

Tennessee Oversight Agreement Status Report to the Public Fiscal Year 2015



**Tennessee Department of
Environment and Conservation
Division of Remediation
DOE Oversight Office**

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Cover Photo: Surface Water Sampling (TDEC Photo)

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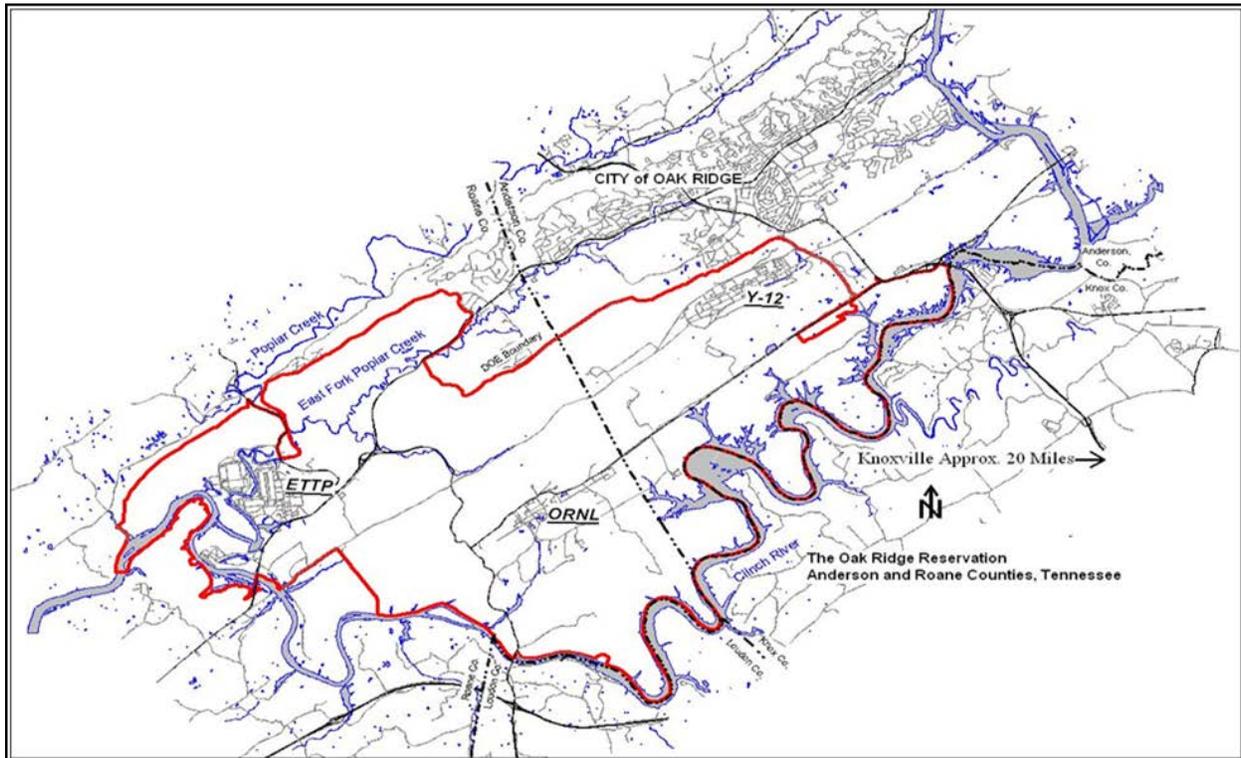
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Acronyms

ASNI	American National Standards Institute
ASTSWMO	Association of State and Territorial Solid Waste Management Officials
BORCE	Black Oak Ridge Conservation Easement
BCV	Bear Creek Valley
BV	Bethel Valley
CBSQG	Consensus Based Sediment Quality Guidelines
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CH	Contact handled
CRM	Clinch River Mile
COC	Contaminant of Concern
CRCPD	Council of Radiation Control Program Directors
D&D	decontamination and decommissioning
DOD	Department of Defense
DOE	U.S. Department of Energy
DOE-EM	U.S. Department of Energy Environmental Management
DOE-O	Department of Energy Oversight Office
DQO	Data Quality Objectives
dw	dry weight
ECA	Energy Communities Alliance
ECOS	Environmental Council of States
EFPC	East Fork Poplar Creek
EMDF	Environmental Management Disposal Facility
EMWMF	Environmental Management Waste Management Facility
EPA	U.S. Environmental Protection Agency
ERSP	Environmental Remediation Sciences Program
ETTP	East Tennessee Technology Park
FFA	Federal Facility Agreement
FFCA	Federal Facility Compliance Act
FY	fiscal year
GW	Groundwater
HAPs	Hazardous Air Pollutants
HFIR	High Flux Isotope Reactor
HPS	Health Physics Society
ITRC	Interstate Technology and Regulatory Council
LEFPC	Lower East Fork Poplar Creek
Linac	Linear Accelerator
LLW	Low Level Waste
LWBR	Lower Watts Bar Reservoir
m ³	cubic meters
mg/L	milligrams per liter
mrem	millirem
MSRE	Molten Salt Reactor
MV	Melton Valley

NA	Not Available
NAAG	National Association of Attorneys General
NEPA	National Environmental Policy Act
NFS	National Fuel Services
NGA	National Governors Association
NNSA	National Nuclear Security Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
NRC	Nuclear Regulatory Commission
NRDA	Natural Resource Damage Act
ORELA	Oak Ridge Electron Linear Accelerator
OREIS	Oak Ridge Environmental Information System
ORNL	Oak Ridge National Laboratory
ORNL ESD	Oak Ridge National Laboratory, Environmental Science Division
ORR	Oak Ridge Reservation
ORRCA	Oak Ridge Reservation Communities Alliance
PCB	polychlorinated biphenol
PCM	Poplar Creek Mile
pCi/g	picocuries per gram
PEC	Probable Effects Concentration
PRG	Preliminary Remediation Goal
RCRA	Resource Conservation and Recovery Act
RH	Remote handled
RMP	Radiation Portal Monitor
RSE	Remedial Site Evaluation
SNS	Spallation Neutron Source
SSAB	Site Specific Advisory Board
STGWG	State and Tribal Government Working Group
STP	Site Treatment Plan
T&E	Threatened and Endangered Species
TDEC	Tennessee Department of Environment and Conservation
TENORM	Technologically Enhanced Naturally Occurring Radioactive Materials
TNWQC	Tennessee Water Quality Criteria
TOA	Tennessee Oversight Agreement
TRU	Transuranic
TWPC	TRU Waste Processing Center
TWRA	Tennessee Wildlife Resources Agency
WAC	Waste Acceptance Criteria
WIPP	Waste Isolation Pilot Plant

Description and Significant Findings



The Oak Ridge Reservation (TDEC map)

The United States Department of Energy Oak Ridge Reservation

The Oak Ridge Reservation (ORR) is located almost entirely within the corporate boundaries of the City of Oak Ridge, Tennessee, and straddles the line between Anderson and Roane counties. To the north and east lie residential areas of the City of Oak Ridge and the Clinch River bounds the ORR on the south and west. Counties adjacent to the Reservation include Knox and Loudon. Meigs and Rhea counties are downstream of Roane County on the Tennessee River. The nearest cities are Oak Ridge, Oliver Springs, Kingston, Lenoir City, Harriman, Farragut, and Clinton. Knoxville is the nearest major metropolitan area and lies approximately 20 miles to the east.

