2. EFFLUENT MONITORING

2.1 SURFACE WATER

2.1.1 Introduction

Environmental monitoring, as defined by DOE Order 5400.1, consists of two components: effluent monitoring and environmental surveillance. Surface waters leaving DOE sites on ORR are a combination of effluent water from facilities and naturally occurring surface water that in some locations may be affected to some extent by complex operations. Monitoring is intended to maintain environmental compliance (EC) and to assess the impact of facility operations on the quality of the environment.

2.1.1.1 Scope

Effluent surface water monitoring is conducted to demonstrate compliance with federal and state regulations, DOE orders, and specific permits. At the three ORR facilities (ORNL, ETTP, and Y-12), effluent monitoring is mandated by NPDES permits. Typically, NPDES permits define discharge limits for specific chemicals that the permittee can discharge to surface waters. The permits set no limits for radiological species but do require monitoring of liquid effluents for radioactivity, which is also required by DOE Orders 5400.1 and 5400.5. Radioactivity information about liquid effluents and surface waters is provided to the state of Tennessee in accordance with an agreement between the state and DOE. The state, in issuing NPDES permits to the ORR facilities, has required each complex to go beyond "end of the pipe" monitoring and incorporate radiological and biological monitoring programs.

Biological monitoring (i.e., characterization and monitoring studies) is described in the ORNL, ETTP, and Y-12 BMAPs. The BMAPs were developed to meet several objectives. First, studies were designed to provide sufficient data to demonstrate that the effluent limitations established in each NPDES permit protect and maintain the uses for which the receiving streams were classified. Second, the BMAP provides ecological characterizations of the receiving streams that can be used to (1) document ecological impacts of past and current operations, (2) identify contaminant sources that adversely affect stream biota, and (3) provide baseline data that can be used to determine the effectiveness of remedial actions. A final objective is to document the effects on stream biota resulting from implementation of various pollution abatement projects and planned remedial actions associated with environmental restoration and waste management (WM) activities.

2.1.1.2 Objectives

Effluent monitoring program objectives include

- verifying compliance with applicable federal, state, and local effluent regulations and DOE orders;

- evaluating the effectiveness of effluent treatment and control;
- identifying potential environmental problems and evaluating the need for remedial actions or mitigation measures;
- supporting permit revision and/or reissuance; and
- detecting, characterizing, and reporting unplanned releases.

In addition, the *Regulatory Guide* requires that this EMP document

- effluent monitoring collection locations used for providing quantitative effluent release data for each outfall,
- procedures and equipment used to perform collection and measurement,
- frequency and analyses required for each collection (continuous monitoring and/or sampling) location,
- minimum detection level and accuracy,
- QA components, and
- effluent outfall alarm settings and bases.

2.1.1.3 Regulations

The primary statute governing the monitoring of effluent discharges to surface water is the Clean Water Act (CWA), which requires the issuance of NPDES permits. The state of Tennessee has been granted primacy by EPA to issue and enforce NPDES permits. In addition, DOE Orders 5400.1, 5400.5, and the *Regulatory Guide* provide general and detailed guidance regarding the establishment of effluent monitoring programs for both chemical and radiological parameters.

2.1.2 ETTP

2.1.2.1 Rationale and design criteria

Evaluation of effluents

Processes at ETTP have been evaluated for both chemical and radiological parameters to assess likely discharge parameters to the effluent streams. Summaries of those evaluations are presented in *Environmental Assessment of the Oak Ridge Gaseous Diffusion Plant Site* (DOE/EA-0106, 1979), and, more recently, in *Environmental Survey Preliminary Report, Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tennessee* (DOE/EH/OEV-26-P, 1989). Monitoring requirements as specified in the site NPDES permit reflect those evaluations.

NPDES permit requirements

The NPDES permit (TN0002950) at ETTP went into effect October 1, 1992, and a major revision was issued effective June 1, 1995. The revision included removal of inactive outfalls, addition of effluent limits for new treatment technologies at the Central Neutralization Facility (CNF), addition of new storm drains, and clarification of various requirements. In accordance with the NPDES permit, ETTP is authorized to discharge process wastewaters, cooling waters,

storm waters, steam condensate, and groundwater to the Clinch River, Poplar Creek, and Mitchell Branch. The permit currently includes two facility outfalls and 136 storm drain outfalls.

The current NPDES permit (TN0002950) at ETTP expired on September 29, 1997. An application for renewal of this permit was submitted to the Tennessee Department of Environment and Conservation (TDEC) in March 1997. To facilitate the transfer of ownership and operations of ETTP facilities to other parties, it was determined that separate NPDES permits would be required for each of the ETTP treatment facilities. In addition, it was determined that a separate NPDES permit for the storm water drainage system would be necessary. ETTP will continue to operate under NPDES permit TN0002950 until it is completely replaced by the four new permits. The first new permit (TN0074233) has been issued, effective March 1, 2000, for the wastewater discharges from the ETTP Water Treatment Plant (formerly Outfalls 009 and 013).

Development and implementation of a BMAP and toxicity testing on effluents from the ETTP Sewage Treatment Plant (STP) are requirements of the NPDES permit. The purposes of the BMAP are to determine the impacts of ETTP discharges on receiving streams (primarily Mitchell Branch but also including the K-1007-P1 and K-901-A ponds), determine whether the effluent limitations established in the ETTP NPDES permit protect the designated uses of the receiving streams, and document the effectiveness of remedial actions. Quarterly reports on the results of the BMAP are prepared, and recommendations for abatement of detrimental effects are identified. Toxicity test reports are prepared and submitted to TDEC for the semiannual toxicity testing at the STP.

Development and implementation of a Storm Water Pollution Prevention (SWPP) program is another critical component of the NPDES permit. This requirement is met annually through a combination of characterization sampling of the site storm water outfalls and semiannual inspections of the site to search for potential storm water runoff pollutant concerns. The results of the storm water characterization sampling are compared to established screening criteria to determine if elevated concentrations are being discharged that would warrant additional investigations. For radiological parameters, the screening criterion used is a predetermined percentage of the DOE Order 5400.5 derived concentration guidelines (DCGs), a measurement that exceeds 15 pCi/L gross alpha or a measurement that exceeds 50 pCi/L gross beta. The results of the annual sampling effort for both radiological and chemical constituents are reported in the annual SWPP report and ASER. Additionally, the sampling results are factored into the annual dose assessment that is also presented in ASER.

NPDES performance standards

Flow measurement. Appropriate flow measurement devices or processes consistent with accepted scientific practices are used to measure flow at NPDES locations.

When nonstandard methods are used, their ability to meet the ±10% flow requirement must be documented against an accepted method and be accepted in writing by regulatory agencies having oversight responsibilities for NPDES monitoring.

Automatic samplers. Automatic samplers must meet two general criteria to be acceptable for NPDES use. They must be capable of taking the samples required by the NPDES permit during dry weather and wet weather conditions. They must also meet the regulatory requirements as specified in guidance documents and the requirements of analytical procedures in use. Operating manual instructions and requirements are incorporated into the field procedures for NPDES sampling.

Effluent samples for radiological analyses are collected with the same sampling equipment described for the NPDES program.

Continuous monitors. During sampling events, the grab sample pH is compared with the continuous monitor readout to ensure proper operation of the monitor.

There are no continuous monitors for radiological parameters.

Design criteria

Automatic samplers. Automatic samplers have been installed following manufacturer guidelines for proper operation. All sampler parts that contact the water sample (e.g., sample lines, sample bottles) are compatible with the expected composition of the sample.

Continuous monitors. Continuous pH monitors are installed and maintained in accordance with manufacturer guidelines to ensure proper operation.

Alarm levels

NPDES. Alarm levels for the continuous pH monitors are set to activate at internal control limits. An alarm is activated in the office of the Park Shift Superintendent, which is occupied 24 hours a day, whenever pH values outside the control limits are measured. The control limits are conservatively set to enable personnel to determine the cause for the alarm activation and to shut down processes if necessary.

Radiological. No alarms are associated with radiological monitoring at effluent sampling locations.

2.1.2.2 Extent and frequency of monitoring

Locations

Treatment facility and primary storm water outfalls covered by the NPDES permits at ETTP are shown in Fig. 2.1.

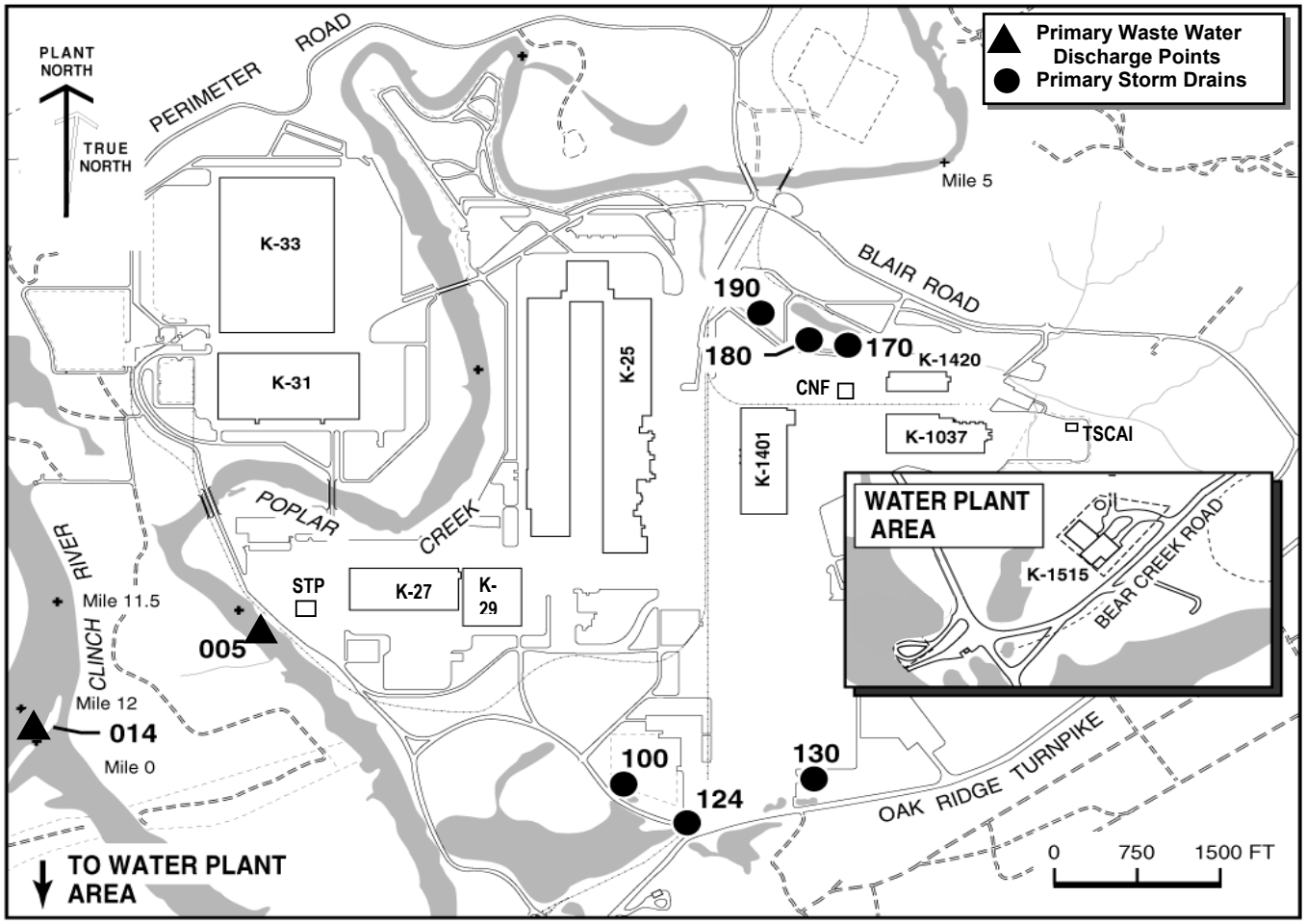

Fig. 2.1. East Tennessee Technology Park National Pollutant Discharge Elimination System major outfalls.

Frequency

Sampling frequencies for each NPDES sampling point are documented in the permits and in the NPDES sampling and analysis plans. Additional sampling frequencies are documented in the SWPP and BMAP sampling and analysis plans.

Parameters

The parameters measured at each outfall and other sampling locations are detailed in the permits and in the NPDES, SWPP, and BMAP sampling and analysis plans.

Associated radiological monitoring

The effluent discharge point 014 is sampled for radionuclides; this discharge point is K-1407-J's treated effluent from CNF and the Toxic Substances Control Act (TSCA) incinerator facility.

Tritium and carbon-14 were added in 1998 to the isotopic analyses due to their presence in waste feeds at the TSCA incinerator. Samples are analyzed monthly for the following parameters.

East Tennessee Technology Park K-1407-J treated effluent radiological parameters		
^{237}Np	Gross alpha	^{3}H
^{137}Cs	Gross beta	
^{238}Pu	^{99}Tc	
^{239}Pu	^{14}C	

2.1.2.3 Quality Assurance/Quality Control requirements

Details of relevant source documents that apply to the NPDES QAP are described in Sect. 9 of this EMP.

Field sampling and monitoring

The NPDES sampling and analysis plan is developed by the EC subcontractor and specifies analytical and sampling requirements as defined in NPDES Permit TN0002950. Required parameters, frequencies, sample locations, analytical methods, and reporting requirements are included in the plan.

Permanent automated composite samplers, flow-measuring equipment, temperature-measuring equipment, and continuous pH monitoring instrumentation are located at some NPDES outfalls to conduct the required monitoring. Portable composite samplers and flowmeters are placed at storm water outfalls as required to conduct the monitoring specified in Part I of the permit and by the SWPP sampling and analysis plan. The equipment and associated sampling stations are owned by the CWA/NPDES program. Maintenance and calibration of the equipment is conducted by the maintenance subcontractor under the direction of the EC subcontractor's CWA/NPDES program personnel.

Laboratory analyses

In addition to implementing the procedures for data recording and chain of custody, the laboratory QAP includes guidance on personnel qualification sampling; selection of specific analytical methods; instrument calibration procedures and frequency; data manipulation procedures; participation in internal and external quality control (QC) sample programs; and assessment of data precision, accuracy, and completeness.

2.1.2.4 Data management and analysis

Analytical data and field readings from samples collected as part of the NPDES program are obtained by the sampling and analytical subcontractors and entered into the Project Environmental Management System (PEMS). Following approval of the data by laboratory and sample management office personnel, CWA/NPDES program personnel review the NPDES data

and utilize a software program that adheres to QA requirements for testing, user documentation, and programmer documentation.

Weekly or monthly averages, maximum daily values, or mass loadings may be required to be calculated from the raw data by the CWA/NPDES computer software programs.

Data analysis and reporting are discussed in detail in the current ETTP NPDES sampling and analysis plan.

2.1.3 ORNL

2.1.3.1 Rationale and design criteria

Evaluation of effluents

Processes at ORNL have been evaluated for both chemical and radiological species likely to become part of the effluent stream. Summaries of those evaluations are presented in ORR ASERs and in documentation prepared for reissue of the NPDES permit.

NPDES requirements

The monitoring requirements for ORNL are detailed in NPDES Permit TN0002941 effective December 6, 1996. In addition to the discharge monitoring requirements, ORNL was required to:

- develop and implement an SWPP plan and a nonstorm water BMPs plan that prevents or minimizes the potential for release of pollutants to surface water;
- maintain a toxicity control and monitoring program;
- develop a proposal for radiological monitoring of ORNL outfalls that have the potential for discharging radioactivity to surface water;
- develop a revised BMAP, which draws on knowledge gained from the BMAP work under the previous permit;
- develop and implement a chlorine-control strategy to monitor and control ORNL releases of chlorine; and
- conduct detailed characterization monitoring of ORNL storm water outfalls.

Routine NPDES sampling at those outfalls selected for radiological monitoring includes analyses for process-related radiological parameters. The rationale for radiological monitoring at NPDES sites is discussed in Sect. 2.1.5.2, criteria “a,” “b,” and “c.”

NPDES performance standards

All sampling equipment has been installed in accordance with manufacturer specifications to ensure proper functioning.

NPDES design criteria

All sampling lines and sample collector reservoirs are Teflon™, which meets EPA liquid sampling requirements. In addition,

- all sampling equipment is either of Teflon™ or stainless steel construction;
- EPA guidelines are followed with regard to appropriate material of construction for the sample container (polyethylene or glass);
- EPA guidelines are followed with regard to appropriate washing procedures for each sample container; and
- EPA guidelines are followed with regard to appropriate preservation for each parameter.

NPDES alarm levels

No alarms are associated with the NPDES sampling locations or with radiological monitoring at effluent sampling locations.

2.1.3.2 Extent and frequency of monitoring

Locations

Main effluent sampling points covered by the NPDES permit are illustrated in Fig. 2.2.

Frequency

Sampling frequencies for each NPDES sampling point are detailed in the permit.

Parameters

The parameters measured at each outfall are detailed in the permit.

Associated radiological monitoring

Locations, frequency, and analytical parameters for radiological monitoring are detailed in the *Radiological Assessment of Oak Ridge National Laboratory's NPDES Permitted Outfalls and Instream Sampling Locations* (Energy Research 1997b).

