BJC/OR-1361/R1

DRAFT FOR PUBLIC REVIEW

Environmental Baseline Survey Report for the Title Transfer of the K-1225 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee

This document is approved for public release per review by:

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BJC ETTP Classification and Information Control Office — Date

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contributed to the preparation of this document and should not be considered an eligible contractor for its review.

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Environmental Baseline Survey Report for the Title Transfer of the K-1225 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee

Date Issued—January 2004

Prepared by
Science Applications International Corporation
Oak Ridge, Tennessee
under subcontract 23900-BA-PR007U
under work release 000300

Prepared for the
U. S. Department of Energy
Assets Utilization

BECHTEL JACOBS COMPANY LLC
managing the
Environmental Management Activities at the
East Tennessee Technology Park
Y-12 National Security Complex   Oak Ridge National Laboratory
Paducah Gaseous Diffusion Plant   Portsmouth Gaseous Diffusion Plant
under contract DE-AC05-98OR22700
for the
U. S. DEPARTMENT OF ENERGY

03-066(doc)/011204

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This report is intended to be used in its entirety. Excerpts, which are taken out-of-context, run the risk of being misinterpreted and are, therefore, not representative of the findings of this assessment. Opinions and recommendations presented in this report apply only to site conditions and features as they existed at the time of SAIC's site visit, and those inferred from information observed or available at that time and cannot be applied to conditions and features of which SAIC is unaware and has not had the opportunity to evaluate.

The results of this report are based on record reviews, site reconnaissance, interviews, and the radiological report reviewed and approved by BJC. SAIC has not made, nor has it been asked to make, any independent investigation concerning the accuracy, reliability, or completeness of such information.

All sources of information on which SAIC has relied in making its conclusions are identified in Chap. 7 of this report. Any information, regardless of its source, not listed in Chap. 7 has not been evaluated or relied upon by SAIC in the context of this report.

CONTENTS

FIGURES

TABLES

ACRONYMS

ACM	asbestos-containing material
BJC	Bechtel Jacobs Company LLC
bgs	below ground surface
CDR	Covenant Deferral Request
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	*Code of Federal Regulations*
COE	U. S. Army Corps of Engineers
DCE	dichloroethylene
DCGL	derived concentration guideline level
$DCGL_{EMC}$	derived concentration guideline level $_{\text{elevated measurement comparison}}$
DOE	U. S. Department of Energy
dpm	disintegrations per minute
EBS	environmental baseline survey
EPA	U. S. Environmental Protection Agency
ESU	exterior survey unit
ETTP	East Tennessee Technology Park
FFA	Federal Facility Agreement
FSU	furnishings survey unit
GCP	Gas Centrifuge Program
H_o	null hypothesis
H_a	alternative hypothesis
ISU	interior survey unit
MARSSIM	*Multi-Agency Radiation Survey and Site Investigation Manual*
MCL	maximum contaminant level
NORM	naturally occurring radioactive material
ORGDP	Oak Ridge Gaseous Diffusion Plant
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
PCE	tetrachloroethylene
PCB	polychlorinated biphenyl
PRG	preliminary remediation goal
QA/QC	quality assurance/quality control
RADCON	Radiological Control Organization
RCRA	Resource Conservation and Recovery Act of 1976
RI	remedial investigation
ROD	Record of Decision
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TCE	trichloroethylene
TRU	transuranic
TVA	Tennessee Valley Authority
UST	underground storage tank
VOC	volatile organic compound

EXECUTIVE SUMMARY

This environmental baseline survey (EBS) documents the baseline environmental conditions of the U. S. Department of Energy's (DOE's) K-1225 building at the East Tennessee Technology Park (ETTP). DOE is proposing to transfer the title of this building to the Community Reuse Organization of East Tennessee or one of its subsidiaries. This report provides supporting information for the transfer of this government-owned facility at ETTP for reuse and redevelopment by a private company. This EBS is based upon the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980.