The State of Tennessee, through the Tennessee Department of Environment and Conservation's (TDEC) Division of Remediation, Department of Energy (DOE) Oversight Office, monitors the area to assure there is no threat to public health and the environment from DOE's activities on the ORR. In addition, TDEC oversees DOE's cleanup of legacy waste resulting from decades of nuclear weapons production and other site missions.

Overall Observations

TDEC monitoring and oversight is important for the area because there are sources of pollutants on the ORR that could be released if engineering and/or administrative controls fail. In addition, sources of radiation exposure still exist that must be effectively isolated from the public.

To date, TDEC monitoring results indicate continuing need to assess potential health risk to the public from ORR activities. TDEC is working with DOE, the U.S. Environmental Protection

Agency (EPA) and the Tennessee Department of Health to evaluate data from residential off-site groundwater sampling events. Efforts are continuing to obtain more results.

During demolition of the K-25 building at the East Tennessee Technology Park (ETTP), technetium-99 was released, resulting in stormwater discharges out of the ETTP outfalls and in contaminated sludge at a local sewage treatment plant. DOE took possession of the sludge and disposed it as radioactive waste.

Mercury in water exceeds standards for protection of aquatic life in East Fork Poplar Creek (EFPC) and originates from legacy contaminants deposited in the stream and floodplain as well as from sources at Y-12. Monitoring indicates potential groundwater elevation issues with the Environmental Management Waste Management Facility (EMWMF) that should be considered in the siting, design, and construction of the proposed new Environmental Management Disposal Facility (EMDF).

The majority of reactors at the Oak Ridge National Lab (ORNL) are in surveillance and maintenance mode. Although defueled, certain reactors [e.g., the Oak Ridge Research Reactor and the Molten Salt Reactor Experiment (MSRE)] still contain components of high activity. During 2014-2015, a leak was discovered in the pool of the Oak Ridge Research Reactor. A number of high activity components remained in the pool being shielded by the water. The leak was located and removal and disposition of the high activity items were completed. At the MSRE, the defueled high activity reactor salts remain as well as a number of other reactor components, which have yet to be disposed.

In 2009, the DOE legacy low level waste (LLW) inventory was comprised of 7,702 containers. The LLW Resource Conservation and Recovery Act (RCRA) inventory is reduced to only six containers of resin waste. It is a significant DOE advancement to have reduced this historical inventory. The work is being done under a TDEC-DOE compliance agreement (2009). Operational LLW and RCRA waste must be disposed within one year.

It is necessary and prudent for the state and DOE to continue monitoring efforts in order to detect and evaluate, as early as possible, potential releases and radiation that could affect the public. The state considers these factors in helping manage cleanup with DOE and the U.S. Environmental Protection Agency (EPA).

Programmatic Functions

Tennessee Oversight Agreement

In 1991, the State of Tennessee and DOE signed the Tennessee Oversight Agreement (TOA), and TDEC created the DOE Oversight office to carry out its responsibilities under the agreement. The TOA provides a framework and funding for the state to oversee DOE's impact on the community in four ways: (1) a regulatory program to support state participation in the Federal Facility Agreement (FFA); (2) a non-regulatory program of independent environmental monitoring and oversight; (3) an emergency response program; and (4) an outreach program to increase public awareness and involvement.

Federal Facility Agreement

The state, DOE, and the EPA ratified the Federal Facility Agreement in 1992. It provides a legal framework allowing TDEC to enforce DOE cleanup of contaminants from past ORR activities. The FFA outlines procedures for investigation of problems, scheduling of activities and implementation and monitoring of appropriate responses. Actions taken under the FFA conform to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, the Resource Conservation and Recovery Act of 1976, and other federal and state laws.

The National Environmental Policy Act of 1969 (NEPA) applies to proposed federal actions that could affect the human environment, requiring federal agencies to consider environmental impacts and provide for public review and comment. DOE is required to incorporate NEPA values into CERCLA actions on the ORR.

Key Products and Services

The TOA provides for joint assessment with DOE of comprehensive and integrated monitoring and surveillance of all media (i.e., air, surface water, soil, sediments, groundwater, drinking water, food crops, fish and wildlife, and biological systems), as well as for oversight to facilitate better public understanding of issues involving the ORR. The emissions of pollutants (hazardous, toxic, chemical and radiological) from DOE operations on the ORR and the surrounding environment are monitored and evaluated. Additionally, this agreement allows the TDEC to make comments and recommendations to DOE on its management of radiological materials and waste otherwise exempted from external regulation by the Atomic Energy Act.

TDEC coordinates with DOE and EPA to ensure that clean-up activities on the DOE ORR are implemented as scheduled and in a way that reduces the potential for further environmental impact. Enforcement is used as warranted, including assessment of stipulated penalties. The state can initiate disputes as provided in the FFA, and participates in resolution of disputes by working with DOE and EPA to address concerns as efficiently as possible.

The commissioner of TDEC also serves as the state natural resource trustee for the DOE Oak Ridge National Priority List (NPL) site, investigating natural resource injuries and determining monetary and other damages in accordance with federal and state laws, including CERCLA.

The Federal Facility Compliance Act (FFCA) Site Treatment Plan (STP) mandates that TDEC promptly review each deliverable submitted by DOE for the characterization and treatment of legacy mixed waste. Reviews result in approval, conditional approval, or disapproval of waste characterization packages and treatment schedules.

Workload Management

TDEC regularly reviews program workload of its Oak Ridge Oversight office, including progress in completing annual work plan activities. TDEC resources are distributed based on overall office workload. TDEC management meets routinely to discuss workloads and staffing patterns. Staffing resources are utilized across program boundaries, when necessary, to achieve a goal or complete a work project.

Challenges & Issues

- 1) Steady funding is needed to address continuous and effective cleanup of the DOE ORR.
 - a) DOE funding shortfalls at DOE ORR have required TDEC and EPA to accept an extended cleanup schedule. Continuous physical onsite remedial action is required by CERCLA.
 - b) Assistance is needed from local, state, and federal representatives to assure DOE conducts effective cleanup of the ORR and sufficient funding is available.
 - c) DOE Oak Ridge operations and DOE headquarters request the funds necessary to perform the environmental investigations and cleanup activities on the ORR from Congress as stipulated in the FFA.

- 2) Mercury concentrations in Lower East Fork Poplar Creek (LEFPC) water and fish are impacted by mercury deposits in the stream sediments and floodplain in addition to deposits from sources in the Y-12 plant. A more comprehensive solution is needed beyond mercury treatment at Y-12, requiring quicker remedial actions for the stream than the current schedule.

- 3) Complicated hydrogeology on the ORR creates technical, regulatory, and design challenges that should be considered for the new disposal facility proposed by DOE. Potential groundwater offsite exposure pathways need to be investigated and evaluated. TDEC is working with DOE and EPA to evaluate cost efficient onsite disposal of CERCLA cleanup generated waste in a way that is protective of the environment and human health.

Annual Budget & Program Staffing

DOE Oversight Annual Funding

Funding Source	Funding Amount (\$)
State General Funds	0
DOE Monitoring and Oversight (M&O) Grant	2,021,400
DOE FFA Grant	3,032,000
Environmental Protection Fees	0
STP Review, Cost Recovery*	112,000
Total Budget	5,165,400

*Billed to the Division of Solid Waste Management (DSWM) and reimbursed by DOE.

Program Staffing

Program Area	Positions (filled)
Administration	7 (6)
Monitoring and Oversight	14 (12)
FFA	21 (18)
NRDA staff	1 (1)
Total*	42 (37)

*Includes one NRDA staff person (EPM2) that works for the Office of General Counsel and two seasonal interns.