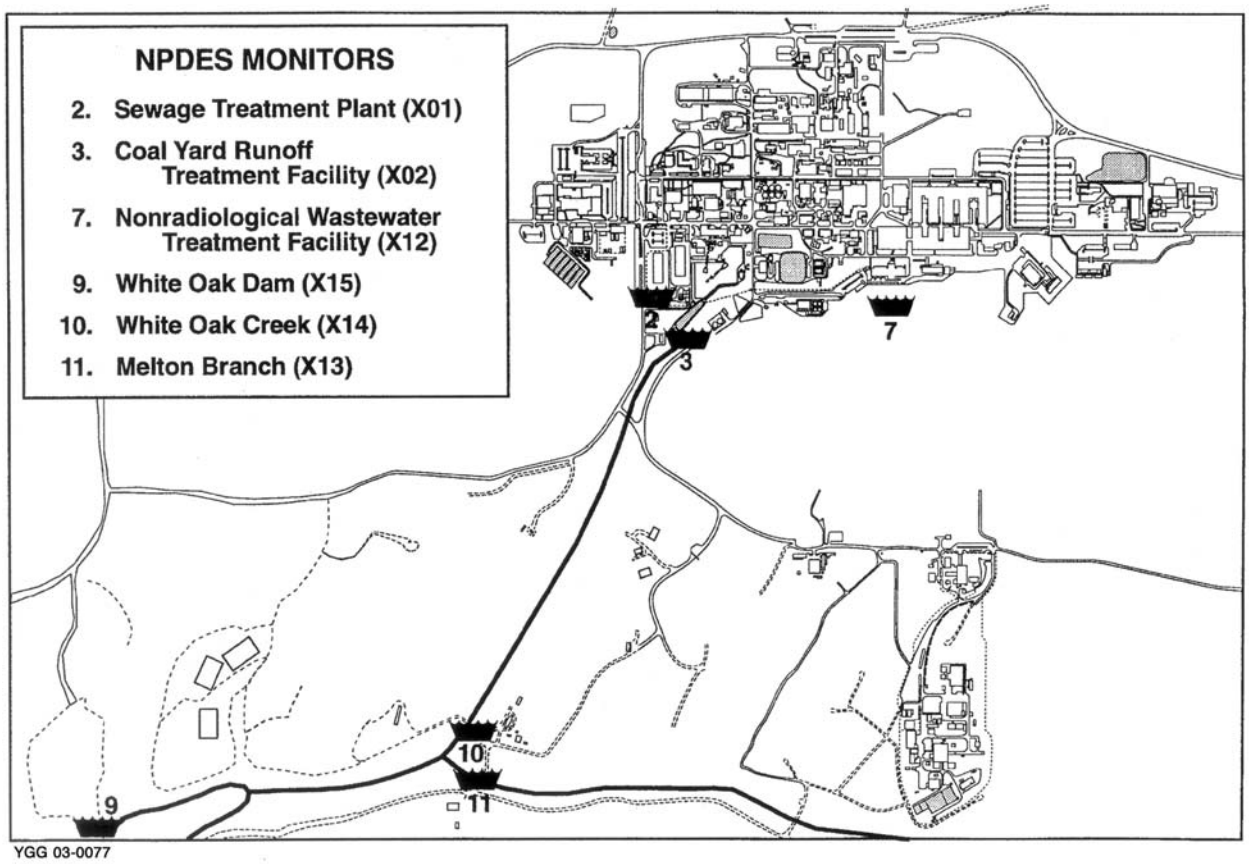

Fig. 2.2. National Pollutant Discharge Elimination System sampling points at the Oak Ridge National Laboratory.

2.1.3.3 Procedures for sampling and laboratory analysis

Sampling procedures for each outfall follow the *Environmental Surveillance Quality Control Program Manual,* ES/ESH/INT-14 (Lockheed 1995a), and/or specific procedures of the Environmental Protection & Waste Services (EP&WS) Division. Procedures for laboratory analysis of effluent samples are cited (by reference) in the NPDES permit and described, in general terms, in Sect. 5 of this EMP.

2.1.3.4 QA requirements

Details of the relevant source documents for the ORNL QA program that apply to the NPDES program (field and laboratory) are described in Sect. 9 of this EMP. Additionally, the radiological portion of the program follows standard operating procedures (SOPs), which are developed by EPWS.

2.1.3.5 Data management and analysis

All field data are collected by field technicians and entered into an NPDES database. All analytical data are transmitted electronically from the Analytical Chemistry organization's Energy Systems Laboratory Information System (ESLIMS) to the EPWS database. Data management [i.e., preparation of the discharge monitoring report (DMR)] includes checks for gross errors, year, series, etc.; completeness; appropriate analytical methods; and a comparison to regulatory limits as well as comparison to historical trends and "expectation charts."

2.1.4 Y-12 National Security Complex

2.1.4.1 Rationale and design criteria

Evaluation of effluents

The existing Y-12 NPDES permit was issued April 28, 1995, with an effective date of July 1, 1995. In October 1999, a complete application for renewal of the NPDES permit was submitted to TDEC. Y-12 will continue to operate under the 1995 permit until TDEC completes the renewal process. Effluents from Y-12 have been evaluated for both chemical and radiological species likely to become part of the effluent stream. Summaries of those evaluations are presented in the NPDES permit application package and supporting documentation.

NPDES requirements

The monitoring requirements for Y-12 are detailed in the NPDES permit (TN002968) dated April 28, 1995. Requirements for storm water monitoring are outlined in the *Y-12 Stormwater Pollution Prevention Plan*, Y/TS-1180 (BWXT 2002a). Each year characterization of storm water flow is performed at 25 locations. In addition to the discharge monitoring requirements, the Complex is required to:

X replace and clean mercury-contaminated piping in specified buildings;
X install a permanent mercury treatment system to treat sump waters from specified buildings;
X maintain a minimum flow of 7 million gal/day at Station 17 on East Fork Poplar Creek;
X prevent instream toxicity to aquatic organisms by providing interim treatment or management practices;
X continue BMAP for East Fork Poplar Creek;
X continue radiological monitoring under the radiological monitoring plan (RMP) and modify the RMP to include storm water monitoring, Station 17, and an assessment of alpha, beta, and gamma emitters;
X develop a temperature profile during hot summer conditions from Outfall 200 to Lake Reality at least once per year;
X investigate high values of fecal coliform in the analyses reported for the NPDES permit application; and
X develop, document, and maintain a storm water pollution control plan.

The current Y-12 RMP, *Radiological Monitoring Plan for the Oak Ridge Y-12 Plant: Surface Water*, Y-TS-1704 (Lockheed 1997b), has been updated to reflect modifications of the monitoring program. These modifications are based on an analysis of past years' data, effectiveness of the plan in satisfying overall objectives, and ongoing changes in Y-12 operations. The radiological monitoring program is designed to monitor effluents at three types of locations: (1) treatment facilities, (2) other point and area discharges, and (3) in-stream locations. With this sampling and analysis program, data are obtained on primary point sources as well as on locations that represent a composite of other potential sources.

Additional monitoring programs

The Y-12 sanitary sewage system (Fig. 2.3) discharges to the city of Oak Ridge's sanitary sewer system. The wastes are then treated at the publicly owned city of Oak Ridge treatment facility. These discharges are monitored as required in Industrial and Commercial User Wastewater Discharge Permit 1-91 issued to Y-12. The current permit was issued to Y-12 on Jan. 1, 2000. Monitoring is conducted at the East End Sanitary Sewer Monitoring Station (SS6). This sampling station represents the total discharge from Y-12 to the city of Oak Ridge's sanitary sewer. Parameters monitored at the sanitary sewer sampling station are listed in Table 2.1. The permit requires monthly sampling; however, sampling is conducted on a more frequent basis (weekly).

NPDES performance standards

Samples are collected and field measurements are made at permitted outfalls in accordance with Y-50 series technical procedures maintained by Y-12's EC organization. Various equipment manuals are used for the operation of specific monitoring equipment, and monitoring requirements are recorded in the Environmental Monitoring Management Information System (EMMIS).

NPDES design criteria

Information relevant to design criteria is maintained in EMMIS. EPA guidelines for equipment construction, sampling containers, container cleaning, and sample preservation are followed.

Alarm levels

No alarms are associated with NPDES effluent monitoring or with radiological monitoring at effluent sampling locations.

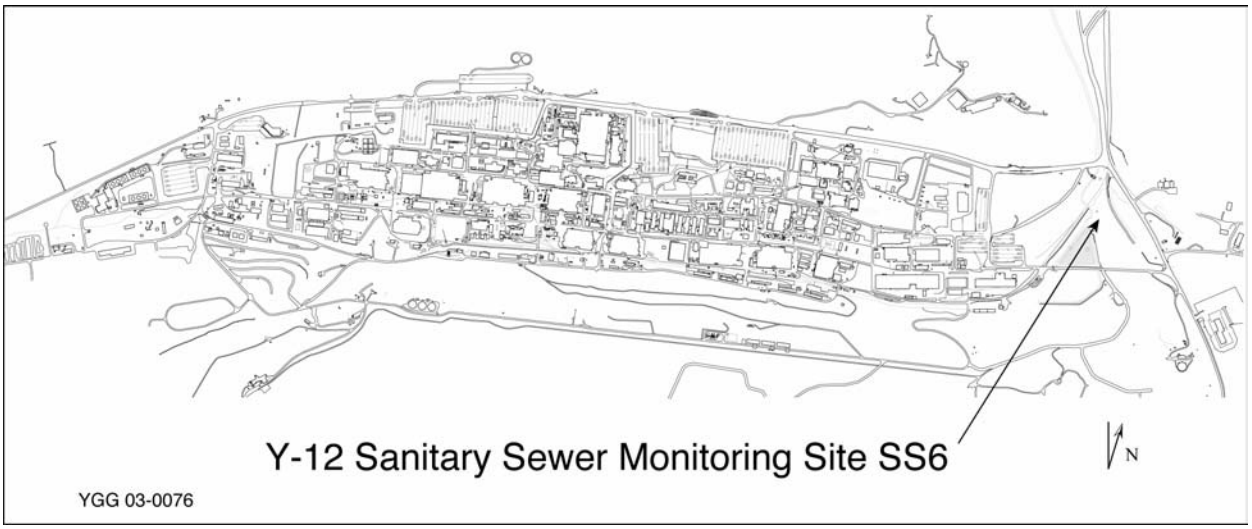

Fig. 2.3. Sanitary sewer sampling location at the Y-12 National Security Complex.

Table 2.1. Parameters monitored per Y-12 National Security Complex industrial and commercial user wastewater discharge permit

Analytical parameters monitored weekly in sanitary sewer effluent		
Arsenic	Biochemical oxygen demand	^{234}U
Cadmium	Oil and grease	^{235}U
Chromium	pH	^{238}U
Copper	Total Kjeldahl nitrogen	Total uranium (soluble and insoluble)
Iron	Total suspended solids	^{235}U (%)
Lead	Phenols	Gross alpha
Nickel		Gross beta
Mercury		
Silver		
Zinc		
Analytical parameters monitored monthly in sanitary sewer effluent		
Benzene	Trichloethylene	
Methylene chloride	Cyanide	
Toluene		
Analytical parameters monitored annually in sanitary sewer effluent		
Gamma spectrometry		
^{238}Pu		
$^{239/240}Pu$		

2.1.4.2 Extent and frequency of monitoring

Locations

Major effluent sampling points covered by the NPDES permit are illustrated in Fig. 2.4. Radiological monitoring sampling locations at the Complex are shown in Fig. 2.5.

Frequency

Sampling frequencies for each NPDES sampling point under the current 1995 permit are documented in the permit and maintained in EMMIS.

Parameters

The parameters measured at each outfall are detailed in the permit.

Parameters monitored at radiological stations are summarized in Table 2.2.

2.1.4.3 Procedures for sampling and laboratory analysis

The *Environmental Sampling Program Procedures Manual*, Y/TS-1887 (BWXT 2002b), defines protocols for Y-12 environmental field sampling and monitoring activities. The manual contains environmental sampling procedures based on procedures first issued in 1988 (*Environmental Surveillance Quality Control Program Manual*, Energy Systems 1988c and Lockheed 1995a) and approved by EPA, DOE, and Y-12 personnel. These procedures continue to be reviewed and revised. During the revision process, teams of environmental sampling personnel assist with reviewing and rewriting these procedures to promote worker involvement consistent with the Integrated Safety Management System (ISMS) philosophy and ensure that field monitoring activities conform to written procedures.

This manual contains 50-series and 71-series management requirements for the EC organization's environmental sampling personnel. Procedures for laboratory analysis are described, in general terms, in Sect. 5 of the EMP.

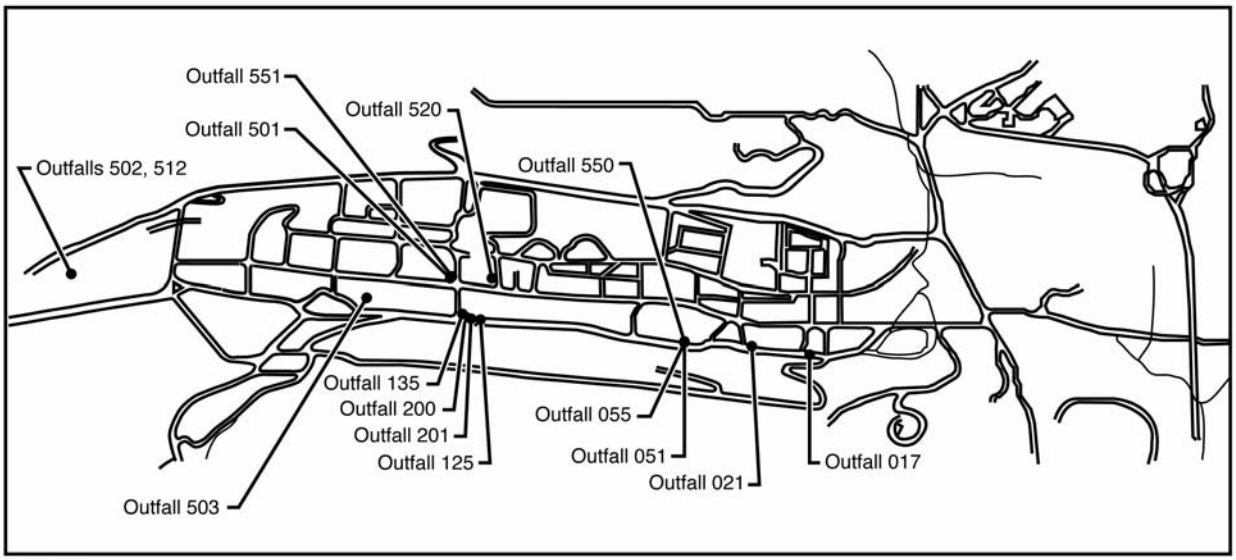

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Fig. 2.4. Major Y-12 National Security Complex National Pollutant Discharge Elimination System outfalls.

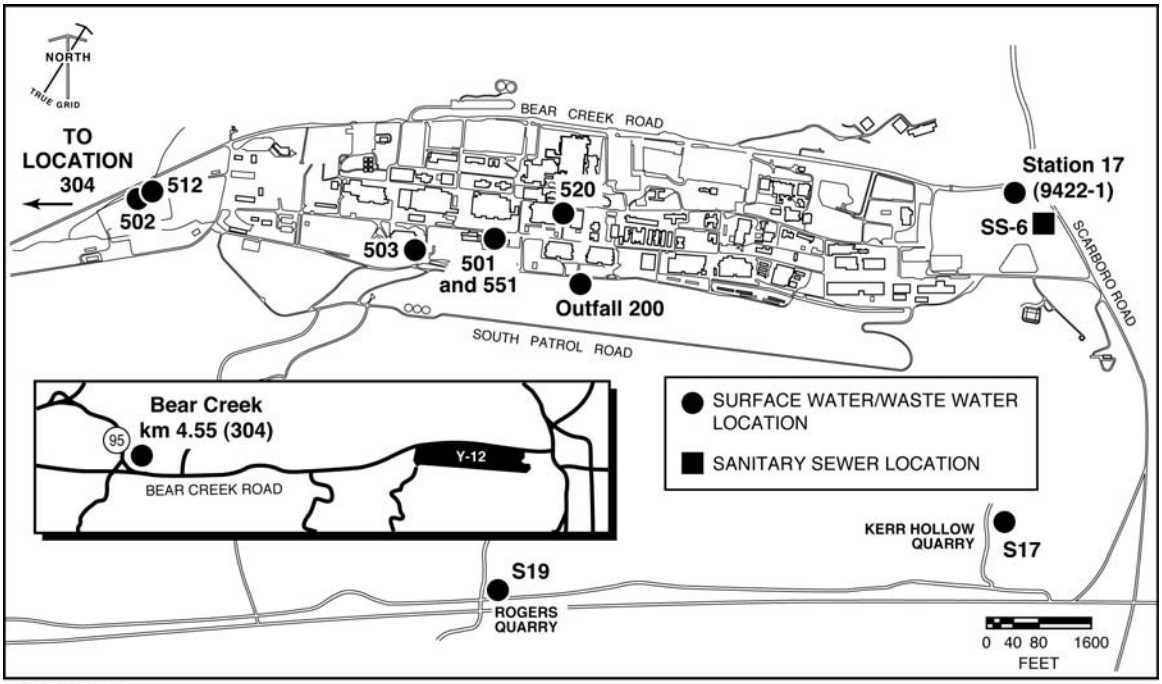

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Fig. 2.5. Liquid effluent radiological monitoring locations at the Y-12 National Security Complex.