The K-1225 building is located in the southeastern portion of ETTP. It was built in 1980 for use as an office building. It is a two-story structure constructed primarily of reinforced pre-cast concrete on a concrete slab. Total floor area is 23,500 ft^2.

The area proposed for title transfer includes the K-1225 building, an electrical transformer, and the underlying property also known as the underlying fee.

Preparation of this report included the review of government records, title documents, aerial photos, visual inspections of the property and adjacent properties, and interviews with current and former employees[1] to identify any areas on the property where hazardous substances and/or petroleum products were stored for one year or more, known to have been released, or disposed of. Radiological surveys were conducted to assess the building radiological condition. Following is a summary of the findings of the evaluation that was performed:

- No chemicals exceeding 1000 kg have been stored and/or used in Bldg. K-1225 for one or more years.

- Asbestos is present in the building in black tar joint compound on duct joints throughout the building and is assumed to be in the stair tread mastic (adhesive). These asbestos containing materials are in good condition. All insulation and ceiling tiles are of non-asbestos containing man-made mineral fibers and are in good condition.

- There was no evidence found of a release of hazardous substances or petroleum products in excess of the substance's reportable quantity occurring in Bldg. K-1225.

- The building interior, exterior, and furnishings were surveyed in accordance with the survey plan (Appendix C). The data were analyzed to determine if any residual contamination was present and if the contamination might exceed the derived concentration guideline level (DCGL) established for each of the survey units. Survey results showed that the K-1225 study area had no areas of elevated residual radioactivity present above DOE contamination limits or the DCGL [total alpha, 5000 disintegrations per minute (dpm)/100cm^2; removable alpha, 1000 dpm/100 cm^2; total beta-gamma, 5000 dpm/100 cm^2; and removable beta-gamma, 1000 dpm/100 cm^2] and, therefore, can be released without radiological restrictions. The radiological survey results are discussed in Sect. 6.3 of this report.

- No soil sampling was conducted to support title transfer of the building and its underlying fee.

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[1]Personal communications with J. R. Russell and T. G Ramsey (either previously or currently employed at the East Tennessee Technology Park).

CONCLUSIONS

Based on the U. S. Department of Energy's (DOE's) review of the existing information, including discussions and interviews referenced herein and evaluation of the data gathered in preparation of the *Environmental Baseline Survey for Building K-1225*, DOE recommends the following.

1. Due to the uncertainty associated with the nature of the on-site groundwater, and its need to be evaluated and possibly addressed in the future, DOE recommends that the transfer of Bldg. K-1225 be achieved by a covenant deferral per Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Sect. 120(h)(3)(c), et seq.

2. Asbestos-containing materials identified in Sect. 5.2 of this report should be periodically inspected to ensure that the asbestos does not become friable. Disposal of the materials, notwithstanding their condition, must be conducted pursuant to applicable regulations.

LAND USE RESTRICTIONS

Land use restrictions are an important component of a CERCLA covenant deferral; they help to ensure that transfer of the property is protective for the intended use. The restrictions that will apply to Bldg. K-1225 are summarized below. Full details are found in the Covenant Deferral Request package.

1. Extraction, consumption, exposure or use in any way of the groundwater underlying the property or water from any streams or ponds located on the property is prohibited.

2. Development of the property must comply with all applicable federal, state and local laws and regulations. Development activities must follow the East Tennessee Technology Park (ETTP) site procedures for obtaining excavation and penetration permits, and construction of basements is prohibited.

3. The property shall not be used or developed in a manner that is inconsistent with the land use assumptions of "unrestricted industrial use" contained in the *Record of Decision for Interim Remediation of Contaminated Soil, Material, and Buried Waste in Zone 1 of the East Tennessee Technology Park* (DOE 2002b). Accordingly, use of the area of the property below 10 ft is prohibited.