Tennessee Oversight Agreement Activities

Monitoring on the Oak Ridge Reservation and Environs

Ongoing environmental monitoring and surveillance programs will provide information on the releases and impacts on public health and the environment from past and present ORR actions. The program objective is to provide a comprehensive and integrated monitoring and surveillance program for all media (i.e., air, surface water, soil, sediments, groundwater, drinking water, food crops, fish and wildlife, and biological systems) and the emissions of any material (hazardous, toxic, chemical, radiological) on the ORR and environs.

Biological Sampling

Stations/Oversight	Number	Met Criteria
Benthic Macroinvertebrates ^a	17	10
Aquatic Vegetation ^b	17	13
Goose Roundup ^c	1	1
Acoustic Bat Surveys ^f	81	81
Fungi Contaminants ^a	18	2
T&E Surveys ^a	6	6
Deer GPS Tracking ^{a, e}	8	5
Deer Hunts ^d	3	1
Turkey Hunts ^d	2	2
Fish Tissue Monitoring ^a	10	results pending
Total	163	121

a Met human and ecological protection (non-impaired) criteria

b >2X background as compared to a reference station

c One or more captured geese failed the administrative release limit of 5 pCi/g

d One or more harvested animals failed the administrative release criteria of 20 pCi/g for bone tissue and/or 5 pCi/g for the whole body count

e Successful deployment/recovery of GPS collar and evaluation of tracking and samples. Three deer had elevated Sr-90 in bone samples

f 5% of observations were federally listed endangered species

Benthic Macroinvertebrate Monitoring

A number of ORR stream sites had biological condition ratings that indicate slight to moderate impairment while some impaired stream sites show continuous improvement.

Ongoing CERCLA remedial activities on the ORR continue to have an impact on the aquatic biological communities in East Fork Poplar Creek, Mitchell Branch, the White Oak Creek watershed, and Bear Creek. Future benthic monitoring could capture temporal and spatial changes by documenting changes in the macroinvertebrate communities on the ORR.



Segregating benthic macroinvertebrates after collection (TDEC photos)

Aquatic Vegetation Monitoring

If surface water bodies have been impacted by radioactivity, aquatic organisms in the immediate vicinity may uptake radionuclides and bioaccumulate radiological contaminants. Vegetation is analyzed for gross alpha, gross beta and gamma radionuclides and is compared to the radiological analysis of vegetation taken from background locations. The data collected in 2014 suggest limited areas of elevated radionuclide concentrations in the aquatic vegetation on the ORR. Analysis indicated some areas where mercury was detected in floodplain vegetation due to contamination at the three sites on the Reservation, but these results were well below levels used for mercury advisory levels in fish tissue.





Collecting vegetation for sample analysis (TDEC photos)

Goose Roundup

Each year DOE-ORNL, Tennessee Wildlife Resource Agency (TWRA) and TDEC form field teams to capture geese on the ORR and perform whole body screenings to determine if the birds are radioactively contaminated.

During the June 2015 roundup, 14 geese were captured at Clark Center Park and none exceeded the game release limit. All captured geese were transported and relocated ten miles to the Clinch River at the Gallaher Bridge. Since none of the birds analyzed showed signs of contamination, no additional offsite sampling was conducted by DOE Oversight Office staff.

Bat Population Monitoring

Twelve bat species on the ORR were detected by acoustic bat surveys. Approximately 5% of all bats detected were federally listed as endangered species.



Northern long-eared bat. Photo courtesy of Steven Thomas/National Park Service.

Study of Metals in Fungi from EFPC Floodplain

TDEC collected 19 fungi samples, including edible chanterelles in the EFPC floodplain. The average 2014 mercury content for edible fungi (seven samples) collected from East Fork Poplar Creek floodplain was 0.52 mg/kg dry weight (dw), but was considerably below the single reference sample result of 5.4 mg/kg (dw). However, due to the small sample size for both the floodplain and reference sites, these results are considered inconclusive. Additional fungi sampling will be conducted during 2015 to address the lack of data.

Threatened and Endangered Species Surveys

Protection and stewardship of threatened, endangered, and rare species (i.e., the overall biodiversity) in their natural habitat is a priority to enable their long-term survival as valuable natural resources on the ORR. In support of this mission, TDEC provided monitoring and mapping of the biodiversity of flora and fauna on the Black Oak Ridge Conservation Easement (BORCE). TDEC staff provided field biology assistance and support to the Resource Management Division (Natural Areas Program, Bureau of Parks and Conservation) and the Tennessee Wildlife Resources Agency (TWRA) at ORR natural areas and TWRA-managed sites (i.e., BORCE and the Three Bends Area).

Deer GPS Tracking

The goal of the deer tracking effort is to determine home range and potential movements of the animals outside their home range. Scientific literature provides considerable evidence that wildlife (i.e., carnivores, herbivores, omnivores and piscivores), subsisting in habitats impacted by industrial pollution, ingest environmental contaminants in their respective food chains. Deer tracked by TDEC sometimes traveled miles outside home ranges, but does were more likely to live within a small home range in closer proximity to contaminated areas than bucks.

Deer Hunts

TDEC staff monitored results from three fall 2014 weekend deer hunts. Two hunts conducted in 2014 had deer retained because of radiological contamination above the game release limit. In total, 416 deer were harvested and three deer were retained due to internal radiological contamination. One of the TDEC GPS tracked deer was harvested by a hunter on a TWRA managed hunt and was retained because of Sr-90 contamination.



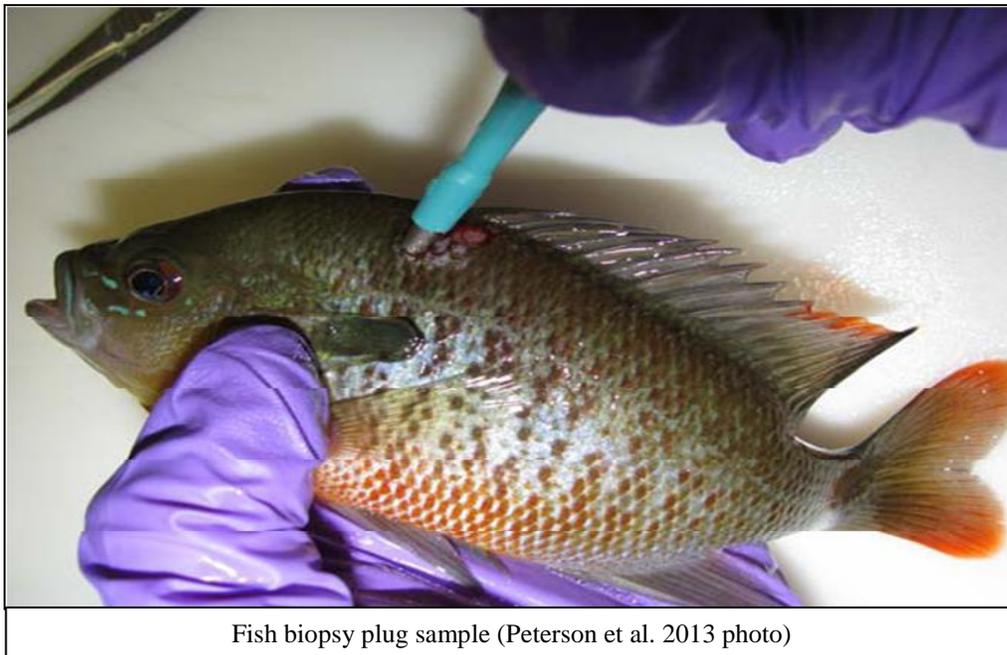
Tracking deer with GPS collars using radio receiver (TDEC photos)

Turkey Hunts

TDEC staff monitored results from the turkey hunts. TWRA conducted two weekend turkey hunts in the spring of 2014. Of the 24 turkeys harvested none were retained for internal radiological contamination. In spring 2015, 45 turkeys were harvested, with none retained.