Table 2.2. Surface water radiological monitoring parameters

Gross alpha activity	$^{89/90}Sr$	Tritium
^{241}Am	^{99}Tc	Total uranium
Gross beta activity	Total thorium	^{234}U
^{137}Cs	^{228}Th	^{235}U activity
^{60}Co	^{230}Th	^{235}U percent
^{237}Np	^{232}Th	^{236}U
^{238}Pu	Gross gamma activity	^{238}U
$^{239/240}Pu$		
^{226}Ra		
^{228}Ra		

2.1.4.4 QA/QC requirements

Field sampling and measurements

Standard sample definitions and monitoring objectives, maintained in EMMIS, provide specific monitoring requirements for each outfall. Procedures for QA and records are maintained in the EC organization's Y-71 series technical procedures.

Laboratory analysis

The laboratory QA/QC program is described in Sects. 5 and 9 of this EMP.

2.1.4.5 Data management and analysis

Required sampling frequencies and analyses are stored in EMMIS along with required bottle types and preservatives to be used. Samples are initiated in EMMIS, bottle labels and chain of custody forms are printed, and all pertinent information about the samples is transmitted to the analytical laboratory's ESLIMS. EMMIS retrieves NPDES analytical data nightly from ESLIMS. Field data are entered by the field personnel following the sampling event. EMMIS performs various quality checks on all data and reports any discrepancies to designated users. It also checks data against regulatory limits and reports exceedences to designated users. On a monthly basis, EMMIS prepares both hard copy and an electronic file of the DMR.

2.1.5 *Regulatory Guide* Performance Criteria

2.1.5.1 ETTP

a. All liquid effluent streams *should be evaluated and their potential for release of radioactive material assessed. Based on this assessment, decisions *should** be made regarding necessary effluent monitoring systems and the rationale *should** be documented in the EMP.**

ETTP radiological monitoring of effluent discharges is discussed in Sect. 2.1.2.2, where it was described that both treatment facility discharges and storm water outfall locations are evaluated for radiological constituents. The results from the annual sampling programs are documented in the ASER discussion section. The sampling results are also factored into the annual dose assessment for all outfalls, including storm water locations.

b. Liquid effluents from DOE-controlled facilities that have the potential for radioactive contamination *should be monitored in accordance with the requirements of DOE Orders 5400.1 and 5400.5.**

The liquid effluents from the ETTP site are evaluated each year in accordance with the NPDES permit and SWPP program requirements. The historical and continuing evaluation of effluents has shaped the existing monitoring program. Program modifications are proposed, evaluated, and implemented as continuing evaluations warrant.

c. Facility operators *should provide monitoring of liquid waste streams adequate to (1) demonstrate compliance with the requirements of DOE Order 5400.5, Chap. II, paragraphs 1a, 1d, 2a, and 3, (2) quantify radionuclides released from each discharge point, and (3) alert affected process supervisors of accidents in processes and emission controls.**

The historical and continuing evaluation of effluents, combined with the requirements of NPDES monitoring, serve to demonstrate compliance and provide the basis for release quantification. Timely reporting of analytical results of monthly samples provides a screening process to detect problems. Both treatment facility discharges and storm water outfall locations are evaluated for radiological constituents. The results from the annual sampling programs are documented in the ASER discussion section.

d. When continuous monitoring or continuous sampling is provided, the overall accuracy of the results *should be determined (±% accuracy and the % confidence level) and documented in the EMP.**

The approaches to developing measures of accuracy and precision are addressed in Sect. 7 of the EMP in response to criterion "a."

e. Provisions for monitoring of liquid effluents during an emergency *should be considered when determining routine liquid effluent monitoring program needs.**

Samples can be taken from automatic samplers at NPDES outfalls.

f. The selection or modification of a liquid effluent monitoring system *should be based on a careful characterization of the source(s), pollutant(s) (characteristics and quantities), sample-collection system(s), treatment system(s), and final release point(s) of the effluents.**

The historical and continuing evaluation of effluent has been and continues to be used in design and modification of the monitoring system.

g. For all new facilities or facilities that have been modified in a manner that could affect effluent release quantity or quality or that could affect the sensitivity of the monitoring or surveillance systems, a preoperational assessment *should be made and documented in the EMP to determine the types and quantities of liquid effluents to be expected from the facility and to establish the associated effluent monitoring needs of the facility.**

The requirements of the National Environmental Policy Act (NEPA) ensure that the impact of all new facilities on the monitoring systems will be assessed. The ongoing evaluation of effluents will provide the basis for determining impacts of changes in existing facilities. Additionally, the NPDES permit sets forth a requirement that TDEC must be notified prior to facility modifications to modify NPDES permit if necessary.

h. The performance of the effluent monitoring systems *should be sufficient for determining whether effluent releases of radioactive material are within the derived concentration guidelines (DCGs) specified in DOE Order 5400.5 and to comply with the reporting requirements of Chap. II, paragraph 7, of that Order.**

Sample results are compared to the DCGs listed in DOE Order 5400.5 each month, and the cumulative sum of the fractions of DCGs are kept below 100% annually to ensure that the level released is within acceptable limits. For annual characterization sampling events, the results of the storm water sampling effort are compared to established screening criteria to determine if elevated concentrations are being discharged that would warrant additional investigations. For radiological parameters, the screening criterion used is a predetermined percentage of the DOE Order 5400.5 DCG, a measurement that exceeds 15 pCi/L gross alpha or a measurement that exceeds 50 pCi/L gross beta.

i. The required detection levels of the analysis and monitoring systems *should be sufficient to demonstrate compliance with all regulatory requirements consistent with the characteristics of the radionuclides that are present or expected to be present in the effluent.**

The use of standard laboratory procedures and adherence to laboratory QA/QC protocols ensures analytical detection levels sufficient to demonstrate compliance.

j. Sampling systems *should be sufficient to collect representative samples that provide for an adequate record of releases from a facility, to predict trends, and to satisfy needs to quantify releases.**

Use of standard collection equipment and procedures ensures collection of representative samples.

k. Continuous monitoring and sampling systems *should be calibrated before use and recalibrated any time they are subject to maintenance, modification, or system changes that may affect equipment calibration.**

Scheduled calibration and maintenance of field sampling systems are addressed in the sampling and analysis plans, maintenance subcontractor procedures, and vendor manuals.

l. Sampling and monitoring systems *should be recalibrated at least annually and routinely checked with known sources to determine that they are consistently functioning properly.**

There is a regular maintenance program for sampling and monitoring systems that includes calibration. Details are discussed in sampling and analysis plans, maintenance subcontractor procedures and schedules, and vendor manuals.

m. Environmental conditions (e.g., temperature, humidity, radiation level, dusts, and vapors) *should be considered when locating effluent monitoring systems to avoid conditions that will influence the operation of the system.**

Environmental conditions are considered in the selection of monitoring systems and the identification of sampling locations, and extreme care is taken to ensure that the most representative sample is taken.

n. Off-line liquid transport lines *should be replaced if they become contaminated with radioactive materials (to the point where the sensitivity of the system is affected) or if they become ineffective in meeting the design basis within the established accuracy/confidence levels.**

Sampling and monitoring equipment is included in a regular maintenance program as described in the sampling and analysis plans and the maintenance subcontractor's procedures and schedules.

o. If continuous monitoring/sampling and recording of the effluent quantity (stream flow) is not feasible for a specific effluent stream, the extenuating circumstances *should be documented in the EMP.**

Not applicable (N/A).

p. Sampling/monitoring lines and components *should be designed to be compatible with the chemical and biological nature of the liquid effluent.**

Historical and ongoing evaluation of the effluents and the equipment manufacturers' specifications ensures that sampling/monitoring lines are compatible with effluent composition.

q. The output signal instrumentation, monitoring system recorders, and alarms *should be in a location that is continuously occupied by operations or security personnel.**

N/A. There are no radiological alarms for effluent water.

r. To signal the need for corrective actions that may be necessary to prevent public or environmental exposures from exceeding the limits or recommendations given in DOE Order 5400.5, when continuous monitoring systems are required, they *should have alarms set to provide timely warnings.**

N/A. There are no radiological alarms for effluent water.

s. As they apply to the monitoring/sampling of liquid effluents, the general QA program provisions described in Chap. 9 of this guide *should be followed.**

The general provisions of the ETTP QA/QC program applicable to monitoring and sampling of liquid effluents are described in Sect. 9 of this EMP.

2.1.5.2 ORNL

a. All liquid effluent streams *should be evaluated and their potential for release of radioactive material assessed. Based on this assessment, decisions *should** be made regarding necessary effluent monitoring systems and the rationale *should** be documented in the EMP.**

Specific outfalls and their descriptions are contained within each site's NPDES permit, and categorization varies with each individual permit. This assessment continues with the RMP required by the 1996 ORNL NPDES permit.

b. Liquid effluents from DOE-controlled facilities that have the potential for radioactive contamination *should be monitored in accordance with the requirements of DOE 5400.1 and 5400.5.**

None of the effluent points at ORNL exceeded one DCG for the constituent isotopes during 1996. There is a potential for some of the locations to have excursions that may reach summed percent DCG levels of 100; however, DCGs are to be applied on an annual-average basis. In the event the summed percent DCGs for an effluent point exceed 100, an evaluation will be conducted in accordance with DOE Order 5400.5, Chap. II.

c. Facility operators *should provide monitoring of liquid waste streams adequate to (1) demonstrate compliance with the requirements of DOE Order 5400.5, Chap. II, paragraphs 1a, 1d, 2a, and 3, (2) quantify radionuclides released from each discharge point, and (3) alert affected process supervisors of accidents in processes and emission controls.**

The historical and continuing evaluation of effluents combined with the requirements of NPDES monitoring demonstrate compliance and provide the basis for release quantification.

The liquid effluents monitoring compliance plan for radionuclide contaminants is as follows:

Sewage Treatment Plant

Sampling location: Between the last treatment point (chlorine addition) and before discharge to the receiving stream or any additional dilution from other streams.

Flow-measuring device: Standard open-channel flow primary device coupled with electronic instrumentation to measure instantaneous flow rate and calculate total discharge. This instrument is also used to pace flow-proportional sampling.

Type of sample: Flow-proportional, continuous.

Frequency of collection: Weekly.

Analytical parameters: Gamma scan, tritium, total radioactive strontium.

Frequency of analysis: Monthly.

Nonradiological Wastewater Treatment Facility (NRWTF)

Sampling location: Directly upstream from the V-notch weir after final treatment and pH adjustment.

Flow-measuring device: Standard open-channel flow primary device coupled with electronic instrumentation to measure instantaneous flow rate and calculate total discharge. This instrument is also used to pace flow-proportional sampling.

Type of sample: Flow-proportional, continuous.

Frequency of collection: Weekly.

Analytical parameters: Gamma scan, tritium, total radioactive strontium.

Frequency of analysis: Monthly.

Category I and Category II (storm drains, storage area drains, once-through cooling water, cooling water blowdown, condensate drains)

Sampling location: Directly from the pipe before effluent enters the receiving stream.

Type of sample: Grab.

Frequency of sampling: Annually for Category I and quarterly for Category II, dependent upon rainfall. After 1 year these data will be reviewed, and each outfall and its analytical parameters will be assessed for inclusion in the Radiological Liquid Effluent Monitoring Program of the EMP. Some outfalls may be deleted from the EMP and continue as part of the NPDES RMP because of the permit requirements.

Analytical parameters: Gamma scan, tritium, total radioactive strontium.

d. When continuous monitoring or continuous sampling is provided, the overall accuracy of the results *should be determined (±% accuracy and the % confidence level) and documented in the EMP.**

The approaches to developing measures of accuracy and precision are addressed in Sect. 7 of the EMP in the response to criterion "a."

e. Provisions for monitoring of liquid effluents during an emergency *should be considered when determining routine liquid effluent monitoring program needs.**

Continuous sampling at both the STP and NRWTF will provide the capability to collect samples at any time (e.g., during an emergency). Although not continuous, the equipment located at the Coal Yard Runoff Treatment Facility (CYRTF) can provide emergency sampling once an event is suspected or identified. Because Category I and Category II outfalls are not tied directly to any process, they would be expected to serve only as "conduits" in an emergency spill. Grab samples can be collected from these pipes once a "spill pathway" has been established.

f. The selection or modification of a liquid effluent monitoring system *should be based on a careful characterization of the source(s), pollutant(s) (characteristics and quantities), sample-collection system(s), treatment system(s) and final release point(s) of the effluents.**

The sampling program outlined in the EMP has taken into consideration process knowledge and information from present and past sampling systems as described in the ASERs.

g. For new facilities or facilities that have been modified in a manner that could affect effluent release quantity or quality or that could affect the sensitivity of the monitoring or surveillance systems, a preoperational assessment *should be made and documented in the environmental monitoring plan to determine the types and quantities of liquid effluents to be expected from the facility and to establish the associated effluent monitoring needs of the facility.**

The Environmental Review and Documentation Program at ORNL documents any changes in present research or operational activities at ORNL and provides an environmental assessment (EA) for any new activities at ORNL. This information, coordinated through the ORNL Environmental Coordinator, will be provided to the environmental monitoring programs. With this information, the environmental monitoring programs will be charged with making decisions as to the necessity of additional monitoring requirements. The basis for these decisions will be source and pollutant characterization, treatment knowledge, and data quality objectives (DQOs), as applicable.

h. The performance of the effluent monitoring systems *should be sufficient for determining whether effluent releases of radioactive material are within the DCGs specified in DOE Order 5400.5 and to comply with the reporting requirements of chapter II, paragraph 7 of that Order.**

The performance of the effluent monitoring systems has been sufficient to determine that releases are within the DCGs specified in DOE Order 5400.5. This is ensured by applying the DQO approach as described in Sect. 7 in the EMP for ORNL.

Reporting requirements are addressed in Sect. 8.

i. The required detection levels of the analysis and monitoring systems *should be sufficient to demonstrate compliance with all regulatory requirements consistent with the characteristics of the radionuclides that are present or expected to be present in the effluent.**

The environmental detection levels are a function of the analytical detection limit and the size of the sample being analyzed. The process of developing DQOs is used to ensure that the sample size is sufficient, given the analytical method sensitivity, to quantify radionuclide signatures at concentrations of 10% of the DCG or less.

j. Sampling systems *should be sufficient to collect representative samples that provide for an adequate record of releases from a facility, to predict trends, and to satisfy needs to quantify releases.**

Flow-proportional samplers at the STP, CYRTF, and NRWTF are placed in the effluent stream where maximal mixing is achieved to obtain the most representative samples. Grab samples from Category I and Category II outfalls will be representative of flow only during the time samples are collected and may not be representative of the complete discharge associated with the effluent discharge or the rain event.

Flow-measuring devices are located at STP, CYRTF, and NRWTF. The three discharge effluent points use standard open-channel flow primary devices coupled with electronic instrumentation to measure instantaneous flow rate and calculate total discharge. These instruments are also used to initiate flow-proportional sampling.

Trend analysis is conducted by the Environmental Monitoring Programs in the Office of Environmental Compliance and Documentation (OECD). Specifics of the program are discussed in Sect. 7 of the EMP for ORNL.

k., l. Continuous monitoring and sampling systems *should be calibrated before use and recalibrated any time they are subject to maintenance, modification, or system changes that may affect equipment calibration.**

Sampling and monitoring systems *should be recalibrated at least annually and routinely checked with known sources to determine that they are consistently functioning properly.**

Sampling systems include sample collectors and flow-measuring devices. The Environmental Monitoring Programs personnel of OECD have established schedules for preventative maintenance and calibration, which includes calibration at least annually. Calibration procedures are based on the manufacturer's recommendations. Recalibration occurs any time the instrument is subject to modification or maintenance that may affect calibration. At a minimum, calibration frequencies are those recommended by the manufacturer, but may be modified (increased) as past history warrants.

m. Environmental conditions (e.g., temperature, humidity, radiation level, dusts, and vapors) *should be considered when locating effluent monitoring systems to avoid conditions that will influence the operation of the system.**

The equipment used for the effluent monitoring program is commercially available and designed for the purpose and conditions generally encountered. Problems with operating conditions will be identified by the maintenance and calibration program discussed under criteria "k" and "l" above.

n. Off-line liquid transport lines *should be replaced if they become contaminated (to the point where the sensitivity of the system is affected) with radioactive materials or if they become ineffective in meeting the design basis within the established accuracy/confidence levels.**

Guidance supporting CWA sampling is followed for replacement and cleaning of sample lines.

Environmental Monitoring Programs of OECD have protocols for cleaning the sample chamber in the sample collectors. These protocols are documented in the group's procedures.

o. If continuous monitoring/sampling and recording of the effluent stream flow is not feasible for a specific effluent stream, the extenuating circumstances *should be documented.**

Continuous sampling will not be conducted for the Category I and Category II discharges. These discharges for the most part depend on rainfall events for flow and must be sampled by grab.

p. Sampling/monitoring lines and components *should be designed to be compatible with the chemical and biological nature of the liquid effluent.**

All sampling lines and sample collector reservoirs are Teflon™, which meets EPA liquid sampling requirements. Additionally, the following protocols also apply to this requirement.

- All sampling equipment is either of Teflon™ or stainless steel construction.
- EPA guidelines with regard to appropriate material of construction of the sample container (polyethylene or glass) are followed.
- EPA guidelines with regard to appropriate washing procedures for each sample container are followed.
- EPA guidelines with regard to appropriate preservation for each parameter are followed.

q., r. The output signal instrumentation, monitoring system recorders, and alarms *should be in a location that is continuously occupied by operations or security personnel.**

To signal the need for corrective actions that may be necessary to prevent public or environmental exposures from exceeding the limits or recommendations given in DOE Order 5400.5 when continuous monitoring systems are required, they *should have alarms set to provide timely warnings.**

Real-time process monitoring is conducted by the Waste Operations Control Center and the ORNL Shift Superintendent's Office. These facilities are manned continuously.

s. As they apply to the monitoring/sampling of liquid effluents, the general QA program provisions described in Chap. 10 of this guide *should be followed.**

The activities discussed in this section are conducted by organizations that have QA programs consistent with the requirements of DOE Order 5700.6C and American Society of Mechanical Engineers (ASME) NQA-1 (ASME 1989). Additional information is provided in the Sect. 9 of this EMP.