4. In order to ensure that the vapor intrusion pathway (i.e., the migration of volatile organic compounds in contaminated groundwater and/or soil to indoor air) does not contribute to an unacceptable risk to human health; DOE will address the potential for vapor intrusion in the ETTP Groundwater Record of Decision (ROD) currently scheduled to be signed by 2006; and will take interim measures to ensure protectiveness until the ROD is signed. The interim measures to be implemented include: collection of samples inside the building to confirm the pre-transfer determination that the vapor intrusion pathway does not pose a significant risk to human health, and making physical modifications to the facility as necessary to ensure protection or otherwise monitoring the stability of groundwater conditions and change in the building.

RESPONSE TO REGULATOR COMMENTS

In May 2003, DOE received a number of comments from Region 4 of the U. S. Environmental Protection Agency (EPA) on document content and level of detail. Those changes have been incorporated throughout this report. Additional comments from EPA, the DOE Oversight Division of the Tennessee Department of Environment and Conservation, and members of the public will be included in the final version of the report.

1. PROPERTY IDENTIFICATION

The K-1225 building discussed in this environmental baseline survey is located in the southeastern portion of the East Tennessee Technology Park (ETTP) [formerly the K-25 Site] on the Oak Ridge Reservation (ORR) in Roane County, Tennessee. Building K-1225 is within the ETTP perimeter fence. Figure 1.1 is a map showing the relationship of Bldg. K-1225 to ETTP, and Fig. 1.2 is an ortho image showing the footprint of the K-1225 study area (the area proposed for title transfer). Figure 1.3 is an aerial photograph showing the location of K-1225 in relation to ETTP.

Preparation of this report included the review of government records, title documents, aerial photos, visual inspections of the property and adjacent properties, and interviews with current and former employees[2] to identify any areas on the property where hazardous substances and petroleum products were stored for one year or more, known to have been released, or disposed.

[2]Personal communications with J. R. Russell, and J. L. Haymore (either previously or currently employed at the East Tennessee Technology Park).