Fish Tissue Monitoring

Fish samples were collected twice during 2014 in several ORR and control streams by biologists with ORNL's Environmental Sciences Division (ORNL ESD). Fish were captured by electroshocking methods to obtain fish tissue and gut content samples for contaminant analysis (i.e., bioaccumulation study). Previous ORR fish monitoring programs have focused on tissue analysis (i.e., fish fillets), but few studies have investigated tissue and gut content contaminants in individual species. Fish fillets were sampled and evaluated for mercury (Hg) and polychlorinated biphenyls (PCBs) content by the ORNL ESD team.



Drinking Water Sampling

Stations	Number	Met Criteria
ORR Potable ^a	11	11
RadNet, utility drinking water ^a	5	5
Total	16	16

^a Rules for Public Water Systems (TDEC 1200-05-01)

In the Oak Ridge area, EPA's RadNet Drinking Water program provides radiochemical analysis of finished drinking water collected quarterly from five local water systems by TDEC air and water staff. These are sampled to determine if contamination from the ORR is impacting water supplied by public water utilities. Results for the five local water treatment facilities in the program have all been well below applicable drinking water standards for the multiple radionuclides analyzed in this project.



Collecting a RadNet Drinking Water sample from a local utility (TDEC photo)

The ORR potable water program conducts monthly and non-routine inspections of the potable water distribution system. Eleven samples were collected and all samples were compliant with TDEC Rules for Division of Water Supply, Public Water Systems (1200-05-01).

Surface Water

Stations	Number of Samples	Met Criteria ^a
Ambient Surface Water	10	9
Benthic Macroinvertebrates, chemicals	7	6
Rain Event Surface Water	7	6 ^d
EMWMF Surface Water	11	10
Sediment Grab ^{b(c)}	10	10 (2)
Sediment Trap ^{b(c)}	6	6 (3)
Physical Field Parameters	7	7
Total	58	53 (5)

a Tennessee Water Quality Criteria (TWQC) TDEC 1200-04-03
 b DOE Recreation Preliminary Remediation Goals (PRG)
 c Probable Effects concentration for toxicity to aquatic invertebrates
 d Mercury at East Fork Poplar Creek, Station 17

Ambient Surface Water Monitoring

Sampling is conducted at six sites on the Clinch River and four sites on tributaries of the Clinch River (McCoy Branch, Raccoon Creek, Grassy Creek, and Poplar Creek). Samples were analyzed for alpha, beta, and gamma emissions, ammonia, dissolved residue, nitrate (NO³) and nitrite (NO²), nitrogen, suspended residue, total hardness, total Kjeldahl nitrogen, total phosphate, arsenic, cadmium, copper, iron, lead, manganese, mercury, chromium, and zinc. In 2014, there was only one case in which Tennessee Water Quality Criteria (TNWQC) was not

met: dissolved oxygen at Clinch River Mile 78.7. Dissolved oxygen was measured at 4.35 mg/L on 10/23/2014 at Clinch River Mile (CRM) 78.7. This value is below the TNWQC of 6.0 mg/L (fish and aquatic life, trout stream). This sampling location is a short distance from Norris Dam. Water discharged from the dam comes from a great depth and is low in dissolved oxygen.



Monitoring water quality (TDEC photo)

Benthic Macroinvertebrate Surface Water Monitoring

The benthic macroinvertebrate surface water monitoring program is performed in conjunction with the benthic macroinvertebrate survey. Water samples are collected and analyzed to determine the stressors for the macroinvertebrates.

TDEC conducted surface water monitoring at the following ORR watersheds in May 2014: Bear Creek, East Fork Poplar Creek, Mitchell Branch, and White Oak Creek / Melton Branch. Surface water samples were collected from 11 impaired stream sites and associated reference sites. Monitoring was also conducted at Clear Creek near Norris Dam, which serves as a reference site for all the ORR watersheds. Samples were delivered to the State of Tennessee Department of Health laboratory for nutrients, metals, and radiological analyses. The surface water data indicate the surface water quality in the four watersheds were impaired compared to reference streams.

Rain Event Surface Water Monitoring

A rain event is defined as when an increase in surface water measuring at least one inch in a 24-hour period or two inches in a 72-hour period occurs. TDEC conducted surface water sampling following rain events at seven stream sites on the ORR in 2014. Samples were collected during the second, third and fourth quarters following qualifying events. Samples were not collected during the first quarter because conditions did not meet the rain event criteria. Results were consistent with results from a background site following a heavy rain, with the exception of radionuclides at Storm Drain Outfall 490. Storm Drain Outfall 490 is connected to the area around K-25 that was contaminated with Tc-99 during building demolition. However, under DOE Order 5400.5, the stormwater discharge is calculated each calendar year using radiological contaminants of concern (COC) results and not by event.

EMWMF Surface Water Monitoring

During 2014, TDEC monitored groundwater elevations, effluents, and surface water runoff at DOE's EMWMF disposal site. The monitoring has shown the potential for groundwater levels to be above the geologic buffer along the north and northeast portion of the disposal cells. A groundwater incursion near piezometer-01 (PP-01) was identified from the 2011 water level data. This incursion has progressed through time. Near PP-01, the water level has risen throughout the year. Additional monitoring is warranted to see if this incursion is stable or increasing. Additional data loggers were installed at several wells to determine how the groundwater system behaves seasonally in relation to precipitation. Results from radiological water samples confirm that radionuclides are being discharged from operations conducted at EMWMF. However, current discharges are in compliance under TDEC Rule 0400-20-11-.16. In addition, TDEC visits the site at least twice weekly to monitor basic water quality parameters and operations. Algal blooms at the facility sediment basin cause fluctuations in pH that periodically fail ambient water quality criteria.

Ambient Sediment Monitoring

Sediment samples from two Clinch River sites and five Poplar Creek sites were analyzed for metals and radiological parameters. Samples were also collected at Bear Creek, EFPC, and Mitchell Branch. One of the sites, Poplar Creek Mile 7.0 (PCM 7.0 / PCK 11.3), is upstream of the mouth of the EFPC on Poplar Creek and serves as a reference site. Samples were analyzed for aluminum, arsenic, cadmium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, and zinc. In addition, samples were analyzed for gross alpha, gross beta and gamma radionuclides.

The East Fork Poplar Creek km 6.3 sediment mercury value (14 mg/kg) exceeds the Consensus Based Sediment Quality Guidelines (CBSQG) Probable Effects Concentration (PEC) of 1.06 mg/kg (MacDonald et al. 2000). The mercury in EFPC and Poplar Creek sediments results from historical activities at Y-12 and, to a lesser extent, the ETTP. EFPC empties into Poplar Creek at Poplar Creek Mile 5.5; the mouth of Poplar Creek is approximately at Clinch River Mile (CRM) 12. Of the sites sampled, mercury levels were highest at EFPC km 6.3 and generally decreased downstream to Poplar Creek and the Clinch River. All sites sampled on EFPC and Poplar Creek reported mercury values above the PEC.

Historical data obtained from Oak Ridge Environmental Information System (OREIS), along with 2014 TDEC sediment data, indicate that sometime between 2004 and 2008, sediment mercury levels increased at Mitchell Branch km 0.1 (K1700). Similarly, nickel, chromium, boron, and barium concentrations increased during the same time period at this location.