2.1.5.3 Y-12 National Security Complex

a. All liquid effluent streams *should be evaluated and their potential for release of radioactive material assessed. Based on this assessment, decisions *should** be made regarding necessary effluent monitoring systems and the rationale *should** be documented in the EMP.**

Specific outfalls and their description are contained within each site's NPDES permit, and categorization varies with each individual permit. This assessment continues through the RMP required by the Y-12 NPDES permit.

b. Liquid effluents from DOE-controlled facilities that have the potential for radioactive contamination *should be monitored in accordance with the requirements of DOE Orders 5400.1 and 5400.5.**

The historical and continuing evaluation of effluents has shaped the existing monitoring program. Program modifications are proposed, evaluated, and implemented as continuing evaluations warrant.

c. Facility operators *should provide monitoring of liquid waste streams adequate to (1) demonstrate compliance with the requirements of DOE Order 5400.5, Chap. II, paragraphs 1a, 1d, 2a, and 3, (2) quantify radionuclides released from each discharge point, and (3) alert affected process supervisors of accidents in processes and emission controls.**

The historical and continuing evaluation of effluents combined with the requirements of NPDES monitoring serve to demonstrate compliance and provide the basis for release quantification. Consistent with this approach, the Y-12 RMP is revised to better characterize radiological components of complex effluents and reflect changes in Complex operations.

d. When continuous monitoring or continuous sampling is provided, the overall accuracy of the results *should be determined (±% accuracy and the % confidence level) and documented in the EMP.**

There are no continuous monitors for radiological species. Composite samplers used in the NPDES program provide samples for radiological analyses. The overall accuracy of the

samplers is ensured by periodic calibrations (Y/TS-1877). The approaches to developing measures of accuracy and precision are addressed in Sect. 7 of the EMP in response to criterion "a."

e. Provisions for monitoring of liquid effluents during an emergency *should be considered when determining routine liquid effluent monitoring program needs.**

A composite sampler is located on East Fork Poplar Creek at Station 17 that may be activated in the event of a release. A composite sampler is also located on Bear Creek at Outfall 304 (BCK 4.55). Seven-day composite samples are collected at this location. There are no backup power supplies for these samplers.

f. The selection or modification of a liquid effluent monitoring system *should be based on a careful characterization of the source(s), pollutant(s) (characteristics and quantities), sample-collection system(s), treatment system(s), and final release point(s) of the effluents.**

The historical and continuing evaluations of effluent emissions have been and continue to be used in design and modification of the monitoring system.

g. For all new facilities or facilities that have been modified in a manner that could affect effluent release quantity or quality or that could affect the sensitivity of the monitoring or surveillance systems, a preoperational assessment *should be made and documented in the EMP to determine the types and quantities of liquid effluents to be expected from the facility and to establish the associated effluent monitoring needs of the facility.**

The requirements of NEPA ensure that the impact of all new facilities on the monitoring systems will be assessed. The ongoing evaluation of effluents will provide the basis for determining impacts of changes in existing facilities.

h. The performance of the effluent monitoring systems *should be sufficient for determining whether effluent releases of radioactive material are within the DCGs specified in DOE Order 5400.5 and to comply with the reporting requirements of Chap. II, paragraph 7, of that Order.**

Compliance with QC procedures in the field (Y/TS-1877) and in the laboratory analyses ensures the reliability of the effluent monitoring system and its ability to determine concentrations of radionuclides within the DCG. The requirements of the drain modification program outlined in procedure Y71-920 also provide an evaluation of liquid discharges from new or modified facilities.

i. The required detection levels of the analysis and monitoring systems *should be sufficient to demonstrate compliance with all regulatory requirements consistent**

with the characteristics of the radionuclides that are present or expected to be present in the effluent.

The environmental detection levels are a function of the analytical detection limit and the size of the sample being analyzed. The process of developing DQOs is used to ensure that the sample size is sufficient, given the analytical method sensitivity, to quantify radionuclide signatures at concentrations of 10% of the DCG or less.

j. Sampling systems *should be sufficient to collect representative samples that provide for an adequate record of releases from a facility, to predict trends, and to satisfy needs to quantify releases.**

Use of standard collection equipment and procedures (Y/TS-1877) ensures collection of representative samples.

k., l. Continuous monitoring and sampling systems *should be calibrated before use and recalibrated any time they are subject to maintenance, modification, or system changes that may affect equipment calibration.**

Sampling and monitoring systems *should be recalibrated at least annually and routinely checked with known sources to determine that they are consistently functioning properly.**

There is a regular maintenance program for sampling and monitoring systems that includes calibration (Y/TS-1877).

m. Environmental conditions (e.g., temperature, humidity, radiation level, dusts, and vapors) *should be considered when locating effluent monitoring systems to avoid conditions that will influence the operation of the system.**

The equipment used for the effluent monitoring program is commercially available and designed for the purpose and conditions generally encountered. Problems with operating conditions will be identified by the maintenance and calibration program discussed under criteria “k” and “l” above.

n. Off-line liquid transport lines *should be replaced if they become contaminated (to the point where the sensitivity of the system is affected) with radioactive materials or if they become ineffective in meeting the design basis within the established accuracy/confidence levels.**

Sampling lines are replaced and cleaned following guidance supporting CWA sampling.

o. If continuous monitoring/sampling and recording of the effluent quantity (stream flow) is not feasible for a specific effluent stream, the extenuating circumstances *should be documented in the EMP.**

N/A.

p. Sampling/monitoring lines and components *should be designed to be compatible with the chemical and biological nature of the liquid effluent.**

Historical and ongoing evaluations of the effluents combined with manufacturers' specifications ensure that sampling/monitoring lines are compatible with the effluent composition.

q. The output signal instrumentation, monitoring system recorders, and alarms *should be in a location that is continuously occupied by operations or security personnel.**

N/A.

r. To signal the need for corrective actions that may be necessary to prevent public or environmental exposures from exceeding the limits or recommendations given in DOE Order 5400.5, when continuous monitoring systems are required, they *should have alarms set to provide timely warnings.**

There are no continuous radiological monitoring systems equipped with alarms or effluent water monitoring locations.

s. As they apply to the monitoring/sampling of liquid effluents, the general QA program provisions described in Chap. 10 of this guide should* be followed.

The general provisions of the Y-12 QA/QC program applicable to monitoring and sampling of liquid effluents are described in Y/TS-1877 and in Sect. 9 of this EMP.

2.2 GROUNDWATER

2.2.1 Introduction

The objective of all groundwater monitoring at DOE facilities is "to determine the effects of operations on groundwater quality and quantity" (DOE Order 5400.1). Specifically, groundwater monitoring is conducted on site and in the vicinity of DOE facilities to:

- obtain data for the purposes of determining baseline conditions of groundwater quality and quantity,
- demonstrate compliance with and implementation of all applicable regulations and DOE orders,
- provide data to permit the early detection of groundwater pollution or contamination,
- provide a reporting mechanism for detected groundwater pollution or contamination,
- identify existing and potential groundwater contamination sources and maintain surveillance of these sources, and

- provide data upon which decisions can be made concerning land disposal practices and the management and protection of groundwater resources.

The groundwater monitoring programs at each of the complexes have been divided into effluent monitoring and environmental surveillance components.

Besides satisfying the general objectives of all groundwater monitoring, effluent monitoring of groundwater satisfies the following specific objectives:

- verification of compliance with environmental laws, regulations, and DOE orders;
- evaluation of the need for remedial actions at the site;
- evaluation of the effectiveness of remedial actions at the site; and
- support of the permitting process.

Two types of groundwater monitoring are described in this EMP: effluent monitoring and environmental surveillance. Effluent monitoring is performed near the source of possible contamination, and environmental surveillance is conducted along possible flow paths at appropriate distances from possible sources of contamination.

Effluent monitoring is required to achieve compliance with applicable federal or state regulations, permit conditions, or environmental commitments made in other official documents. Included under this heading are groundwater monitoring at either interim-status or permitted-status Resource Conservation and Recovery Act (RCRA) units; monitoring of 3004(u/v) RCRA facilities; monitoring in conjunction with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) actions [e.g., remedial investigation/feasibility studies (RI/FSs)]; monitoring around landfills in compliance with permit regulations; and monitoring around underground storage tanks (USTs). In addition, groundwater monitoring in response to administrative orders or a memorandum of understanding (e.g., Agreed Order between the facility and EPA) is included as effluent monitoring. [Note: monitoring performed specifically for CERCLA baseline and remediation is addressed by WRRP, and the results are documented in remediation effectiveness reports.]

Environmental surveillance monitoring is defined as perimeter exit pathway monitoring and off-site water well monitoring. Perimeter exit pathway monitoring is initiated by the facility to better understand the effects of facility operations on the regional groundwater quality and quantity. In addition to providing verification of compliance with regulatory requirements at the ORR boundary, perimeter exit pathway monitoring provides a means of detecting previously unidentified on-site groundwater quality problems. Off-site water well monitoring is initiated by DOE to address the public's concern about off-site groundwater contamination, especially of drinking water sources.

It should be noted that water resource monitoring approaches are changing in the regulatory community, both at the national and state levels. Traditional effluent monitoring is moving toward a more integrated ecosystem approach. The ecosystem protection perspective being adopted by the regulatory agencies dovetails with ORR being listed as a single NPL site under

CERCLA. This perspective has compelled restoration personnel to evaluate the net impact of ORR upon the Clinch and Tennessee river systems. In 1996, the Integrated Water Quality Program (IWQP) was established by DOE. This program was subsequently renamed WRRP in 2000. All restoration-funded monitoring is coordinated through this program. A report entitled *Environmental Restoration Integrated Water Quality Program Plan* (ES/ER/TM-205) issued in September 1996, describes the IWQP plans and provides a summary of monitoring activities by other organizations. It also describes the overall approach for a comprehensive surface water, groundwater, and biological monitoring program to support watershed management decisions. Details of monitoring efforts performed specifically for CERCLA baseline and remediation are published in the fiscal year WRRP sampling and analysis plans, and in remediation effectiveness reports. The remediation effectiveness report is an FFA document intended to collate all ORR CERCLA decision requirements, compare pre- and post-remediation conditions at CERCLA sites and present the results of any required post-decision monitoring. The remediation effectiveness report is issued annually to update the performance histories of completed actions and to add descriptions of new decisions and field activities.

2.2.2 ETTP

Groundwater monitoring at ETTP is primarily focused on investigating and characterizing the site for remediation under CERCLA. As a result of the FFA and certification of closure of the K-1407-B and K-1407-C Ponds, the principal regulatory driver at ETTP is CERCLA. However, the annual groundwater sampling program does include DOE Order 5400.1 exit pathway locations, as described in the WRRP annual sampling and analysis plan. The results of the sampling program are described in the ORR annual remedial effectiveness report that is issued to the public stakeholders in much the same manner as ASER.

2.2.3 ORNL

2.2.3.1 Site geology and hydrogeology

The following summary of the geological and hydrogeological settings at ORNL is based on similar summaries in the *Groundwater Protection Program Management Plan, Oak Ridge National Laboratory* (Energy Systems 1990b) and the *Oak Ridge Reservation Environmental Report for 1989* (Energy Systems 1990a). Updated information is contained in *Oak Ridge Reservation Annual Site Environmental Report for 1995* (ES/ESH-69, Energy Research 1996). More detailed discussions of the geology and hydrogeology of the ORNL site may be found in the references of the latter document.

Site geology

ORNL is located in the southern Valley and Ridge physiographic province, where the topography is dominated by narrow elongated ridges and valleys that trend in a northeast-southwest direction. The site geology (Fig. 2.6) is dominated by thrust faults that are part of the Southern Appalachian orogenic thrust fault system. Movement along the faults in the area has been toward the northwest. The strike and dip of bedding in the area, although locally variable, average N55EE and 45ESE, respectively.

Bedrock units in the ORNL area (Fig. 2.6) include the Cambrian shales and siltstones of the Rome Formation that form Haw Ridge; the Cambrian limestones, shales, and siltstones of the Conasauga Group that underlie Melton Valley; the Cambro-Ordovician dolostones of the Knox Group that form Chestnut Ridge and Copper Ridge; and the limestone and carbonate-rich shales of the Ordovician Chickamauga Group beneath Bethel Valley.

Joint and fracture sets, associated with the structural deformation of the region, are common features of the bedrock geology. These structural features, as well as bedding planes, serve as major conduits for groundwater flow. Bedrock porosity is often enhanced in carbonate bedrock by solution activity along structural features.

Bedrock throughout the area is overlain by varying thicknesses of unconsolidated residuum, alluvium, colluvium, or manmade fill.

Site hydrogeology

The site hydrogeology is directly linked with the surface water drainage system surrounding ORNL. Most ORNL facilities, including the WM areas, are located within the White Oak Creek (WOC) drainage basin (Fig. 2.7). From its headwaters on the southern flank of Chestnut Ridge, WOC flows west in Bethel Valley through the main ORNL complex, where it turns south through Haw Ridge and into Melton Valley. Before discharging into White Oak Lake (WOL), a manmade impoundment, WOC is joined by the Melton Branch tributary.

Groundwater flow in the ORNL area can be divided into three zones comprising a near-surface, intermittently saturated storm-flow zone; a shallow water table aquifer; and a deeper bedrock aquifer (Moore 1989). Flow paths in the storm-flow zone are relatively short and follow topography to discharge points at springs or streams. Flow in the shallow and deeper aquifers generally follows a path from recharge areas along ridge tops to discharge points in valley streams.

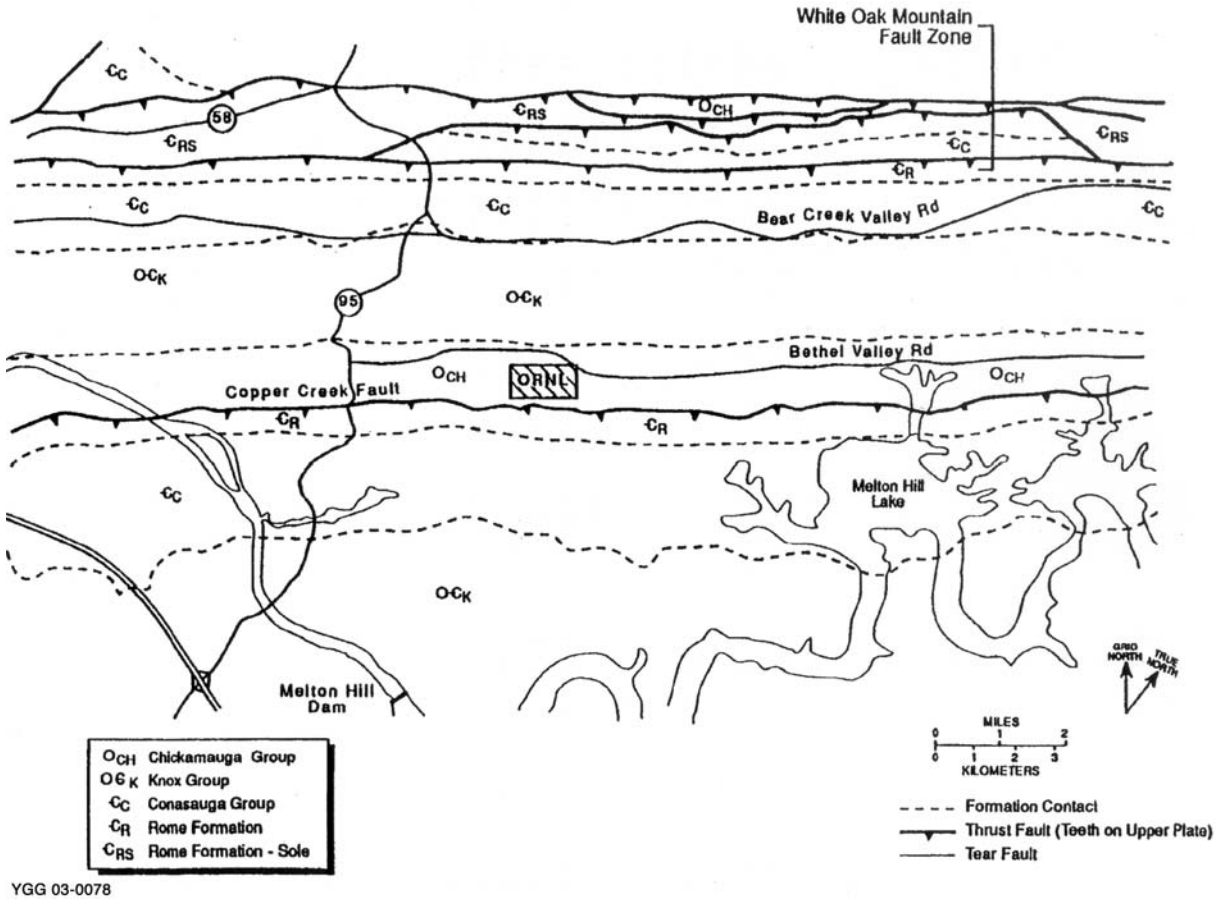


Fig. 2.6. Geology of the Oak Ridge National Laboratory area.