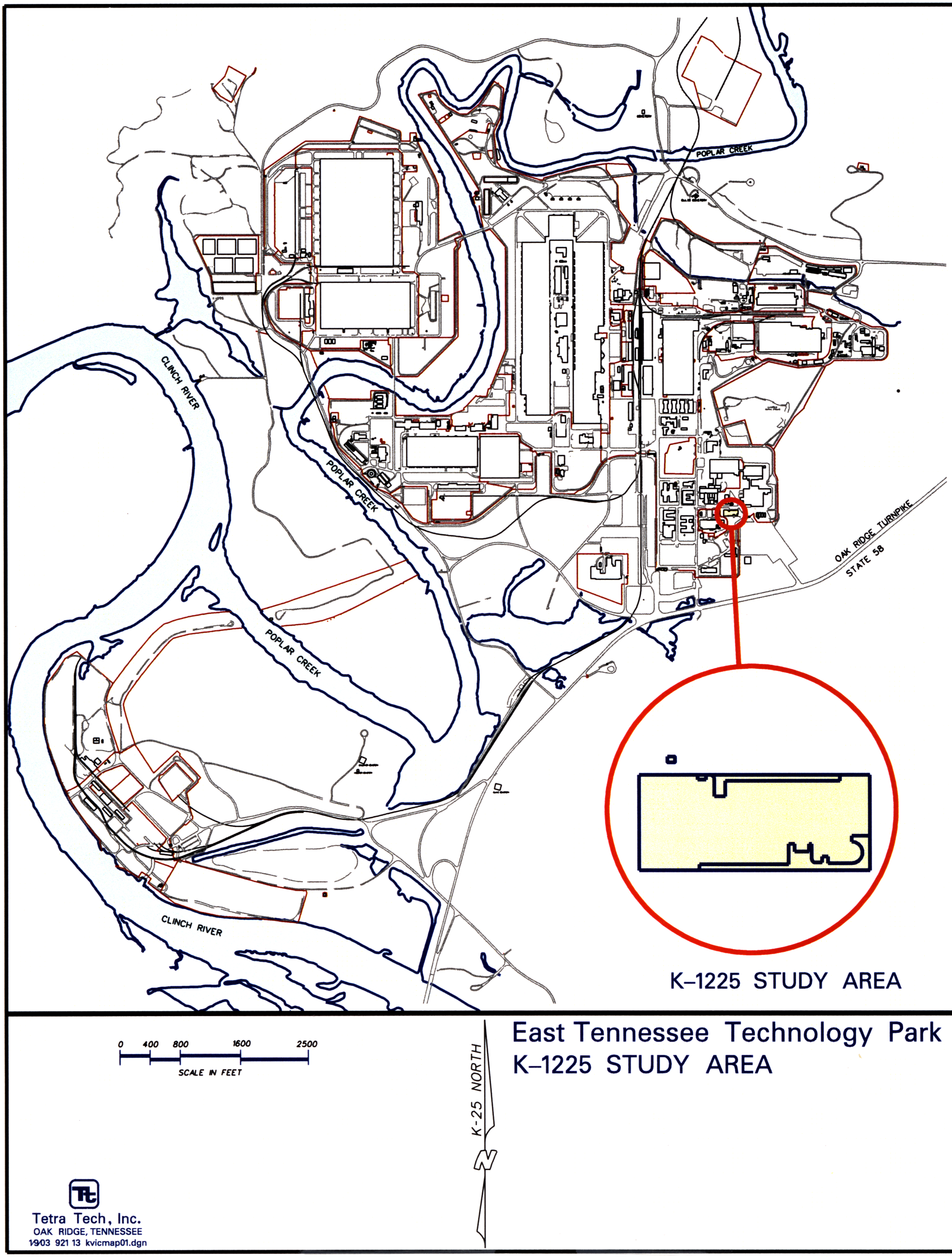

Fig. 1.1. Location map of the K-1225 study area.

