustainability outreach and one for excess materials disposition programs.
- Two Tennessee Chamber of Commerce and Industry Awards.
- Three National Nuclear Security Administration (NNSA) Pollution Prevention/Sustainability Best in Class Awards.
- Tennessee Pollution Prevention Partnership Performer Level Status Award.
- FEC Gold-Level Award.

ORNL Awards

- DOE Bronze GreenBuy Award.
- Two DOE Sustainability Awards.
- Three Tennessee Chamber of Commerce and Industry Achievement Certificates for air and water quality excellence.
- *HPCwire* Readers' Choice Award for best application of green computing in high-performance computing.
- Federal Laboratory Consortium 2012 Award for Excellence in Technology Transfer.

Chapters 3, 4, and 5 discuss major accomplishments associated with pollution prevention and sustainability programs at ETTP, the Y-12 Complex, and ORNL.

Cleanup Operations in 2012

ORR has played key roles in US defense and energy research. However, past waste disposal practices and unintentional releases have left land and facilities contaminated. These contaminants include radioactive elements, mercury, asbestos, PCBs, and industrial wastes. The DOE Environmental Management (EM) Program is responsible for cleaning up these sites, and numerous cleanup projects are under way at the reservation's three major facilities.

In 2012, some of the most notable EM accomplishments in Oak Ridge took place at ETTP. Demolition was completed on most of the K-25 building east wing in FY 2012, and preparations began for the K-27 building demolition. Additionally, removal of the K-33 building and slab were completed, and the 13 ha (32-acre) site has been transformed into green space that is available for new development.

One of EM's greatest achievements this year was the formal completion of a memorandum of agreement between federal, state, and local historic preservation groups that will honor the site's early workers and allow the EM program to continue cleanup operations at the site that have been under way for nearly a decade.

At ORNL, EM continues moving forward with the Uranium-233 Disposition Project, and a plan that reduces the schedule by 10 years and the cost by \$500 million has been developed. EM also removed

Tank W-1A, ORNL's largest source of groundwater contamination, and excavated and disposed the 4,000 gal waste storage tank and surrounding contaminated soil. Finally, EM removed four Building 3026 hot cells on the ORNL Central Campus and continues processing transuranic waste at the site.

At the Y-12 Complex, EM is intently focused on mercury remediation. In FY 2012, engineers began projects that focused on mercury abatement through treatability studies, removing mercury tanks, cleaning storm drains, and designing treatment facilities that will reduce mercury migration into the East Fork of the Poplar Creek.