The water table is usually located near the contact between residuum and bedrock, and its configuration is generally a subdued reflection of the local topography. Thus, groundwater flow in the shallow aquifer is toward WOC in Bethel Valley and toward Melton Branch, WOC, and WOL in Melton Valley. The detailed flow paths followed by groundwater in both the shallow and deep aquifers may be dominated by the anisotropic nature of the aquifers. Actual flow directions may be skewed away from perpendicular to piezometric contours by the orientation of preferred flow paths, typically along strike. Similar influences of relict structures may influence groundwater flow in Conasauga residuum.

2.2.3.2 Rationale and design criteria

Groundwater effluent monitoring at ORNL is conducted to meet EPA and TDEC requirements and to assess the impact of *current* facility operations on the quality of the environment. (Responsibility for dealing with the impact of past facility operations resides with the Environmental Management Program.) Because of the number of individual waste sites, their areal distribution, and, in many cases, their proximity, the sites have been organized into 20 waste area groups (WAGs). Each WAG (Fig. 2.7) is a hydrologically definable area, such as a small watershed, wherein there may be one or several potential radioactive and/or hazardous contamination sources.

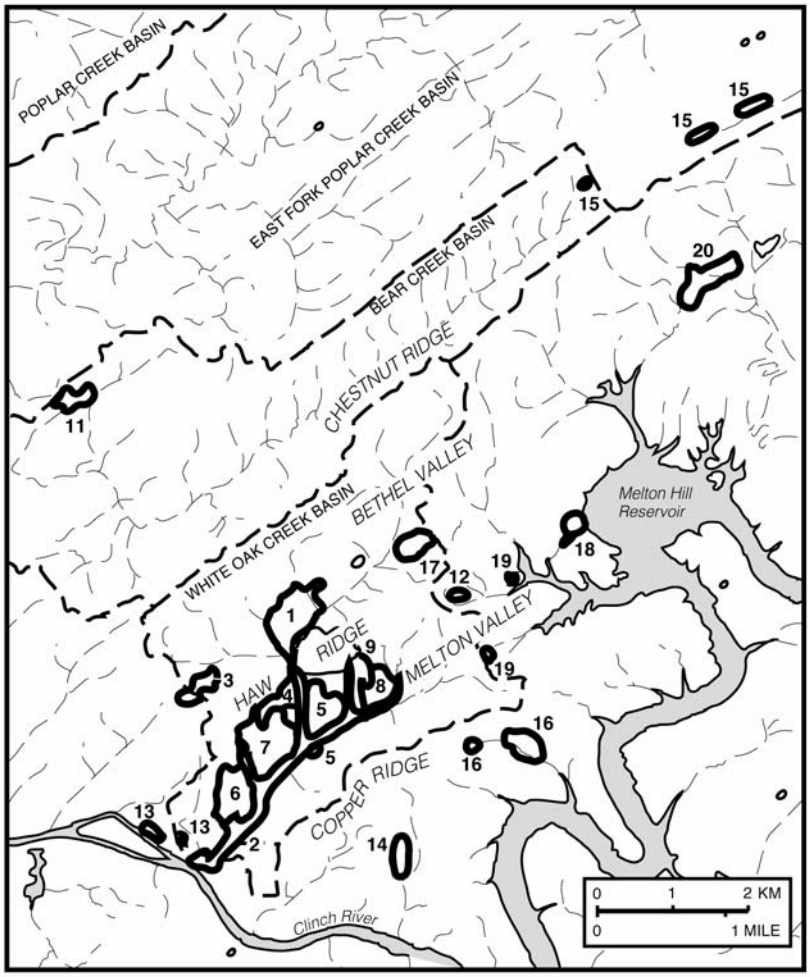


Fig. 2.7. Oak Ridge National Laboratory waste area groups (WAGs). WAG 10 sites are underground beneath WAG 5.

Each WAG has a series of groundwater quality monitoring wells at its perimeter. Both upgradient and downgradient wells are included in these well networks. The placement of these wells is used to pinpoint the extent and direction of the flow of contamination should any be detected.

2.2.3.3 Extent and frequency of monitoring

A major review of the ORNL groundwater effluent monitoring program and the ORNL WAGs was conducted in 1996. Twelve WAG 6 wells are monitored semiannually under a RCRA/CERCLA-integrated monitoring approach as part of the *Environmental Monitoring Plan (EMP) for WAG 6 at ORNL* (DOE 1995). The other WAGs were examined to determine which are associated with current facility operations. Data from previous groundwater effluent monitoring for the WAGs determined to be associated with current facility operations were evaluated and analyzed on a well-by-well basis to determine appropriate target parameters. In 2000, the discovery of a tritium leak in the process waste drain at the High Flux Isotope Reactor (HFIR) resulted in extensive characterization monitoring in the WAG 8 vicinity. In 2001, the *Operational Monitoring Plan for the High Flux Isotope Reactor Site—Final Design*, ORNL/CF-01/35 (UT Battelle 2001) was developed and implemented to monitor the effectiveness of corrective actions, acquire baseline data, and provide a more comprehensive groundwater monitoring network in the HFIR area. This plan will be reviewed and updated frequently as baseline data become available. Details of the extent and frequency of sampling are described in the sampling and analysis plans for the individual WAG. Table 2.3 provides a general overview of sampling frequency, number of wells, and parameters for each of the 11 WAGs.

Table 2.3. Groundwater effluent monitoring at Oak Ridge National Laboratory waste area groups (WAGs)

WAG	Number of wells	Sampling frequency	Parameters
1	27	Annual	Wells 807, 808, 809, and 830: radionuclides,[a] field measurements[b]
2	20	Annual	Wells 1189, 1190, 1191, 1192: radionuclides,[a] VOCs,[c] metals, field measurements[b] Remaining WAG 2 wells: radionuclides,[a] field measurements[b]
6	26	Semiannual	See the *Integrated Water Quality Program* (ES/ER/TM-205) for details associated with WAG 6
8	see *Operational Monitoring Plan for the High Flux Isotope Reactor Site—Final Design* (ORNL/CF-01/35, March 14, 2001)		
9	2	Annual	Radionuclides,[a] field measurements[b]
17	8	Annual	Radionuclides,[a] field measurements,[b] VOCs

[a]Gross alpha and beta, ^{3}H, gamma scan (^{60}Co, ^{137}Cs), total radioactive strontium.
[b]pH, conductivity, turbidity, oxidation/reduction potential, temperature, and dissolved oxygen.
[c]VOCs = volatile organic compounds.

2.2.3.4 Procedures for laboratory analysis

The approved procedures of the responsible organizations will be used. These are referenced through the QA flowdown in Sect. 9 of this EMP. Laboratory analysis is addressed in Sect. 2.2.3.5 and specifically in Sect. 5 of this EMP.

2.2.3.5 QA/QC

These requirements are addressed in Sect. 9 of this EMP.

2.2.3.6 Program implementation procedures

Preparation of individual sampling and analysis plans, monitoring, data management and analysis, and reporting is the responsibility of the environmental monitoring personnel at ORNL.

2.2.3.7 Data analysis and statistical treatment

These requirements are addressed in Sect. 7 of this EMP.

2.2.3.8 Reports and records

These requirements are addressed in Sects. 8 and 9 of this EMP.

2.2.4 Y-12 National Security Complex

2.2.4.1 Site geology and hydrogeology

The following summary of the Y-12 geological and hydrogeological settings is based on similar summaries in the *Groundwater Protection Program Management Plan for the U.S. Department of Energy Y-12 National Security Complex, Oak Ridge, Tennessee (*BWXT 2001*)* and the *Comprehensive Groundwater and Surface Water Monitoring Plan for the Department of Energy Y-12 Plant, Oak Ridge, Tennessee* (Geraghty and Miller 1990a). More detailed discussions of the geology and hydrogeology of the Y-12 site may be found in the references contained in those two documents.

Site geology

Y-12 is located in the southern Valley and Ridge physiographic province wherein topography is dominated by narrow elongated ridges and valleys that trend in a northeast-southwest direction. The site geology (Fig. 2.8), reflected in the topographic expression of resistant sandstone, siltstone or siliceous limestone ridges, and eroded shale and/or carbonate valleys, is dominated by thrust faults that are part of the Southern Appalachian orogenic thrust fault system. Movement along the faults in the area has been toward the northwest. The strike and dip of bedding in the Y-12 area are generally N55EE and 45ESE, respectively.

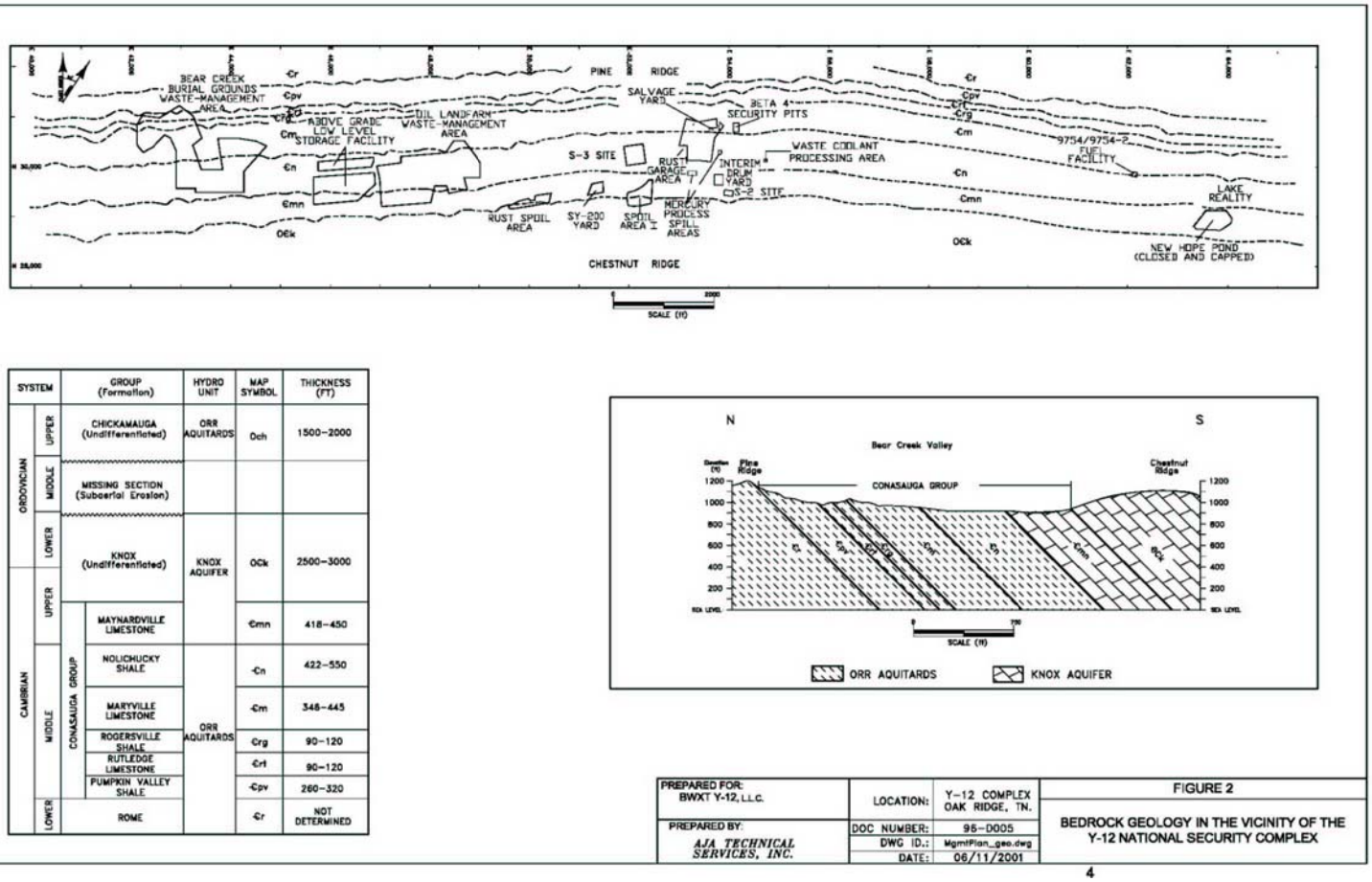


Fig. 2.8. Bedrock geology at the Y-12 Nuclear Security Complex.

Bedrock units in the Y-12 area (Fig. 2.8) include the Cambrian shales and siltstones of the Rome Formation that form Pine Ridge, the Cambro-Ordovician dolostones of the Knox Group that form Chestnut Ridge, and the intervening Cambrian limestones, shales, and siltstones of the Conasauga Group that underlie Bear Creek Valley (BCV).

The bedrock units are generally overlain by unconsolidated materials of varying thickness. Residuum, or weathered bedrock, comprises the majority of unconsolidated materials with the remainder consisting of anthropogenic fill materials, alluvium, and colluvium.

Site hydrogeology

The hydrogeologic system at Y-12 has been divided into three hydrogeologic regimes (Fig. 2.9). The three regimes are Bear Creek, Upper East Fork Poplar Creek, and Chestnut Ridge and are based on topography and surface water and groundwater flow patterns.

The first division, based on topography, separates the BCV regimes from the Chestnut Ridge regime. While hydraulically interconnected, the distinct characteristics of the two major systems are sufficient to warrant their separation (Geraghty and Miller 1990a).

Surface water drainage in BCV is divided between the Bear Creek watershed and the Upper East Fork Poplar Creek watershed. A topographic divide, located at the west end of Y-12, separates the two surface water systems, acts as a shallow groundwater divide, and forms the boundary between the two hydrogeologic regimes.

Groundwater flow in all three regimes occurs in an interconnected aquifer comprising an upper zone of weathered, unconsolidated material overlying a lower bedrock zone. Whereas permeability may differ between the two zones, they both respond in the same general way to water-level fluctuations and groundwater flow directions.

The direction of groundwater flow in BCV is generally toward the two creeks that drain the valley. The details of groundwater flow direction are complicated by the nature of available flow paths in the underlying bedrock. BCV is underlain by rocks of the Conasauga Group, predominantly the Maryville Limestone (predominantly shale with interbedded limestone in the Oak Ridge area), the Nolichucky Shale, or the Maynardville Limestone (Fig. 2.8). The results of aquifer pumping tests in the Maryville and Nolichucky indicate the strong anisotropy of the formations where bedding planes provide the preferred pathways for groundwater flow. Studies of the Maynardville Limestone (which underlies both creeks throughout most of BCV) have shown that groundwater movement has been enhanced by solution-enlargement of structural and stratigraphic features such as fractures, joints, and bedding planes. This system of solution cavities is believed to be the major discharge area for groundwater. The hydraulic connection between Bear Creek (in BCV) and the Maynardville Limestone consists of a series of springs and a sequence of gaining and losing stream reaches wherein water alternately discharges from and to the Maynardville Limestone cavity system.

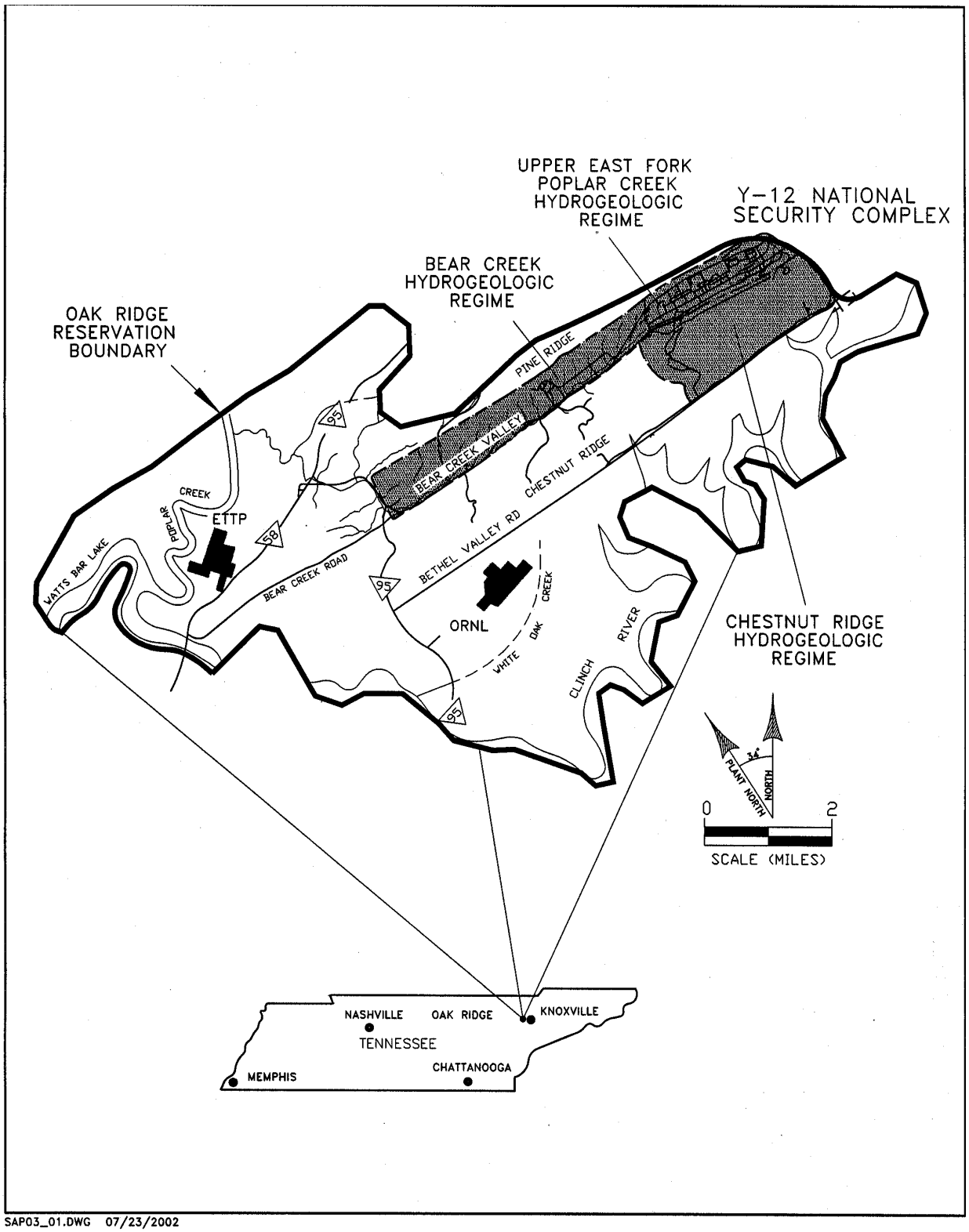


Fig. 2.9. Hydrogeologic regimes at the Y-12 National Security Complex.