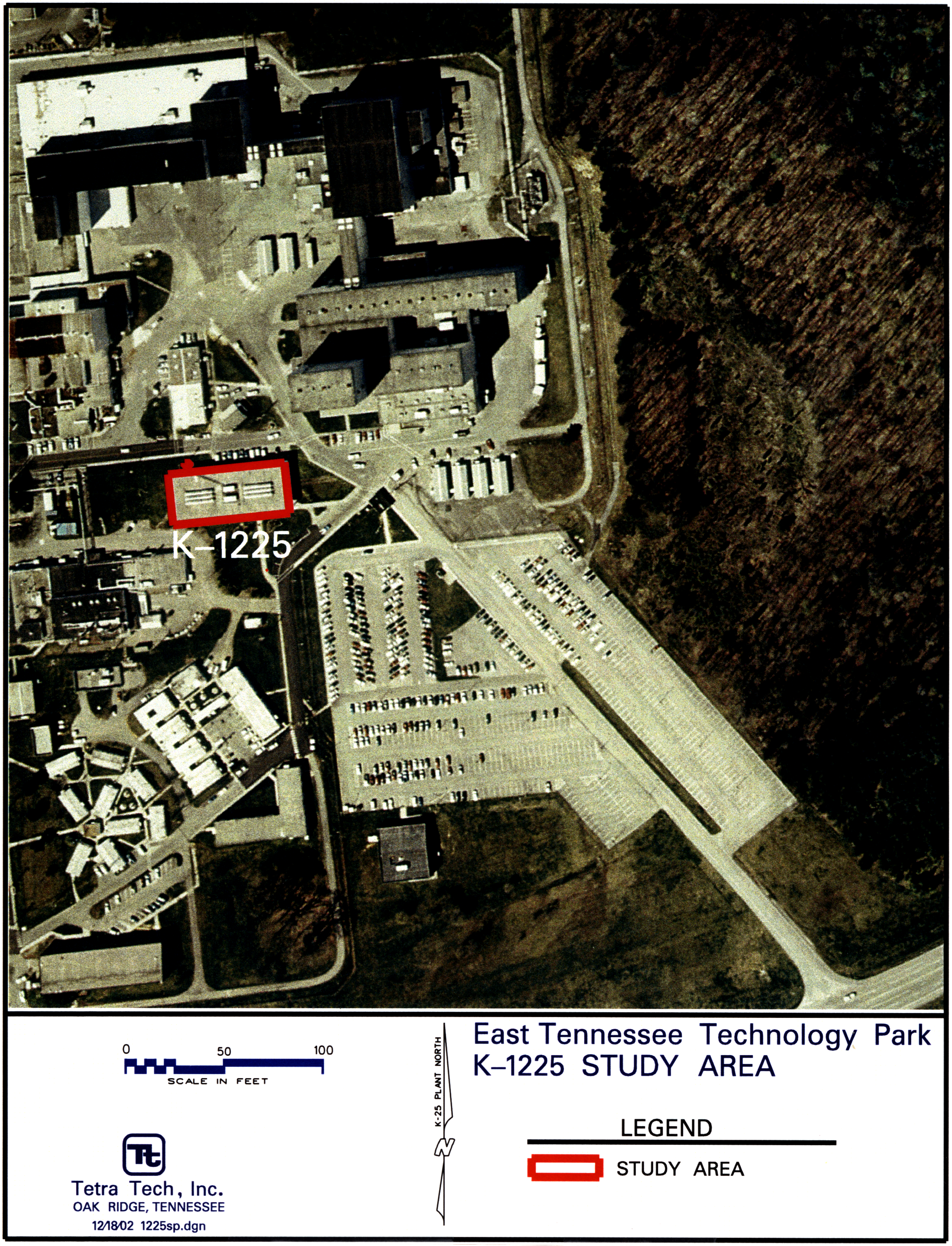

Fig. 1.2. Ortho image of the K-1225 study area.

Fig. 1.3. Aerial photograph showing location of Bldg. K-1225.

2. TITLE SEARCH

On June 4, 1996, a visit was made to the state of Tennessee Roane County Recorder's Office to conduct a review of the recorded deeds documenting previous ownership of the land tract H-720 where the K-1225 study area is located. The deeds contained no information or references to other recorded evidence that, prior to U. S. Department of Energy (DOE) ownership, the property was utilized for the storage of hazardous substances and/or petroleum products or their derivatives. Additionally, no information contained in the deeds would indicate that hazardous substances and/or petroleum products or their derivatives were released from or disposed of on the property. Prior to acquisition by the government, the area was farmland and was a combination of cultivated fields, pastures, and forested areas.

The deeds that conveyed the property from the previous owner to the U. S. Government, and any deeds that conveyed the property to that previous owner, were reviewed as a part of the title search. Generally, the deeds from the previous two owners of a particular ORR parcel provide information that goes back to the early 1900s or even earlier. The deeds were reviewed for any references to previous land uses (e.g., homestead, farm, school, business, etc.). Also reviewed were any easements or conveyances referenced in the deeds that might indicate that portions of the land were used for pipelines, power lines, etc. Partial disposal or acquisition conveyance deeds were also reviewed because, in some instances, the land comprising a large farm had been acquired via several separate acquisitions.

In addition, property assessment records from the County Property Assessor's Office were reviewed because these documents may also contain evidence of a particular land use. Survey or subdivision maps referenced in deeds and maintained in the Register of Deeds office were also reviewed for any indications of a previous land use. Furthermore, because the Tennessee Valley Authority (TVA) was the previous owner of several large tracts of ORR land, the TVA Real Estate Office was contacted regarding their knowledge of any previous land uses. The U. S. Army Corp of Engineers (COE) was another source of information that was contacted.

3. FEDERAL RECORDS SEARCH AND REGULATORY SUMMARY

3.1 FEDERAL RECORDS SEARCH

TVA in Knoxville, Tennessee, and the COE District Office in Nashville, Tennessee, were contacted in 1996, 1997, and again on April 6, 1998, to determine if they maintained any records reflecting past or present land use relative to the land presently comprising ETTP (TVA 1998; COE 1998). Neither TVA nor COE had any information regarding the history of past or present land use that would indicate if hazardous substances or petroleum products were stored or released on the DOE-owned property currently comprising the ETTP.