All parameters are well below DOE Preliminary Remediation Goals (PRGs), therefore the radiological sediment data show no cause for human health concerns.

Trapped Sediment Monitoring

All samples from EFPC exceeded the CBSQG PEC (1.06 mg/kg) for mercury. The PECs are CBSQGs that were established as concentrations of individual chemicals above which adverse effects in sediments are expected to frequently occur (Ingersoll et al. 2000). The CBSQGs are considered to be protective of human health and wildlife except where bioaccumulative or

carcinogenic organic chemicals, such as PCBs or methylmercury, are involved. In these cases, other tools such as human health and ecological risk assessments, bioaccumulation-based guidelines, bioaccumulation studies, and tissue residue guidelines should be used in addition to the CBSQGs to assess direct toxicity and food chain effects. The threshold effects concentrations (TECs) are concentrations below which adverse effects are not expected to occur.

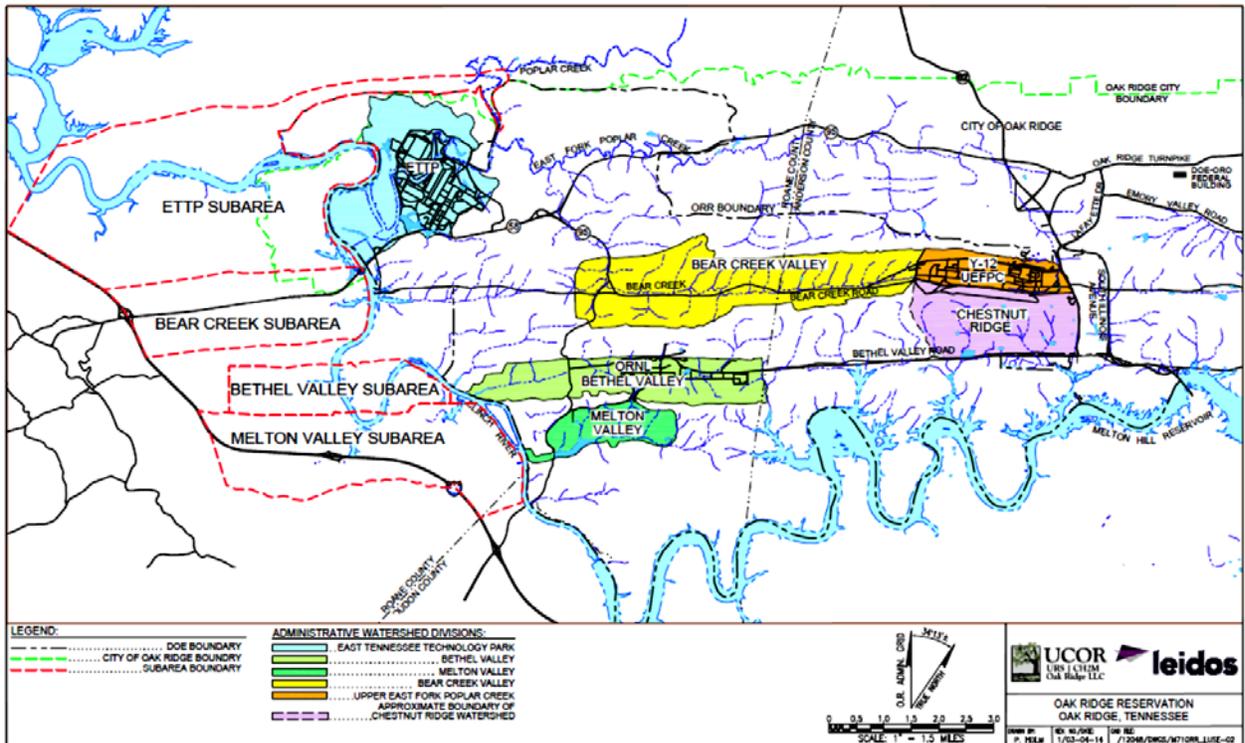


Fluvial sediment trap (TDEC photo)



Fluvial sediment trap deployed (TDEC photo)

Groundwater Sampling



Oak Ridge Reservation Groundwater Strategy map showing four subareas of groundwater study (Map courtesy of DOE)

Following November 2011 Data Quality Objectives (DQO) meetings between DOE, EPA, and TDEC, DOE set up an ORR Groundwater Program.

The Offsite Groundwater Assessment project is the first project being implemented under the ORR Groundwater Program as a tri-party effort. This project is focusing on investigation of groundwater in four subareas to the west and south of the ORR and across the Clinch River in Bethel Valley (BV), Bear Creek Valley (BCV), and Melton Valley (MV); and north and southwest of ETTP.

Stations	Number	Did not met Criteria
Springs	22	Results continue to be evaluated
Residential Well GW	10	3 ^a
EMWWMF Piezometers	8	2 ^b
Total	40	5

a Groundwater (GW) Criteria is EPA maximum contaminant level (MCL)

b 10-foot dry zone buffer maintained



TDEC measures water parameters prior to collecting samples at a residential well (TDEC photo)

Ten residential wells were sampled by TDEC between July 1, 2014 and June 30, 2015. Initial data indicates three of the ten wells sampled exceeded EPA primary drinking water standards for at least one parameter. Additional investigation is ongoing to determine the source.

Under the separate independent monitoring program TDEC personnel collected samples from 22 springs on and off the ORR. Evaluation of this data continues and results will be reported in the next Environmental Monitoring Report. TDEC continues to monitor piezometers at the EMWWMF disposal site.



Collecting water parameters prior to sampling a residential spring offsite (TDEC photo)

Air Quality Sampling

	Stations	Number Met Criteria*
HAPs**	8 (not summed)	NA
RadNet Air	5	5
Fugitive Air	7	7
RadNet Precipitation	3	3
Total***	15	15

*For hazardous air pollutants or radionuclides

**HAPs will be analyzed from fugitive Rad monitors only in the case of an accidental release incident

***HAPs not included

Hazardous Air Pollutants

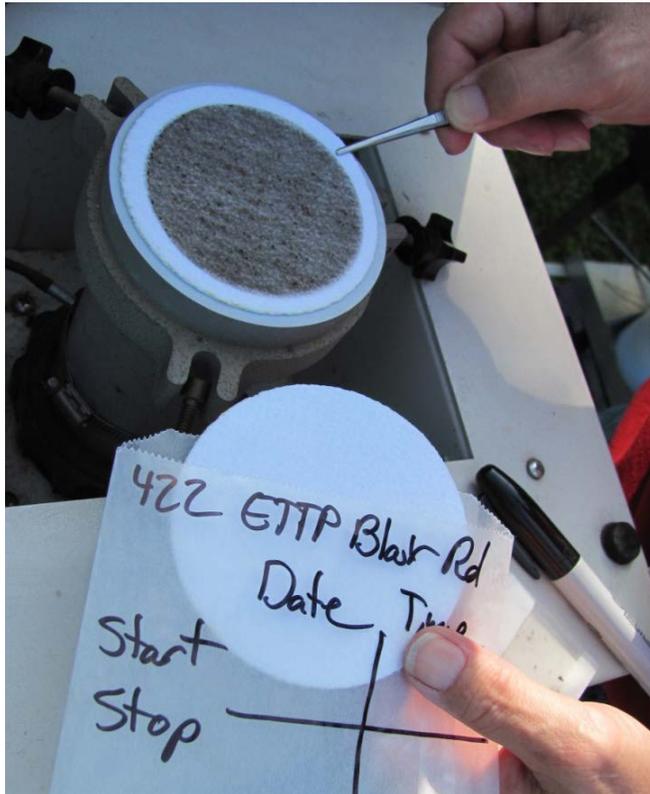
The hazardous air pollutants (HAPs) program was initially developed to provide independent monitoring of hazardous metals in air at the ETTP and to verify monitoring results reported by DOE. Monitoring at ORNL and at the Y-12 National Security Complex was added as an extension of the HAPs monitoring at ETTP. Due to the continuing reduction in permitted sources on the ORR and the completion of the demolition of the K-25 building at ETTP, this project will be discontinued until other major demolition projects on the ORR are initiated or other potential sources of HAPs are identified. No metals analyses were conducted or required during the 2014 calendar year. Samples from radiological monitoring stations can be analyzed for HAPs, if needed.