2.2.4.2 Rationale and design criteria

In the past, groundwater effluent monitoring at Y-12 has been conducted primarily on a site-by-site basis. Monitoring results were reported to TDEC and EPA in site-specific annual Groundwater Quality Assessment Reports (GWQARs) or other site-specific documents. Monitoring data collected since 1986 indicate that contaminant plumes from many waste disposal units have overlapped and that contaminant releases from solid waste management units (SWMUs) may also have contributed to these plumes.

Based on these findings, it was determined that a larger perspective on the assessment of groundwater contamination was needed than could be achieved in site-specific annual GWQARs. Therefore, a comprehensive groundwater monitoring program (Geraghty & Miller 1990a) was developed for Y-12 based on the naturally occurring topography, surface water drainage, and groundwater flow patterns (i.e., hydrogeologic regimes). This comprehensive program consolidates all groundwater sampling under one comprehensive sampling program. In 1997 monitoring responsibilities were split between DOE-EM and NNSA contractors. However, the larger perspective concept and approach of hydrogeologic regimes has not changed.

In November 1989, ORR was added to the NPL and in January 1992, DOE, EPA, and TDEC negotiated an FFA regarding environmental restoration at ORR under CERCLA. Under this agreement, CERCLA became the lead regulatory requirement for several RCRA treatment, storage, and disposal (TSD) units at Y-12. Therefore, DOE appealed the applicability of RCRA postclosure care, corrective action, and groundwater monitoring requirements to CERCLA operable units (OUs).

In April 1993, DOE, TDEC, and Martin Marietta Energy Systems signed an Agreed Order for a postclosure permit for the S-3 Site, thereby resolving the appeal and formally agreeing to proceed with CERCLA as a lead regulatory program with RCRA as an applicable or relevant and appropriate requirement (ARAR). Under this agreement, RCRA is applied as an ARAR to the extent that postclosure maintenance and care of former TSD facilities is conducted in compliance with the terms of RCRA postclosure permits. Groundwater monitoring is integrated with CERCLA RI/FS programs, with RCRA corrective action deferred to CERCLA. Groundwater monitoring data reporting complies with RCRA postclosure permit conditions as well as CERCLA requirements.

2.2.4.3 Extent and frequency of effluent monitoring

Groundwater effluent data are currently collected to meet the requirements of nonhazardous, permitted solid waste disposal facilities (SWDFs); RCRA postclosure corrective action and detection monitoring; CERCLA Records of Decision (RODs); and some RI/FS monitoring. To address the various objectives for the collection of data and ensure a technical consistency to the data collection and evaluation process, equivalent procedures and open communications are implemented by each of the respective groundwater monitoring programs.

Details of the extent and frequency of sampling for each hydrogeologic regime are described in annual groundwater monitoring reports for each hydrogeologic regime. Sampling and analysis plans (BWXT 2002d) are prepared annually, noting locations for sampling, frequency, and parameters for analysis. A generalized list of groundwater parameters is given in Table 2.4. Semiannual monitoring reports are also required for SWDFs and RCRA postclosure monitoring.

2.2.4.4 Procedures for sampling and laboratory analysis

A laboratory QA plan (BWXT 2002c) for groundwater monitoring activities performed by the Y-12 Groundwater Protection Program (GWPP) governs sample analysis, laboratory QC/QA, and data approval evaluation. Separate procedures govern groundwater sampling (BWXT 2002b). The procedures in both the laboratory QA plan and the sampling program are based on EPA-approved laboratory procedures.

2.2.4.5 QA requirements

A comprehensive quality program plan (QPP) has been prepared for the Y-12 GWPP [Science Applications International Corporation (SAIC) 1994].

A data management plan, which incorporates sample tracking and data transfer, data screening, verification, entry into the database, and data validation and evaluation, was issued in 2000 (SAIC 2000).

2.2.4.6 Program implementation procedures

DOE Order 5400.1 requires the GWPP management plans to be reissued every 3 years. To meet this requirement, the Y-12 GWPP management plan was revised and reissued in 2001 (BWXT 2001). This program plan outlines the various elements of GWPP and discusses the overall program structure. Programmatic element plans detail operational requirements for sampling and analysis, data management, health and safety, and other elements.

2.2.4.7 Preparation and disposition of reports

The Y-12 GWPP coordinator is responsible for the preparation of all DOE Order-required reports and for coordinating groundwater surveillance input to ASER. The groundwater monitoring program responsibilities are split between DOE-EM and NNSA contractors at Y-12. All data collected by the Y-12 GWPP and DOE-EM contractors are compiled and evaluated in the annual groundwater monitoring report. In addition, specific reports required by permits (e.g., SWDF operating permits and RCRA postclosure permits), by CERCLA requirements, or by special studies are prepared separately and submitted to the appropriate regulatory groups or customer organizations by the appropriate monitoring programs.

Table 2.4. Parameters for groundwater effluent monitoring at the Y-12 National Security Complex[a]

Metals
Total uranium
Specific conductivity
Total suspended solids
Turbidity
Gross alpha
Gross beta
Volatile organic compounds
Major anions
Total dissolved solids
Field measurements
Radionuclides[b]
Alkalinity

[a]Specific details for each location can be found in the annual sampling and analysis plan.

[b]Selected sites only, based on regulatory requirements (i.e., CERCLA, RCRA, TDEC SWDF) and DOE Order 5400.5.

2.3 AIRBORNE

2.3.1 ORR

2.3.1.1 Introduction

Certification was submitted to EPA staff in January 1993 to indicate that all actions required under the Federal Facilities Compliance Agreement (FFCA) were complete and ORR facilities were in compliance with NESHAP. This includes *National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities* (EPA 1993), referred to hereafter in Sect. 2.3 as "NESHAP." The number of major sources may vary from year to year, depending upon operating hours of the process or processes involved and minor changes in the meteorological and wind rose data. All major sources will be sampled continuously as required by 40 CFR 61.93(b)(1, 2) or by an approved alternative method under 40 CFR 61.93(b)(3) and the *Regulatory Guide*. Radionuclides that contribute ∃10% of the resulting dose from each release point will be analyzed.

Each source is permitted in accordance with regulations developed and enforced by TDEC and EPA. Point sources that emit radionuclides are regulated through Tennessee's NESHAP

program. EPA developed criteria for periodic and continuous monitoring of air pollutants released into the atmosphere, and these criteria are documented in the ORR NESHAP compliance plan (Energy Systems 1994a) and in this EMP. The design, techniques, and QA planning for airborne emissions sampling are part of a total program of environmental management to ensure that emissions are within regulatory standards.

Definitions

- An effluent, for the purpose of this EMP, is any air emission released into the atmosphere at a DOE site or facility.
- NESHAP is a set of EPA standards that set regulatory limits for the airborne release of hazardous air pollutants.
- An off-line monitoring system is one in which a sample is withdrawn on a short-term basis from the effluent stream for collection or conveyance to a detector or assembly.
- TDEC and EPA Region IV are regulatory agencies responsible for enforcing the Clean Air Act.
- Continuous monitoring is the real-time measurement of contaminants in liquid, gaseous, and/or airborne effluents using in situ measurement systems.
- Continuous sampling is the continuous collection of a liquid, gaseous, and/or airborne effluent for analysis at a later time.

This section documents the rationale, design, frequency, QCs, and analytical procedures for airborne effluent monitoring on each facility at ORR and is designed to satisfy the criteria in applicable state and federal regulations and DOE orders. Radionuclide and nonradionuclide emission sources will be addressed separately for each ORR facility.

At the end of each facility's section, a subsection titled "Additional program activities" describes effluent monitoring programs that are not mandated by regulation, but are voluntary BMPs. The additional monitoring data from these programs are used for internal self-assessment only, so the monitoring criteria of DOE and state and federal regulations do not apply.

2.3.1.2 Rationale

For purposes of compliance, a major source is a release point that has the potential to emit, during 1 year, radionuclides that can cause an individual member of the public off site to receive an annual effective dose equivalent (EDE) >0.1 mrem. A minor source is a release point or group of release points that have the potential to emit radionuclides that produce a dose <0.1 mrem/year. In accordance with the FFCA compliance plan, the potential to emit may be calculated using stack sampling data. When calculating "potential emissions," it is assumed that pollution abatement equipment does not exist, but the facility or process operations are otherwise normal. This definition is consistent with 40 CFR 61.93(b)(4)(ii). Equipment integral to the proper operation of the process will not be considered abatement even though radionuclides may be removed by this equipment. In other words, if the process could not function as intended without the equipment, it is considered integral to the process and will not be considered

abatement equipment. NESHAP regulations and the *Regulatory Guide* criteria require that all emission points with potential doses >0.1 mrem/year be sampled continuously.

The development of an airborne effluent monitoring program for airborne emissions is required under guidelines set by EPA, TDEC, and DOE. Specifically, standards established by EPA for radionuclides are found in NESHAP regulations at 40 CFR 61, Subpart H.

The guidelines set by DOE are noted in DOE Orders 5400.1 and 5400.5 and in the *Regulatory Guide*. In addition to following regulatory and DOE guidelines, air pollutant sources will require stack monitoring if they are

- sources with air pollution permits that have specific conditional emission restrictions (e.g., opacity limits, mass limits) with which compliance cannot be verified through current means (i.e., engineering calculations, mass balance determinations, published emission factors, or other accepted means); or
- unmonitored air pollutant sources recommended, through NEPA documentation, to be monitored.

An assessment of radiological airborne effluents to the off-site environment is required by NESHAP and DOE Order 5400.1.

The following steps will be taken to document compliance with opacity limits.

- Under normal process operation, visible emission (VE) readings (EPA Method 9) or continuous opacity monitoring will be conducted at selected emission points. The frequency of the reading will depend on the variability of the process.
- When possible, VE readings will be taken during unusual occurrences and/or malfunctions in process equipment that may affect opacity.
- A summary of VE evaluations will be referenced in the ORR ASER.

2.3.2 ETTP

2.3.2.1 Site operations

ETTP continuously monitors any source (while operating) at the stack for radiological and nonradiological air pollutants if required by regulations. One example of an ETTP radiological source, the K-1435 TSCA incinerator (Fig. 2.10), has the potential for radionuclide emissions exceeding 0.1 mrem/year and therefore is subject to regulatory requirements in NESHAP (40 CFR 61, Subpart H) and DOE orders. Radiological effluent is continuously sampled at the TSCA incinerator, and samples are taken weekly.

Continuous monitoring of nonradiological emissions is required at the TSCA incinerator. The incinerator is continuously monitored for carbon monoxide (CO), carbon dioxide (CO_2), and oxygen (O_2) to ensure the incinerator's destruction and removal efficiency (DRE) of 99.99% for nonradiological

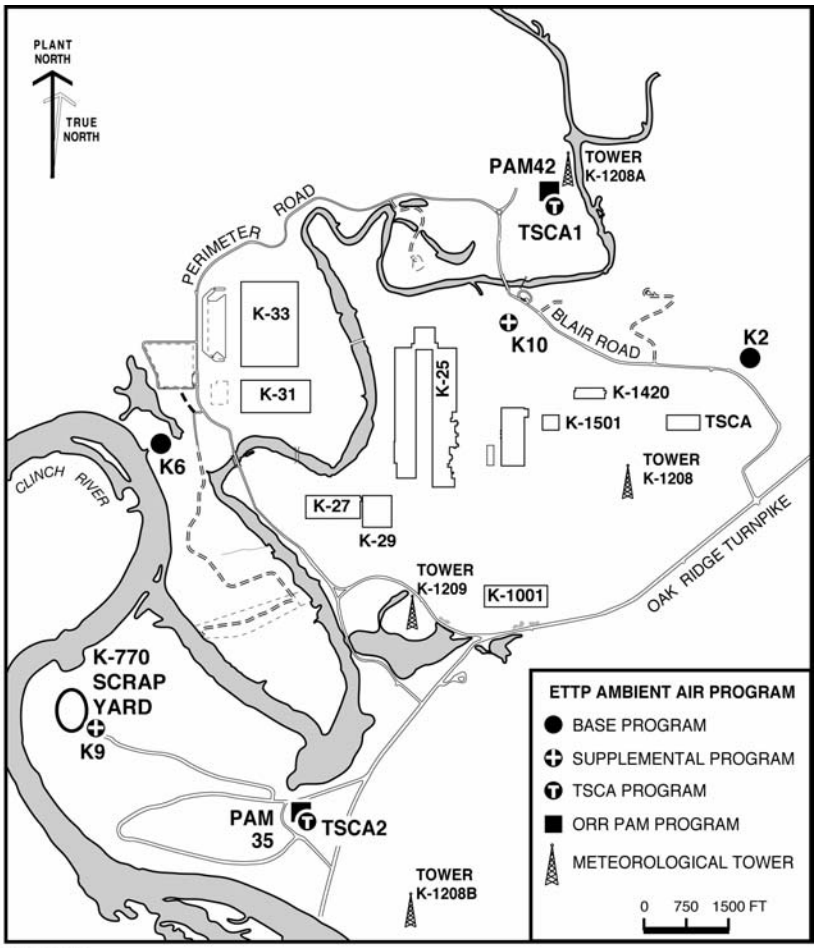


Fig. 2.10. Location of the K-1435 Toxic Substances Control Act Incinerator at the East Tennessee Technology Park.

organics. TDEC approves the DRE as confirmation of regulatory compliance. The waste feed on the incinerator will shut off if the CO or O_2 parameters exceed permitted limits.

2.3.2.2 Design criteria

The design criteria for an acceptable radionuclide effluent monitor are documented in the ORR NESHAP compliance plan (Energy Systems 1994a). The compliance plan also addresses many of the requirements stated in the *Regulatory Guide* and DOE 5400-series orders. A NESHAP compliance plan has been approved by EPA. A preoperational assessment will be made for any new or modified source affecting radionuclide emissions and/or the current monitoring program's effectiveness. Specific sampling and monitoring methodologies and operating procedures are listed in the following sections.

Radiological

The K-1435 TSCA incinerator (Fig. 2.10) is an example of a continuously stack-sampled source of radionuclides. If other sources requiring continuous sampling are started in the future, they will be sampled according to the radionuclide portion of the NESHAP requirements. An acceptable monitor design is a modified EPA Method 5 bubbler designed to sample isokinetically within 10% as mandated in NESHAP regulations and the *Regulatory Guide*. Isokinetic variation will be checked routinely, and adjustments will be made to the sampler flow rate if necessary. Sampling velocity variation with stack gas velocity greater than 10% will require an instrumentation check. The system will be leak-checked weekly in accordance with EPA Method 5 requirements. All radionuclides that could individually contribute more than 10% of the potential EDE for a release point shall be measured. Other identifiable radionuclides will be measured based on the individual requirements for each source.

Total radiological activity measurement and gamma spectroscopy will be performed on each sample as required for determining emissions from a source.

Nonradiological

The K-1435 TSCA incinerator is an example of nonradiological continuous monitoring of CO_2, CO, and O_2 to ensure that the DRE for organics is maintained at 99.99%. The unit is shut down if the CO or O_2 levels exceed permitted limits. Design criteria of the TSCA Gas Monitoring System follows EPA 40 CFR 264, Subpart O requirements.

2.3.2.3 Extent and frequency of monitoring

Radiological

The K-1435 TSCA incinerator is continuously stack-sampled for radionuclides (Sect. 2.3.2.2). Stack gas and sample gas flow conditions are continuously monitored electronically. Monitored sample gas velocity is controlled to within ±10% of monitored stack gas velocity.

Nonradiological

The K-1435 TSCA incinerator is continuously monitored for CO, CO_2, and O_2. The incinerator will shut down if these parameters exceed regulatory and permit requirements. Any other sources requiring nonradiological monitoring will incorporate similar operational standards and safeguards.

2.3.2.4 Procedures for laboratory analysis

General guidelines for laboratory analysis and procedures for ORR are documented in Sect. 5 of this EMP. Specific procedures are as follows:

Radiological

Sampling and analytical plans developed by contractors specify the appropriate operating procedures. These plans must meet the requirements stated in Chap. 6 of the *Regulatory Guide*. Table 2.5 lists the minimum detection limits for some of the radionuclides potentially sampled at the TSCA incinerator. Other source-specific procedures will be prepared specific to the requirements of the individual source.