In February 1997, DOE real estate records that document previous ownership of land tract H-720, where Bldg. K-1225 is located, were examined. Page A-3 of Appendix A is a statement[3] from the Realty Officer of the DOE Oak Ridge Operations Office (ORO) that the real estate records contained no information or references to other recorded evidence that, prior to DOE ownership, the property was utilized for the storage of hazardous substances. Additionally, no information contained in these records would indicate that hazardous substances were released from or disposed of on the property.

The following pre-construction aerial photographs and maps reflecting prior use of this land were also reviewed. Copies of these photographs and maps are maintained on file in the Bechtel Jacobs Company LLC (BJC) Real Estate Office.

Aerial Photographs:

Photograph Nos. and Date	Flight By	Source
No. 130-3-9, dated 1939	Unknown	BJC, Real Estate Office
Nos. 820-2-20 through -23 and 820-3-20 through -24, dated September 25, 1942	Aero Service Corp. for Stone and Webster	BJC, Real Estate Office

These photographs, which were taken in 1939 and 1942, show that the land where the study area is located was predominantly used for agricultural purposes. The remaining land was wooded. A map depicting pre-World War II structures, churches, and cemeteries that were present in the area of ETTP is also included on page B-3 in Appendix B.

Topographic and real estate maps:

1. A November 2, 1942, topographic map identified as Sect. A-1 of ORR was prepared by Aero Services Corporation for Stone and Webster.

2. A February 19, 1945, real estate map (sheet 9 of 16) prepared by the U. S. Army shows the boundaries of all land tracts upon which facilities at the site are currently located. The study area is on Land Tract H-720.

Neither the aforementioned photographs nor maps contained any information regarding the history of the past land use that would indicate that storage or releases of hazardous substances or petroleum products have occurred on the land where Land Tract H-720 is located. Copies of the 1942 topographic

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[3]DOE 2002a. Statement from Realty Officer, DOE Oak Ridge Operations Office, "CERCLA 120(h) Review Tract No. H-720, East Tennessee Technology Park, Oak Ridge Reservation," U. S. Department of Energy, Oak Ridge, TN.

map and real estate map are maintained in the BJC Real Estate Office and the DOE-ORO Real Estate Office.

3.2 REGULATORY SUMMARY

As discussed previously, prior to ownership by DOE (and its U. S. Government predecessor agencies), the property was farmland. Any DOE operations within the footprint of K-1225 occurred under DOE's own authority, without external regulation. The facility manager was interviewed,[4] and records for the time that DOE has been externally regulated were checked for information about spills, permits, or violations. No records were identified that provide information about spills, permits, or permit violations. In addition, the former underground storage tank (UST) manager stated that there were no regulated USTs associated with K-1225.[5]

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[4]Personal communication with J. R. Russell (either previously or currently employed at the East Tennessee Technology Park).

[5]Email communication from S. T. Goodpasture (either previously or currently employed at the East Tennessee Technology Park).

4. PAST AND PRESENT ACTIVITIES

4.1 PAST AND PRESENT ACTIVITIES FOR THE REAL PROPERTY PROPOSED FOR TRANSFER

Prior to the acquisition of the land by the government, the entire area comprising ETTP was farmland. Over 800 acres of land were leveled and prepared in support of the Manhattan Project (to supply enriched uranium for nuclear weapons production).

During the construction of the process buildings in the 1940s and 1950s, there were hundreds of temporary buildings that provided support operations for the construction. These included warehouses, fabrication and maintenance facilities, cafeterias, housing, and offices. One of the areas where there was a concentration of maintenance facilities was the Ford, Davis, Bacon Construction Support Area that was located in the vicinity of the present K-1225 Office Building. From the 1940s through the late 1950s, this area was occupied by the K-1044 Heavy Equipment Repair Shop, the K-1236 Paint Shop, the T-17 Light Equipment Garage, the T-27/T-5 Pipe Welding Shop, the T-21 Oil/Grease Station, the K-1045-A Waste Oil Burning Pit, and the K-1045 Incinerator. All of these facilities, with the exception of K-1045, were demolished by the late 1950s. Most of the concrete slab foundations remained until the 1970s when the gas centrifuge program began a major expansion and construction project in the area.