Air filter used in HAPs monitoring

RadNet Air Monitoring

Particulate air samples are collected twice weekly at five RadNet air monitoring stations on the ORR and analyzed for radioactive contaminants at the EPA's National Air and Radiation Environmental Laboratory in Montgomery, Alabama. In 2014, all five sites sampled met the criteria.



RadNet sample media being collected for shipment to EPA labs (TDEC photos)



Fugitive Air Sampling

In 2014, eight high-volume air samplers were deployed in the program. One of the samplers was stationed to collect background information. The remaining units were positioned to monitor remedial and waste management activities on the ORR. Monitored activities included the decommissioning and demolition of facilities constructed during the World War II Manhattan Era to produce enriched uranium, plutonium, and other radioisotopes used to manufacture the first atomic weapons; remediation of associated waste disposal facilities; and disposal of radioactive waste at the EMWMF. During 2014, the results were very similar to background except for the elevated February to March Tc-99 airborne concentrations observed at the K-25 / K-11 sample location. The yearly average of concentrations for all sites was below the federal standards.



A Fugitive Air Monitoring sampler (right) with the remaining section of the K-25 building in the background. The remainder of the K-25 building has since been removed.

(TDEC photo)

RadNet Precipitation Monitoring

The RadNet precipitation monitoring program analyzes monthly composite precipitation samples from three stations on the ORR. Analysis of the samples measures radiological contaminants that are washed out of the atmosphere and carried to the earth's surface by precipitation. The radiological results seen in the precipitation samples collected during 2014 at the RadNet sites on the ORR were all well below the EPA drinking water limits and thus can be considered protective of human health and the environment. It should be noted that the EPA drinking water limits pertain to drinking water, not precipitation, and are only used here as a conservative reference value.



Collection of a precipitation sample in Melton Valley at ORNL (TDEC photo)

Radiological Monitoring

Stations/events	Number	Met Criteria*
Real Time Gamma	5	5
Haul Road Survey	52	52
Environmental Dosimetry	137	119**
Transportation	NA	NA
Facility Surveys	0	NA
Surplus Sales	6	6
Total	200	182

* Contamination not present and exposure pathways below criteria.

** Criteria is 100 millirem/year (allowable dose to members of the public). None of the areas that exceeded criteria were accessible to the public.

Real Time Gamma

Monitoring of gamma radiation exposure rates occurred at five ORR locations and one offsite control station in 2014. These units measure and record gamma radiation levels at predetermined intervals over extended time periods, providing an exposure rate profile that can be correlated with activities and/or changing conditions. The use of gamma radiation exposure rate monitors equipped with microprocessor-controlled data-loggers has proven to be a flexible and reliable method for monitoring gamma radiation on the reservation.

- EMWFM gamma levels were consistent with background measurements.
- ORNL Central Campus deconstruction and decommissioning (D&D) (3000 Area) gamma levels were within anticipated levels.
- Measurements taken at the Molten-Salt Reactor Experiment (MSRE) did not indicate there were any releases during the period. Exposure levels measured during the year have been attributed to a contaminated salt probe stored near the monitor.

- Gamma levels at Spallation Neutron Source (SNS) were within expected levels and consistent with measurement collected in previous years.

All results were below limits specified by state and Nuclear Regulatory Commission (NRC) regulations, which require their licensees to conduct operations in such a manner that the external dose in any unrestricted area does not exceed 2.0 millirem (2,000 μ rem) in any one-hour period.



Gamma tracer monitoring the Molten Salt Reactor Experiment (MSRE) at ORNL (TDEC photo)

Haul Road Radiological Surveys

The Haul Road was constructed for, and is dedicated to, trucks transporting CERCLA radioactive and hazardous waste from remedial activities on the ORR to the EMWMF in Bear Creek Valley for disposal. To account for waste that may have blown or dropped from the trucks in transit, personnel from TDEC perform walk over surveys of different segments of the nine-mile road and associated access roads weekly. Anomalous items found are surveyed for radiological contamination, documented, and their description and location submitted to DOE for disposition. During 2014, twenty-two items that had potentially fallen from trucks transporting waste to the EMWMF were documented. None of the items exhibited radioactivity in excess of free release limits and all were removed expeditiously after being reported to the DOE.



Conducting a radiological survey of the EMWMF haul road.
(TDEC photo)

Ambient Gamma Radiation Monitoring using Environmental Dosimetry

Environmental dosimeters are placed at locations on and near the reservation. Results from the dosimeters are compared to background values and the state 100 millirem dose limit for members of the public.

The radiation doses measured in the Environmental Dosimetry program in 2014 decreased or remained statistically the same as in 2013. A total of 18 locations exceeded the 100 millirem screening level over the year: 17 at ORNL and one at the Spallation Neutron Source (SNS) located at ORNL. The majority of these sites are access-restricted areas of the reservation or legacy facilities undergoing or scheduled for remediation. Future measured doses are expected to lower as the clean-up progresses.



Environmental Dosimeter used to monitor quarterly dose at each location (TDEC photo)

Facility Survey and Infrastructure Reduction Program

Evaluation and characterization of the facilities intended to be demolished is being performed under the FFA Program. TDEC supports the work effort in evaluating FFA remedial / removal work documentation including site visits to the demolition sites and CERCLA generated waste audits.

Survey of Surplus Materials Released to the Public

The DOE offers a wide range of surplus items for auction/sale to the general public. TDEC conducts independent radiological monitoring of these surplus materials prior to each auction/sale. During 2014, a total of six inspection visits were conducted at the ORR facilities. Two visits were made for ORNL sales and four visits were made for Y-12 sales. No sales were conducted at the East Tennessee Technology Park (ETTP) facility. Only one item of potential concern was found at the Y-12 auction. During 2014, hundreds of surplus materials items were sold through ORNL and Y-12 surplus sales organizations in separate sales events.



Scanning a surplus desk (TDEC photo)

EMWMF Radiation Portal Monitor

Only radioactive waste with concentrations below limits imposed by waste acceptance criteria (WAC) agreed upon by FFA parties are authorized for disposal in the EMWMF. TDEC has a Radiation Portal Monitor (RPM) at the check-in station for trucks transporting waste into the facility. As the waste passes through the portal, gamma radiation levels are measured and recorded. The portal monitor results are viewable over the Internet in real time and data logs are downloaded remotely. When anomalous measurements are noted, EMWMF personnel are notified, the source and nature of the waste determined, and readily available information on the waste reviewed. If the preliminary review fails to account for the elevated results, the information is submitted to TDEC's waste audit team for further investigation and disposition. TDEC monitored 6404 truckloads of waste in 2014. The only anomalies observed in the results were due to a nuclear density gauge, which contains sealed cesium-137 and americium-241 sources. The density gauge is not a waste, but a tool transported into the EMWMF disposal cells as needed and otherwise stored outside the facility.