Table 2.5. Minimum detection limits for National Emission Standards for Hazardous Air Pollutants filters and solutions for Toxic Substances Control Act incinerator[a] sampling

Radionuclide	Filter (pCi/filter)	Solution (wash or inpinger) (pCi/L)
^{238}Pu	5	10
$^{239/240}Pu$	5	5
^{237}Np	5	5
^{228}Th	5	10
^{230}Th	2	5
^{232}Th	2	5
Uranium alpha	1	5
^{99}Tc	550	4,000
^{234m}Pa	4,000	27,000
^{137}Cs	25	40

[a]This list represents only a sampling of minimum detection limits for radionuclides. Other minimum detection limits will be established based on the actual menu of measured radionuclides.

Nonradiological

The K-1435 TSCA incinerator CO, CO_2, and O_2 monitors are examples of real-time extractive monitors that demonstrate destruction efficiencies of the incinerator. Other sources may require different uses of nonradiological monitoring data.

2.3.2.5 QA/QC requirements

General QA/QC requirements for each site are documented in Sect. 9 of this EMP. Routine calibration of the sampling and monitoring systems at the ETTP will be done annually. In addition, calibration will be done before the monitor or sampler is used and when the monitor or sampler is subject to maintenance and/or modification.

QA/QC requirements for radiological sources subject to NESHAP 40 CFR 61, Subpart H requirements will follow QA criteria stated in EPA 40 CFR 61, Appendix B, Method 114.

Radiological

The minimum required QA/QC procedures for radionuclide sampling at ETTP are documented in the current site NESHAP QAP (Lockheed 1997a). Source-specific QA/QC requirements will be addressed in individual source documentation.

Nonradiological

All CO_2, CO, O_2, and other nonradiological monitors are operated in accordance with the QA/QC procedures noted in EPA 40 CFR 60 Appendix F.

2.3.2.6 Data analysis and statistical treatment

Overall data analysis and statistical treatment of airborne effluent data for ETTP shall follow guidelines stated in Sect. 7 of this EMP. The following are examples of specific procedures.

Radiological

The data analysis and statistical treatment quantifying radiological emissions from the TSCA incinerator are referenced in the current version of sampling and analysis plans and the operating procedures developed by the contractors.

Nonradiological

The K-1435 TSCA incinerator CO_2, CO, and O_2 monitors do not require data or statistical analysis.

2.3.2.7 Reporting requirements

The following reports concerning airborne effluent monitoring will be submitted in compliance with the following orders and regulations:

Radiological and nonradiological

DOE Order 5400.1:

- An annual submission of the Radiological Effluent Information System/On-site Discharge Information System Report,
- An ASER, and
- A report documenting significant nonroutine releases of any pollutant or hazardous substance.

DOE Order 232.1A, *Occurrence Reporting and Processing of Operations Information*, requires reports of unusual occurrences (i.e., effluent monitor malfunction, abnormal operation, etc.).

DOE Order 231.1, *Environment, Safety and Health Reporting*, establishes requirements for reporting to DOE on matters of significance to environmental protection, safety, and health protection.

Radiological

DOE Order 5400.5 states policy on notification of significant actual or potential exposures of the public to radionuclides.

The *Regulatory Guide* addresses timely notification of occurrences in environmental surveillance and effluent monitoring. Section 5 of this EMP describes criteria to be met in reporting analytical results.

NESHAP 40 CFR 61, Subpart H:

- A report to EPA headquarters and Region IV or to the delegated state technical administrator is required by June 30 of each year (CFR 1993). This report pertains to monitoring results and dose calculations and must follow strict guidelines defined in 40 CFR 61.94.

- If the facility exceeds emission limits, it will report remediation progress monthly to the administrator until the administrator has determined that reports are no longer necessary.

Nonradiological

EPA 40 CFR 264, Subpart O requires records to be available regarding continuous measurements of CO_2, CO, and O_2 at the K-1435 TSCA incinerator. Emissions data specific to the requirements of the individual source will be available from other sources.

2.3.2.8 Recordkeeping requirements

Section 9 of this EMP documents general recordkeeping procedures. Specific recordkeeping responsibilities should be assigned and documented at ETTP to ensure that records are organized, complete, and accurate. The following recordkeeping requirements apply to all sites:

Radiological and nonradiological

DOE Order 5400.1: The EC organization shall maintain documentation of responses to environmental occurrences and have them available for regulatory agency inspectors, DOE auditors, and the general public.

Radiological

DOE Order 5400.5:

- Information and data that identify and characterize releases of radioactive material (effluent) to the environment, its fate in the environment, and its probable contribution to radiation doses to the public will be retained by the EC organization consistent with the requirements of DOE Order 1324.2A as well as any other applicable requirements.

- A permanent record will be documented and filed concerning applications of the as low as reasonably achievable (ALARA) policy.

Regulatory Guide:

- Auditable records relating to environmental surveillance and effluent monitoring will be maintained by the EC organization. These include, but are not limited to, calculations, computer programs, and other forms of data.

- Reports or data from studies conducted to evaluate the operational performance or real or suspected deficiencies of the systems will be provided at the operating facility.

- Records documenting QA/QC will be maintained in auditable condition.

NESHAP (40 CFR 61, Subpart H):

- Documentation of calculations, measurements, methods, input parameters, and procedures used to estimate dose equivalent shall be kept on site by the EC organization for a minimum of 5 years. These records will be sufficient to enable an independent audit to verify compliance. Records will be made available for inspection at EPA's request.

Nonradiological

EPA 40 CFR 264, Subpart O requires records to be kept concerning CO_2, CO, and O_2 parameters.

2.3.2.9 Additional program activities

No additional airborne effluent surveillance is being done at this time.

2.3.3 ORNL

2.3.3.1 Site operations

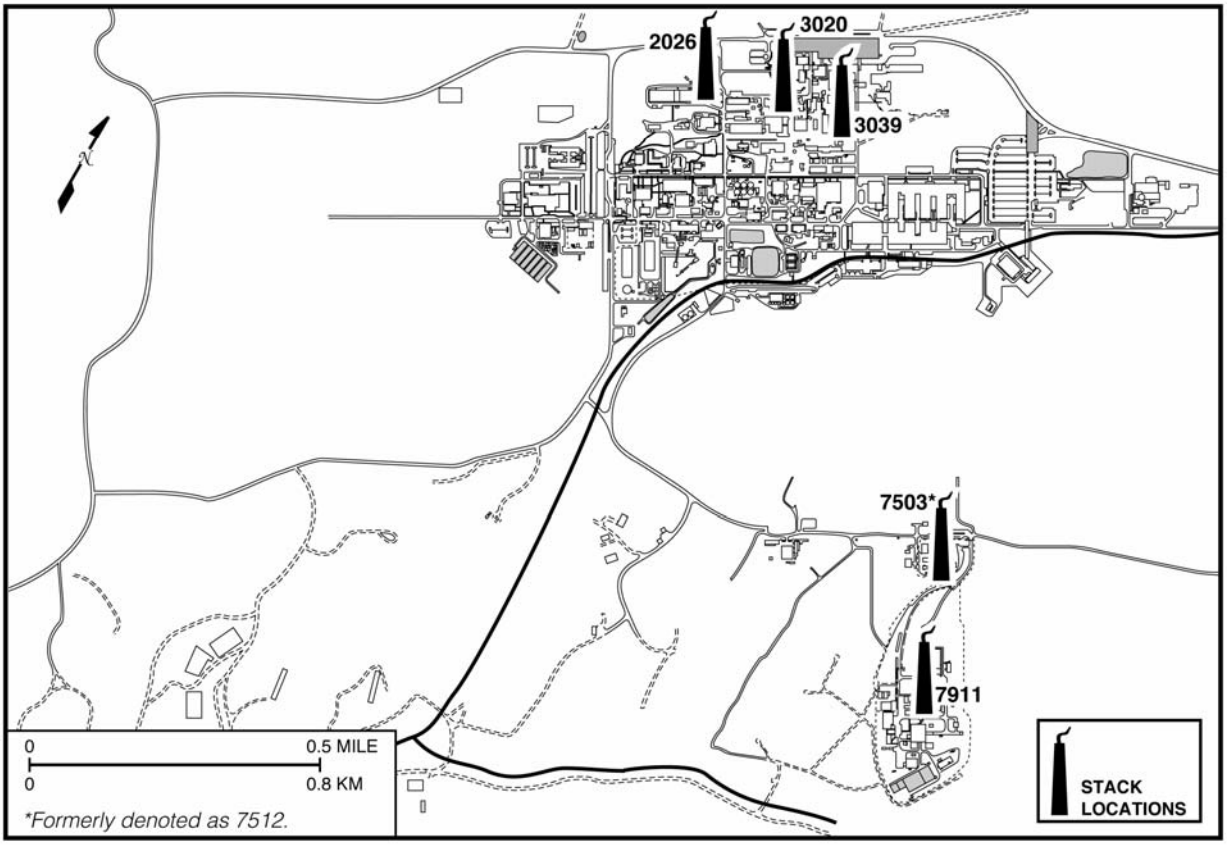
ORNL has five sources with the potential for doses >0.1 mrem/year: (1) Stack 7911, (2) Stack 2026, (3) Stack 3020, (4) Stack 3039, and (5) Stack 7053 (Fig. 2.11). Each stack is currently being continuously sampled. All sampling systems have been upgraded and meet NESHAP requirements.

Nonradiological effluents at ORNL result mainly from experiments at the laboratory and the operation of the ORNL Steam Plant, and a smaller portion result from routine maintenance functions. Effluents resulting from experiments are emitted through hundreds of small vents around the laboratory, and many individual vent effluents will change depending on the experiment being conducted at the time. All effluent monitoring at ORNL is performed in accordance with monitoring requirements contained in air pollution operating permits issued by TDEC.

2.3.3.2 Sampling systems

ORNL has five stacks that are continuously sampled for radiological effluent as required by NESHAP and the *Regulatory Guide*.

- Stack 2026 sampling systems consist of a sampling probe with five nozzles, samples transport line, glass fiber particulate filter, multiple impregnated charcoal canisters, a tritium collection system, mass-flow controllers, pumps, and sample return line. The sampling probe is located at the 35-ft level in the stack.
- Stack 3020 sampling systems consist of a sampling probe with six nozzles, samples transport line, glass fiber particulate filter, mass-flow controller, pump, and sample return line. The sampling probe is located at the 50-ft level in the stack.
- Stack 3039 sampling systems consist of a sampling probe with eight nozzles, samples transport line, glass fiber particulate filter, multiple impregnated charcoal canisters, a tritium collection system, mass-flow controllers, pumps, and sample return line. The sampling probe is located at the 50-ft level in the stack.
- Stack 7503 sampling systems consist of a sampling probe with five nozzles, samples transport line, glass fiber particulate filter, a tritium collection system, mass-flow controllers, pumps, and sample return line. In addition, adsorbable gases are sampled using a sample probe consisting of a single nozzle, samples transport line, impregnated charcoal column and canister, mass-flow controller, pump, and sample return line. The sampling probes are located at the 50-ft level in the stack.
- Stack 7911 sampling systems consist of a sampling probe with six nozzles, samples transport line, glass fiber particulate filter, multiple impregnated charcoal canisters, a tritium collection system, mass-flow controllers, pumps, and sample return line. In addition, noble gas is monitored using an in-line detector. The sampling probe is located at the 50-ft level in the stack.



YGG 03-0087

Fig. 2.11. Location of major emission points at Oak Ridge National Laboratory.

2.3.3.3 Extent and frequency of monitoring

Radiological

ORNL will continuously sample stacks 2026, 3020, 3039, 7053, and 7911 for radionuclide emissions. The collection media, sample frequencies, and analytical parameters are shown in Table 2.6. In addition, the monitoring system at Stack 7911 contains a continuous on-line detector to quantify specific noble gas isotopic concentrations in the stack. The system consists of a high-purity germanium detector with a NOMAD analyzer.

Table 2.6. Oak Ridge National Laboratory stack sampling parameters

Sampling media	Sampling frequency	Analytical parameters
Particulate filter	Weekly	Gross alpha Gross beta, gamma scan
Particulate filter	Quarterly Composite	Isotopic analysis
Charcoal cartridge	Weekly	Gamma scan
Silica gel	Weekly	Tritium

Nonradiological

The ORNL Steam Plant boiler emissions are continuously monitored for opacity. In addition, visible emissions of effluents from other nonradiological sources are periodically monitored using EPA Method 9 to ensure that emission sources conform to visibility standards set in their permits. All other nonradiological sources of effluents are monitored in accordance with methods specified in their operating permits or by use of inventory and air quality modeling techniques.

2.3.3.4 Procedures for laboratory analysis

Laboratory procedures are found in Sect. 5 of this EMP.

2.3.3.5 QA/QC requirements

General QA/QC requirements for each site are documented in Sect. 9 of this EMP. In addition, a specific NESHAP QAP was completed and implemented in 1992 (Energy Systems 1992a). For QA/QC requirements for radiological sources subject to NESHAP (40 CFR 61, Subpart H), requirements will follow QA criteria stated in EPA 40 CFR 61, Appendix B, Method 114.

2.3.3.6 Data analysis and statistical treatment

Overall data analysis and statistical treatment of airborne effluent data for ORNL shall follow guidelines in Sect. 7 of this EMP.

2.3.3.7 Reporting requirements

The following reports concerning airborne effluent monitoring will be submitted in compliance with the following orders and regulations:

Radiological and nonradiological

DOE Order 5400.1:

- An ASER,
- A report documenting significant nonroutine releases of any pollutant or hazardous substance in accordance with the requirements of DOE 5484.1, and
- An annual submission of the Radiological Effluent Information System/On-Site Discharge Information Report.

DOE Order 5000.3A, *Unusual Occurrence Reporting System*, requires reports of unusual occurrences (i.e., effluent monitor malfunction, abnormal operation, etc.).

DOE Order 5484.1, *Environmental Protection, Safety and Health Protection Information Reporting Requirements*, establishes requirements and procedures for investigating and reporting to DOE on matters of significance to environmental protection, safety, and health protection.

Radiological

DOE Order 5400.5 states policy on notification of significant actual or potential exposures of the public to radionuclides. Section II.7 requires the reporting "of actual or potential exposures of members of the public that could result in either an EDE from DOE sources exceeding 10 mrem in a year; or exceeding any limit or not meeting any other requirement specified in the order or any other legally applicable limits, or a combined dose equivalent to or greater than 100 mrem EDE in a year due to DOE and other manmade sources of radiation (medical, consumer products, and natural sources excepted)."

The Regulatory Guide addresses timely notification of occurrences in environmental surveillance and effluent monitoring.

NESHAP 40 CFR 61, Subpart H:

- A report to TDEC is required by June 30 of each year (CFR 1993). This report pertains to monitoring results and dose calculations and must follow strict guidelines that are described in 40 CFR 61.94.

- If the facility exceeds emission limits, it will report remediation progress monthly to the TDEC technical secretary until the technical secretary has determined that reports are no longer necessary.

2.3.3.8 Recordkeeping requirements

Section 9 of this EMP documents general recordkeeping procedures required by NQA-1. EPWS at ORNL will maintain required records. In addition, the following records will be maintained:

Radiological and nonradiological

DOE Order 5400.1: ORNL's Environmental Safety, Health and Quality (ESH&Q) directorate shall maintain documentation of responses to environmental occurrences and have them available for regulatory agency inspectors, DOE auditors, and the general public.

Radiological

DOE Order 5400.5:

- Information and data that identify and characterize releases of radioactive material (effluent) to the environment, its fate in the environment, and its probable contribution to radiation doses to the public will be retained by ESH&Q in accordance with the requirements of DOE Order 1324.2A as well as any other applicable requirements.
- A permanent record will be documented and filed concerning applications of ALARA policy by ESH&Q.

Regulatory Guide:

- Auditable records relating to environmental surveillance and effluent monitoring will be maintained by ESH&Q. These include, but are not limited to, calculations, computer programs, and other forms of data.
- Records documenting QA/QC will be maintained in auditable condition by ORNL's EPWS.

NESHAP (40 CFR 61, Subpart H): Documentation of calculations, measurements, methods, input parameters, and procedures used to estimate dose equivalents shall be kept on site by EPWS for a minimum of 5 years. These records will be sufficient to enable an independent audit to verify compliance. Records will be made available for inspection at EPA's request.

Nonradiological

EPWS at ORNL maintains records documenting that permits have been issued for all emission sources at ORNL that require a permit and that no emission source is operating in violation of its current permit.

2.3.3.9 Additional program activities

A survey was performed at ORNL to review all sources of nonradiological emissions to determine the status of current air permits and whether additional air permits were required. Permitting exemptions for emission sources operating in Tennessee are given in 1200-3-9-.04 of the Tennessee Air Pollution Regulations.

2.3.4 Y-12 National Security Complex

2.3.4.1 Site operations

Procedures for permitting, compliance inspections, and documentation of compliance are in place. Assessments of significant air emission sources are conducted on a regular basis. Major source areas are appropriately permitted, and documentation of compliance is developed. A number of minor sources that are exempt from permitting under state of Tennessee rules are also addressed. All major emission sources are permitted by TDEC and are operating in compliance with those permits.

Y-12 has approximately 40 active air permits covering approximately 120 air emission points. The number of permits and permitted emission points has decreased because of the elimination of some operations and exemption of some points from permitting requirements.

An FFCA that established methods and schedules for DOE facilities on ORR to become fully compliant with NESHAP requirements was negotiated between DOE ORO and EPA in 1991 and signed in 1992. As required by the plan, Y-12 implemented a stack and vent survey to identify and characterize all radionuclide emission points. A report submitted to EPA in June 1992 identified all major and minor radionuclide emission points. Major radionuclide sources, as defined in the regulations, are continuously sampled to quantify emissions. Periodic emissions estimates will be made for the minor emission points as specified in the compliance plan. Certification was submitted to EPA in January 1993 indicating that all actions required under the FFCA were complete and that the ORR facilities were in compliance with NESHAP.