The sites where six of these former facilities were located—K-1044, K-1236, T-27/T-5, T-21, T-17, and K-1045-A—are listed in Appendix C of the Federal Facility Agreement (FFA) [DOE 1992].[6] [The FFA is an agreement between DOE, the U. S. Environmental Protection Agency (EPA), and the state of Tennessee to integrate the requirements of the Resource Conservation and Recovery Act of 1976 (RCRA) corrective actions and Comprehensive Environmental Response, Compensation, and Liability Act of 1980 remedial investigations at specific sites within the ORR. The facilities to which the FFA applies are listed in Appendix C of the FFA.] Additional detailed descriptions of these former facilities are provided in Sect. 4.2. Figure 4.1 is a 1946 aerial photograph of Oak Ridge Gaseous Diffusion Plant (ORGDP) that shows the location of these facilities and an outline showing the location of the present K-1225 building. Note that the northern section of the K-1044 Heavy Equipment Repair Shop is located within the footprint of the K-1225 building; it is discussed in this section.

The area where K-1225 is located was involved in the Gaseous Centrifuge Program (GCP). It was begun in the 1960s as an alternate method of enriching uranium. The project was concentrated in the southeast portion of ETTP (north of K-1225) and grew to include over 170,000 ft^2 of support facilities (these are discussed in Sect. 4.2). Figure 1.3 shows the majority of the GCP facilities.

The K-1044 Heavy Equipment Repair Shop, built in 1943 or 1944 and originally designated T-18, was a heavy equipment repair shop that supported the construction of the ORGDP. The building included one or more grease racks, a paint shop, and a heavy equipment store. By 1945, the building designation had been changed to T-6, a number also used by a building to the north. In 1946, the designation was changed to Bldg. K-1044. From 1947 to 1953, the building was a spare parts warehouse. In 1953, the building was sold and dismantled, leaving the concrete foundation. The foundation remained in place until the construction of K-1225 in 1980, at which time it was removed and the K-1225 footprint covered a large portion of it.

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[6]DOE 1992. *Federal Facility Agreement for the Oak Ridge Reservation*, DOE/OR-1014, EPA Region 4, DOE, and TDEC, Washington, D.C.