ORNL Neutron Sciences, Spallation Neutron Source, and High Flux Isotope Reactor

Neutrons are produced for experimental purposes at ORNL to perform materials research and sample analysis. The Spallation Neutron Source (SNS) uses a linear accelerator (linac) to produce neutrons by mercury spallation. The High Flux Isotope Reactor (HFIR) uses a nuclear reactor to produce neutrons by uranium fission.

The newest of ORNL's neutron sources is SNS, a linear hydrogen ion accelerator with a liquid mercury target fully commissioned in 2006. Construction materials in the linac, proton accumulator ring, beam dumps, and target become activated by protons or neutrons impacting on SNS confinement structures. Escaping protons can, to a lesser degree, activate soil berms that are placed on top of the linac and accumulator ring for protective shielding. Air from around target components is filtered and released through a stack. TDEC monitors the ambient environment on the linac berms with environmental dosimeters and the stack with a gamma radiation logger. The berm and stack measurements indicate levels that are compliant with DOE orders and state regulations for radiation dose to the public. The stack-mounted gamma logger is able to track the operation of SNS closely when compared to the operational schedule and power levels. Long term monitoring will capture activation of berm soils and the potential for migration of activation products into groundwater. Specialized nuclear instruments to monitor muons (unstable nuclear particles) are being considered by the state. Relativistic velocities at high operating power levels may cause muons to escape shielding and be detectable in the ambient outdoor environment. SNS is located in an interior area of the ORR.

HFIR, a uranium fueled research reactor was first operated in 1965 and has been used for a variety of research purposes for almost 50 years. The fundamental design and vessel is vintage, but associated experimental facilities and control features are modernized. TDEC environmental monitoring for HFIR is incorporated into a number of projects. Ambient air and precipitation monitoring is done at an adjacent site. Environmental dosimeters and gamma loggers positioned on the ORR do not indicate a public dose above criteria from HFIR. HFIR is located in the interior of the ORR and does not impact the public during normal operations. During 2014 and 2015, TDEC documented elevated levels of radionuclides in vegetation samples around a National Pollutant Discharge Elimination System (NPDES) outfall at HFIR. The amounts are a concern for uptake into wildlife, but not a direct human health risk. The investigation is proceeding to determine whether elevated levels are the result of direct discharge or other sources co-located with the discharge pipe.

Molten Salt Reactor Experiment Audit and Old Oak Ridge Research Reactor Oversight

TDEC conducted an oversight level tour and met with the Molten Salt Reactor Experiment (MSRE) staff to assure that day to day operations and the overall stability of the facility were environmentally compliant. TDEC found no issues and noted that a previous observation had been corrected. The old degraded sump pumps that assure the facility remains dry were replaced with new ones.

The historical Oak Ridge Research Reactor (X3042) suffered a slow drip leak from its reactor pool during 2014-2015. This reactor has the core removed and the pool only has legacy waste and some objects that cause the pool water to remain contaminated. TDEC closely followed DOE's efforts to correct the problem and provided feedback and response to public information

inquiries. This incident demonstrated that old nuclear facilities at ORNL continue to deteriorate and can cause issues without preventive maintenance.

Emergency / Environmental Response

Events	Number	Met Criteria
Exercises, Graded	1	1
General Emergencies	0	n/a
Site Area Emergency	0	n/a
Exercises, not graded	2	2
Total	3	3



Inside the Emergency Management Control Center (EMCC) at TEMA East (TDEC photo)

All emergency / environmental response exercises were performed meeting core objectives established for the exercise.

National Environmental Policy Act Review

The National Environmental Policy Act (NEPA) requires federal agencies to ensure that citizen participation and environmental impacts are properly factored into the agency’s decision-making.

In 2014, TDEC commented on the Draft Supplemental Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor.

NEPA requires decisions to be made through a sustained process of inquiry, analysis, and learning. It ensures that federal agencies provide the public an opportunity to learn about and

comment on significant proposals. When followed as required, it should ensure adequate planning and prevents costly mistakes.

NEPA documents related to federal decisions affecting the ORR are available for the public to review at DOE's Information Center.

Low Level Radioactive Waste

Legacy Low Level Radioactive Waste

The Compliance Agreement between TDEC and DOE, signed on August 13, 2009, addresses DOE-EM's legacy inventory of industrial and low level waste stored at ETTP. This inventory potentially contained RCRA constituents. The implementation of the agreement, which is almost complete, resulted in sorting, segregation, processing, characterization and disposition of 7,702 waste containers. Phase II of the Compliance Agreement is being implemented as funding and capacities become available. As of the end of FY 2015, this inventory was down to just six containers of resin low level waste. This represents a decrease of 114 containers / items since the end of fiscal year (FY) 2014.

At Y-12, a separate legacy inventory consisting of low level waste and potential RCRA components was stored in containers that formed a security wall around building 9720-5. This inventory has now been removed, processed and shipped for disposal. As of the end of FY 2015, Y-12 did not have any legacy low level waste inventory.

Newly Generated Low Level Radioactive Waste

The "newly generated" category contains low level waste generated since October 1, 2000. As of the end of FY 2015, DOE-EM's inventory of this category of waste stood at 24 cubic meters (m³). This represents a decrease of 36 m³ from the previous year.

The National Nuclear Security Administration (NNSA) has established a track record of routinely disposing of the newly generated LLW within the 365-day DOE required timeframe. At the end of FY 2015, this inventory was 470 containers (in storage for less than 365 days).

As of the end of FY 2015, ORNL had generated 221 m³ of low-level waste since October 1, 2014. Of this amount, 64 m³ had been shipped for disposal. The remaining 157 m³ had been in compliant storage awaiting shipment for disposal.



Waste awaiting shipment from ETTP (DOE photo)

Federal Facility Compliance Act, Site Treatment Plan

Transuranic Waste Processing



ORR's transuranic (TRU) waste inventory is being processed onsite at the Transuranic Waste Processing Facility (TWPC). (DOE photo)

The contractor is tasked with:

- safely and compliantly managing and operating TWPC in support of processing legacy TRU waste
- performing surveillance and maintenance activities
- providing support to the Central Characterization Project (CCP) for final certification and disposition of TRU soil and debris waste at the Waste Isolation Pilot Plant (WIPP) in New Mexico
- processing other Contact Handled/Remote Handled (CH/RH) TRU waste originating from the Oak Ridge National Laboratory
- processing Nuclear Fuel Services, Inc. (NFS) soils from Erwin, Tennessee

As of the end of FY 2015, DOE had met all TRU waste-related milestones of the Site Treatment Plan for the entire calendar year. They are as follows:

- award a contract for the design of the TRU Sludge Processing Facility (March 30, 2015)
- complete physical preparation of the remaining inventory of 274 m³ of CH-TRU debris, enabling the final characterization of waste for disposal (January 21, 2015)
- accomplish final WIPP certification of 50% of the remaining RH-TRU waste inventory as shown in Table 4.1 of the STP (April 2, 2015)
- accomplish final WIPP certification of 50% of the remaining CH-TRU waste inventory as shown in Table 4.1 of the STP (April 2, 2015)

During the year, TDEC actively performed site visits, reviewed multiple documents, and participated in 32 meetings at the TRU Waste Processing Center (TWPC).