Nonradiological effluent monitoring at Y-12 is performed in accordance with monitoring requirements contained in air pollution operating permits issued by TDEC. Opacity monitoring is performed at the Y-12 Steam Plant using continuous opacity monitoring equipment.

2.3.4.2 Design criteria

A stack and vent survey has been conducted to identify and assign unique numbers to all emission points at Y-12. The potential of each stack and vent to emit hazardous materials has been assessed, which considered routine, accidental, and fugitive emissions. Those without any emission potential, such as steam vents, do not require further documentation. Emission estimates have been generated for the potentially hazardous points.

All Y-12 stacks that have the potential to contribute ≥0.1 mrem/year EDE to an off-site individual are sampled continuously in accordance with NESHAP and DOE requirements. The sampling methodology for these stacks is designed to provide a near-isokinetic sample flow rate. Each sampling system consists of a multiple-point sample probe, filter, and thermal mass sample flowmeter/controller. The continuous samplers use applicable methodologies specified by EPA and/or American National Standards Institute standard N 13.1-1969.

A plan for using these samplers to meet the requirements of the FFCA for NESHAP for radionuclides for sampling significant radionuclides emission points was completed in 1992. In order to comply with the FFCA, the uranium stack samplers at Y-12 have been modified to allow for leak testing. In addition, velocity profiles and measurement of probe retention factors are conducted on a quarterly basis. This action addresses prior concerns that the large variability in the measured stack velocities in some Y-12 stacks would prevent the continuous samplers from operating at acceptable isokinetic conditions and that the stack flow used in emissions calculations would be incorrect. For stacks that exhibit significant flow variation between quarterly measurement, a conservative method of calculating emissions was agreed to in exchange for not having to install expensive continuous stack flow monitors. EPA concurrence with this design was received in March 1993.

The minimum detection sampling limit for Y-12's continuous samplers is based on the laboratory analytical detection limit. For a one-day sample, the following are the minimum detection limits for an enriched or depleted uranium sample that is handled manually:

Depleted uranium: 6.9×10^{-16} Ci/m^3

Enriched uranium: 9.9×10^{-14} Ci/m^3

The above minimum detection levels are lower than the DCG levels in DOE Order 5400.5.

2.3.4.3 Extent and frequency of monitoring

At the end of 2002, continuous monitoring capability on 55 stacks was in place; however, 9 of these were temporarily shut down. Sample filters are removed from one to three times per week, depending on the emission potential from each individual stack. Sample results are normally obtained within 4 working days from the time the sample was taken. During 2002, 43 of the 55 Y-12 monitored stacks were judged to be major sources. Sources will be sampled in accordance with the requirements and guidelines stated in the NESHAP compliance plan.

All continuous stack sampling systems use a multipoint sampling probe that collects uranium particulate matter on a 47-mm diam filter paper. The filter paper is then analyzed for uranium by the Y-12 laboratory to quantify emissions. In addition, the sampling probes are removed quarterly and washed with nitric acid; the washing is analyzed for total uranium. The probe wash data are included in the final calculations in determining emissions from each stack.

The Y-12 Steam Plant boiler emissions are continuously monitored for opacity in accordance with TDEC permit requirements and Y-12 procedure USOP-009, "Steam Plant Procedure for Opacity Monitor Operation and Recording of Readings."

2.3.4.4 Procedures for laboratory analysis

Y-12 uses laboratory procedures Y/P65-7019, "Determination of Uranium in Process, Production, and Waste Samples by Trioclylphosphine Oxide (TOPO) Extraction and a Personal Computer-Controlled Fluorometer" [and ASO-TP-7224, "Determination of Uranium on Stack

Monitor Filters Using Kinetic Phosphorimetry" (manual)] for analysis of all radionuclide sources regulated through NESHAP and DOE.

2.3.4.5 QA/QC requirements

The *Oak Ridge Y-12 Plant Quality Assurance Project Plan National Emission Standards for Hazardous Air Pollutants (NESHAP) Radionuclide Emission Measurements* (Lockheed 1998) specifically addresses the QA/QC procedures developed for radionuclide sources at the Y-12 subject to NESHAP regulatory requirements. The steam plant continuous opacity monitor is calibrated in accordance with state air permit requirements.

2.3.4.6 Data analysis and statistical treatment

Data analysis and statistical treatment for quantifying radiological emissions are documented in Sects. 6 and 7.

2.3.4.7 Reporting requirements

The ASER may be submitted to meet the following reporting requirements for airborne effluent monitoring, provided it follows EPA 40 CFR 61.94 and applicable DOE guidelines. The following reports will be submitted in compliance with the following orders and regulations.

Radiological and nonradiological

DOE Order 5400.1:

- An ASER, and
- A report documenting significant nonroutine releases of any pollutant or hazardous substance.

DOE Order 232.1A, *Occurrence Reporting and Processing of Operations Information*, requires reports of unusual occurrences (i.e., effluent monitor malfunction, abnormal operation, etc.).

DOE Order 231.1, *Environment, Safety and Health Reporting*, establishes requirements for reporting to DOE on matters of significance to environmental protection, safety, and health protection.

Radiological

DOE Order 5400.5 states policy on notification of significant actual or potential exposures of the public to radionuclides.

Regulatory Guide:

- Addresses timely notification of occurrences in environmental surveillance and effluent monitoring.

- Section 5 of this EMP requires that certain criteria be met in reporting analytical results.

NESHAP (40 CFR 61, Subpart H):

- A report is required to EPA headquarters and Region IV by June 30 of each year. This report pertains to monitoring results and dose calculations and must follow strict guidelines that are defined in 40 CFR 61.94.

- If the facility exceeds NESHAP emission limits, it will report remediation progress monthly to the TDEC technical secretary until the technical secretary has determined that monthly reports are no longer necessary.

2.3.4.8 Recordkeeping requirements

Section 9 of this EMP documents general recordkeeping procedures. Specific recordkeeping responsibilities should be assigned and documented at Y-12 to ensure that records are organized, complete, and accurate. The following recordkeeping requirements apply to all sites.

Radiological and nonradiological

DOE Order 5400.1: Documentation of responses to environmental occurrences shall be maintained and be available for regulatory agency inspectors, DOE auditors, and the general public. These records are kept in the Occurrence Reporting System report files.

Radiological

DOE Order 5400.5:

- Information and data that identify and characterize releases of radioactive material (effluent) to the environment, its fate in the environment, and its probable contribution to radiation doses to the public will be retained by the EC organization in accordance with the requirements of DOE Order 1324.2A, as well as any other applicable requirements.

- A permanent record concerning applications of ALARA policy will be documented and filed.

Regulatory Guide:

- Auditable records relating to environmental surveillance and effluent monitoring will be maintained by the EC organization. These include, but are not limited to, calculations, computer programs, and other forms of data.
- Reports or data from studies conducted to evaluate the operational performance of real or suspected deficiencies of the systems will be provided at a single, readily accessible location.
- Records documenting QA/QC will be maintained in auditable condition.

NESHAP (40 CFR 61, Subpart H): Documentation of calculations, measurements, methods, input parameters, and procedures used to estimate dose equivalent are maintained by Y-12 for a minimum of 5 years. These records will be sufficient to enable an independent audit to verify compliance. Records will be made available for inspection at EPA's request.

2.3.4.9 Y-12 National Security Complex additional program activities

In addition to continuously sampling all radionuclide stacks that can potentially emit >0.1 mrem/year EDE to the off-site public (sources regulated by DOE and NESHAP), a number of other minor sources are continuously sampled at Y-12 as BMP.

Continuous breakthrough stack monitoring systems are used at Y-12 on stacks that could potentially emit significant quantities of radionuclides during a process upset or emission control device failure. These real-time monitoring systems provide alarm capability on these sources so that significant increases in radionuclide emission can be identified as quickly as possible. Actual emissions measurements are made based on laboratory results of the filter papers taken from the continuous stack sampling systems.

Laboratory procedures

- "Determination of Uranium in Process, Production, and Waste Samples by Trioclylphosphine Oxide (TOPO) Extraction and a Personal Computer-Controlled Fluorometer" (Y/P65-7019)

- "Determination of Uranium on Stack Monitor Filters, Using Kinetic Phosphorimetry" (ASO-TP-7224)

QA/QC procedures

A QAP for these sampling systems has been addressed in the *Oak Ridge Y-12 Plant Quality Assurance Project Plan for National Emission Standards for Hazardous Air Pollutants (NESHAP) Radionuclide Emission Measurements* (Lockheed 1998).

Data analysis and statistical treatment

Data analysis and statistical treatment are noted in the laboratory procedures stated above.

2.3.5 *Regulatory Guide* Performance Criteria

a. All airborne emissions from each facility (DOE site) *should be evaluated and their potential for release of radionuclides assessed. Based on this assessment decisions *should** be made regarding necessary effluent monitoring systems and the rationale *should** be documented in the site EMP. The potential for emissions *should** include consideration of the loss of emission controls while otherwise operating normally.**

An initial comprehensive analysis was conducted in 1992. This survey is reviewed annually for completeness.

b. Airborne emissions from DOE-controlled facilities that have the potential for causing doses exceeding 0.1 mrem (EDE) to a member of the public under realistic exposure conditions from emissions in a year *should be monitored in accordance with the requirements of DOE 5400.1 and DOE 5400.5.**

ETTP has identified one source that has the potential for causing doses exceeding 0.1 mrem to members of the public in a year. The K-1435 TSCA incinerator will be monitored as required by DOE Orders 5400.1 and 5400.5 and NESHAP.

ORNL has identified four sources that have the potential for causing doses exceeding 0.1 mrem to members of the public in a year. Facilities 2026, 3020, 3039, and 7911 will be monitored as required by DOE Orders 5400.1 and 5400.5 and NESHAP.

Y-12 identified 55 sources in 1996 that have the potential for causing doses exceeding 0.1 mrem to members of the public in a year. Each of these will be monitored as required by DOE Orders 5400.1 and 5400.5 and NESHAP.

Radiological sources are reviewed annually, and additional monitoring will be conducted if facilities identify any unsampled emission sources with the potential for causing doses exceeding 0.1 mrem/year to a member of the public.

c. The criteria for monitoring listed in Chap. 3 of this guide *should be used to establish the airborne emission monitoring programs for DOE-controlled sites.**

All sources on ORR that have the potential to contribute 0.1 mrem in a year will be continuously sampled. Radionuclides that contribute 10% or more of the dose will be identified, assessed, documented, and verified annually. For sources with potential emissions <0.1 mrem/year, measurements, including engineering calculations, will be conducted periodically. The frequency of periodic measurements will depend upon variability in the sources' emissions.

d. For all new facilities or facilities that have been modified in a manner that could affect effluent release quantity or quality or that could affect the sensitivity of monitoring or surveillance systems, a preoperational assessment *should be made and documented in the site EMP to determine the types and quantities of airborne emissions to be expected from the facility, and to establish the associated airborne emission monitoring needs of the facility.**

ETTP, ORNL, and Y-12 each have an environmental review and documentation organization reporting to an environmental manager at each site who is responsible for ensuring that all environmental documentation requirements for projects are met. The basis for this organization is the institutionalization of NEPA determinations of environmental impact. A synopsis of the review documents, including the project name, reference number, and whether the project was assessed to have net impact upon airborne emissions, will be maintained on file at each site.

e. The performance of the airborne emissions monitoring system *should be sufficient for determining whether the releases of radioactive materials are within the limits or requirements specified in DOE 5400.5.**

Performance and level of detection for each isotope is discussed in the site NESHAP QAP as required by 40 CFR 61, Subpart H, Method 114.

f. Sampling and monitoring systems *should be calibrated before use and recalibrated any time they are subject to maintenance or modification that may affect equipment calibration.**

All equipment is calibrated prior to on-line operation and after maintenance or modification that may affect calibration.

g. Sampling and monitoring systems *should be recalibrated at least annually and routinely checked with known sources to determine that they are consistently functioning properly.**

All applicable sampling and monitoring systems on ORR are calibrated at least annually.

At ETTP and ORNL, sampling system components (mass-flow controllers and totalizers) will be calibrated based on instrument drift. The calibrations will be done at a minimum annually.

Y-12 continuous samplers and continuous monitors are calibrated on a quarterly basis and the continuous monitors are checked with a known radioactive source.

h. Provisions for monitoring of airborne emissions during accident situations *should be considered when determining routine airborne emission monitoring program needs.**

All airborne radionuclide emissions monitoring programs for sources >0.1 mrem/year on the ORR are designed to operate continuously with periodic collection of sampling media. In the event of an accident, the sampling media of an affected area will be sampled upon notification and analyzed if it is determined that sample data may help quantify the effects of the accident.

i. Diffuse sources (i.e., area sources or multiple point sources in a limited area) *should be identified and assessed for their potential to contribute to public dose and *should** be considered in designing the site emissions monitoring and environmental surveillance program. Diffuse sources that may contribute a significant fraction (e.g., 10%) of the dose to members of the public resulting from site operations *should** be identified, assessed, documented, and verified annually.**

ETTP, Y-12, and ORNL will identify and assess diffuse sources for their potential to contribute to public dose. The EMP will take into account diffuse sources that contribute more than 10% of the off-site dose. Those sources will be identified, assessed, documented, and verified periodically. The frequency of verification will be contingent upon the magnitude of dose and potential for change.

j. Airborne emission sampling and monitoring systems *should demonstrate that quantification of airborne emissions is timely, representative, and adequately sensitive.**

The ORNL continuous stack samplers currently monitor for a variety of airborne constituents including radiological particulates, adsorbable gases, tritium, and noble gases. The particulate filters are collected weekly. The initial analysis includes a gamma scan and eighth-day analysis for gross alpha and beta. Results from this analysis are received approximately 2 weeks after samples are collected. To increase sensitivity, the filters are then held for a quarterly composite for isotopic analysis. The charcoal canisters are collected weekly and analyzed using a gamma scan for iodine and other adsorbable gases. The results are normally reported within 3 to 5 working days. For iodine-129, the canisters are held for 60 to 90 days to allow other isotopes to decay out before counting. These results are reported 4 to 6 months after collection. The silica gel is collected weekly. Routine turnaround is 2 to 4 weeks after sample collection. The noble gas monitors are read and recorded weekly. The total counts are converted to specific isotopes using isotopic ratios.

Y-12 continuous sampler and continuous monitor filters are changed one to three times per week. The laboratory analysis detection limit for the filters is <1μg of uranium per filter, and the turnaround time is 4 to 7 working days on regular samples and 24 hours on

rush samples. The continuous monitors are designed to generate an alarm within 1 hour in response to a slope of 50 d/min/min.

As information is collected during the comprehensive analysis of radionuclide sources for facilities on the ORR, this data will be evaluated and conclusions included in the revised EMP.

k. To the extent practicable, samples *should be extracted from the effluents from a location and in a manner that provides a representative sample, using multiport probes if necessary.**

The radionuclide airborne emissions sampling program for sources with a dose >0.1 mrem/year at ORR are designed to comply with the requirements specified by EPA and any variance allowed.

l. Where a significant potential (greater than once a year) exists for approaching or exceeding a large fraction of the emission standard (e.g., 20%), continuous monitoring *should be required.**

Section 3.0 of the *Regulatory Guide* indicates that "the potential for emissions *should** include consideration of the loss of emission controls while otherwise operating normally." To ensure consistent interpretation of this requirement, a decision on whether to install a continuous (real-time) monitoring system will be based on the following:

For emission points with annual uncontrolled emissions resulting in a dose >20% of the standard (2 mrem), an evaluation of the need for a continuous monitoring system will be conducted. For this evaluation, it will be assumed that effluent controls are nonexistent for the amount of time required to identify that the controls have failed or are not operational. This amount of time will be dependent on the existence of alarms or other systems to signal that the emission controls have failed. When such alarms or systems are not in place to signal failure of emission controls, the period shall be the amount of time required to identify that a release has occurred using the results from the continuous sampling system. This time period will be dependent on the amount of time required to obtain analytical results from the continuous sampler. If the uncontrolled emissions during the established time period exceed 2 mrem, a continuous monitoring system will be installed. In addition to failure of emission controls, consideration should also be given to unplanned releases.

Continuous monitoring systems may also be installed as a BMP on emission points not meeting the above criteria.

m. The design of radioiodine monitors will be such that replacement of sorbent and filter *should not disturb the geometry between the collector and detectors.**

ETTP: N/A
ORNL: N/A
Y-12: N/A

n. To signal the need for corrective actions that may be necessary to prevent public or environmental exposures exceeding the limits or recommendations given in DOE 5400.5, when continuous monitoring systems (as required by the criteria in Table 3-1) are required, they *should have alarms set to provide timely warnings.**

Table 3-1 of the *Regulatory Guide* does not require continuous (real-time) monitoring systems. The criteria for continuous monitoring systems are defined in Sect. 3.5.8 of the *Regulatory Guide,* and the interpretation of the criteria is provided in criterion "l" above. When a continuous monitoring system is required by the criteria provided in criterion "l," appropriate alarms will be installed to signal the need for corrective action.

o. As they apply to the monitoring of airborne emissions, the general QA program provisions of Chap. 10 of the guide *should be followed.**

Section 9 of the EMP for ORR documents QC procedures and guidelines for addressing *Regulatory Guide* Chap. 10 QA provisions.