Waste shipments to WIPP remain suspended. WIPP suspended operations on February 5, 2014, following a fire involving an underground vehicle. Nine days later, on February 14, 2014, a radiological event occurred underground, contaminating a portion of the mine primarily along the ventilation path from the location of the incident, releasing a small amount of contamination

into the environment. The schedule to commence waste emplacement operations is toward the end of calendar year 2016, with the intent to incrementally increase waste emplacement operations over time.

Non-CERCLA Decontamination and Decommissioning

Y-12 National Security Complex

Modernization at Y-12 is a high priority. However, due to a federal sequestration, followed by non-availability of funds, Building 9107 was the only non-CERCLA D&D activity preformed during FY 2015.

Oak Ridge National Laboratory

During FY 2015, the following activities took place at ORNL under the non-CERCLA D&D program:

- demolition of personal property trailer 9983-FY located at the Y-12 site
- waste cleanout and dismantlement of the Environmental Remediation Sciences Program (ERSP) Field Research Center at Y-12 was initiated
- structure 3619 was removed and disposed
- supported the development of scrap metal procurement package for ORNL facilities located at Y-12 (Buildings 9201-2 and 9201-4) to support ultimate goal of enabling utility isolation
- Building 6010 Oak Ridge Electron Linear Accelerator (ORELA) equipment was disassembled, removed and disposed

Oak Ridge Reservation Landfills

TDEC oversees DOE’s solid waste disposal activities to ensure that DOE adheres to provisions of RCRA and to the rules and regulations governing solid waste disposal in Tennessee. DOE disposes of ORR’s solid waste in landfills located at the Y-12 National Security Complex. All waste going to these landfills must be non-radioactive and non-hazardous. DOE must use approved procedures when receiving, compacting, and covering waste.

TDEC performs a monthly audit of DOE’s landfills on the ORR. It also reviews DOE practices to ensure that radioactive waste is not disposed in these landfills. This includes review of the DOE special waste requests and regular visits to the landfills.

During FY 2015, the landfills were found to be operating in full compliance with all regulations. For this reporting period, the summary of the approximate waste deposition in the three ORR landfills and the remaining capacities is as follows.

Landfill	Volume (Cubic Yards)	Remaining Capacity (Years)
Industrial Landfill IV	<1,000	127
Sanitary/Industrial Landfill V	472,941	35
Construction/Demolition Landfill VII	40,820	21

Federal Facility Agreement for the ORR (Negotiated Activities)

Y-12 National Security Complex

Upper East Fork Poplar Creek

- Planning efforts continue on the Outfall 200 mercury treatment facility

Bear Creek Valley

- No activities have occurred here since the completion of Phase I of the Bear Creek Valley Interim Record of Decision
- Planning continues on the EMDF

ORNL

Bethel Valley

- Disposal of surveillance and maintenance waste continues
- Planning removal of most highly radioactive items from pool at the Oak Ridge Research Reactor "Old Research Reactor" (B-3042)

Melton Valley

- Monitoring of offsite monitoring wells continued
- Continued surveillance and maintenance of the Molten Salt Reactor Experiment

ETTP

Zone 1

- Work continues toward developing a final ROD for this area

Zone 2

- Characterization work continues for some exposure units. Covenant Deferral Requests are being processed
- D&D of the K-25 building was completed
- D&D of the K-31 building continues

Offsite (Outside the DOR-ORR Boundary)

Lower Watts Bar Reservoir (LWBR)

- Long-term monitoring continues

Clinch River/Poplar Creek

- Long-term monitoring continues

Lower East Fork Poplar Creek (LEFPC) floodplain

- This action was completed in 2000. Factors affecting the risk to ecological receptors from floodplain soils are being reevaluated. The FFA parties approved the Remedial Site Evaluation (RSE) for Offsite Groundwater Assessment. The first round of sampling was completed by April 2015.

Natural Resource Damages

Lower Watts Bar Reservoir

- The Trustee Council finalized all matters pertaining to the settlement of damages. An Administrative Order of Consent was signed by DOE and

the state to finalize this agreement. Construction of a recreational fishing project at Whites Creek closed out this project.

ORR

- The Trustee Council is pursuing a final settlement for damages on the entire ORR

Local Outreach

TDEC is supportive of efforts to inform the community on environmental issues associated with the ORR. TDEC provides grant funding for the ORR Communities Alliance (ORRCA) and a TDEC representative attends ORRCA meetings. TDEC has an *ex officio* membership on DOE's Oak Ridge Site Specific Advisory Board (SSAB) and has a representative present at its monthly meetings. Upon request, TDEC may provide speakers for schools and / or citizen groups.

TDEC presents information on ORR environmental issues and disseminates information and materials related to general pollution prevention, home radon monitoring, recycling, and similar activities.

TDEC works specifically with the following local and regional organizations on issues associated with the ORR:

- Watts Bar Interagency Working Group
- ORRCA
- Oak Ridge SSAB

National Outreach and Cooperative Interstate Activities



TDEC participates in activities and meetings as a member or affiliate of the following organizations.



Interstate Technology and Regulatory Council

The Interstate Technology and Regulatory Council (ITRC) was formed in 1995 as a multi-state coalition working to achieve regulatory acceptance of innovative environmental technologies. The state-led council became affiliated with the Environmental Council of States (ECOS) in 1999 and has been working closely with that organization to promote innovative technologies that would lead to more cost-effective and efficient site cleanups. ITRC offers free Internet training and documents provided by the different teams. ITRC has trained over 100,000 participants since 1997. TDEC has a representative on the Institutional Controls Team and the Complex Sites Team. Another TDEC representative is the point of contact for the State of Tennessee and has been successful in promoting ITRC products throughout the state.” The ITRC Web site is www.itrcweb.org.



National Governors Association Federal Facilities Task Force

The National Governors Association (NGA) task force is composed of governor-appointed policy and technical representatives from states hosting major DOE facilities. NGA task force members work collaboratively with DOE officials on technical, economic, and political challenges, including budget and regulatory issues, waste treatment and disposal options, and equitable decisions on waste management.

STGWG

State and Tribal Government Working Group

The State and Tribal Government Working Group (STGWG) is a forum in which all states and tribes affected by DOE sites can interact directly with DOE. The working group helps ensure that DOE facilities are operated and cleaned up in compliance with all applicable federal and state laws and regulations, and tribal rights. These rights include those retained by treaty and conferred by statute and the trust responsibility. The working group more specifically focuses on long-term stewardship and institutional controls, natural resource damage assessment and restoration, and tribal issues.



Association of State and Territorial Solid Waste Management Officials

The Association of State and Territorial Solid Waste Management Officials (ASTSWMO) radiation task force tracks radiation-related issues that could affect states. The group emphasizes federal facility issues and has cooperative projects with the EPA, DOE, Department of Defense (DOD), Council of Radiation Control Program Directors (CRCPD), the Health Physics Society (HPS), and the American National Standards Institute (ANSI).

A TDEC staff member currently serves as chair of the Materials Management Radiation Task Force. The task force is currently developing a national position paper designed to raise awareness of Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM) and issues related to handling and disposal of these materials.

The Radiation Task Force chair represented the national Task Force, EPA Region 4, and TDEC during a plenary session presentation on TENORM on August 12 of 2015. Approximately 170 representatives of state, federal, and private organizations attended the session.

TDEC also has a member on the Sediment Focus Group.

Intergovernmental Meeting with DOE

The Energy Communities Alliance (ECA), ECOS, National Association of Attorneys General (NAAG), NGA, and STGWG meet annually with DOE. The meeting provides an opportunity for senior DOE officials to talk with these groups collectively. It also allows the groups to coordinate on issues involving the operation and cleanup of the DOE complex.

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