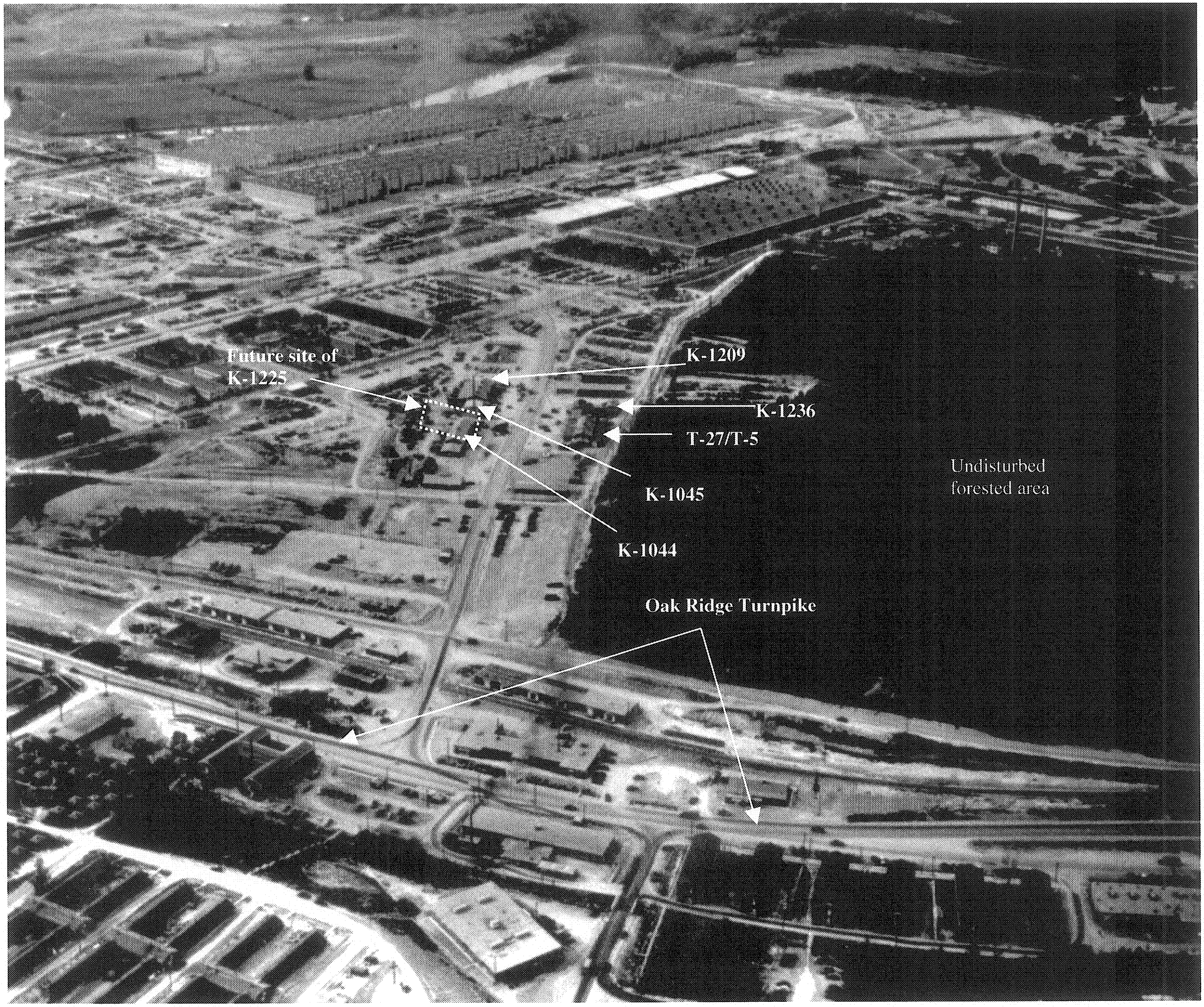

Fig. 4.1. 1946 aerial photograph of ORGDP.

The K-1225 building was built in 1980 to provide office space for GCP personnel. The project was shut down in 1985, and since that time the building has been used by several organizations for offices. It is now an office facility for the DOE prime contractor at ETTP.

As discussed in Sect. 1.0, interviews with current and former employees assigned to Bldg. K-1225 were conducted to identify any areas on the property where hazardous substances and/or petroleum products were stored for one year or more, known to have been released, or disposed.

Based on record searches and interviews, no underground tanks existed on this property. There are floor drains in the bathrooms. These have not been plugged because they go to the sanitary sewer. There are labels that state no hazardous materials are to be disposed of in the drains. There are no records that the drains were sampled.

4.2 PAST AND PRESENT ACTIVITIES FOR THE ADJACENT PROPERTY

The K-1225 study area is located within the bounds of ETTP. The nearest non-DOE property is Tennessee State Highway 58/Oak Ridge Turnpike, which is located 1100 ft south of the area. There is no indication that activities from this non-DOE area would have contributed any contamination to the study area.

Several nearby facilities and sites of former and existing facilities are potential areas of contamination that are in close proximity to Bldg. K-1225 (listed in Sect. 4.1). These areas are listed as environmental restoration units in *Site Descriptions of the Environmental Restoration Units at the Oak Ridge K-25 Site, Oak Ridge, Tennessee*, K/ER-47/R1 (Energy Systems 1995a). Report No. K/ER-47/R1 was prepared to "baseline" conditions (at the time of its writing) so that decisions could be made to establish cleanup priorities. Most of these areas and facilities are also listed in Appendix C of the FFA.

4.2.1 Former Adjacent Facilities

The K-1236 building (T-7 prior to 1947) was a paint shop used during the construction of ORGDP. It was demolished in late 1947 and stood in the immediate vicinity of Bldg. K-1220. It is listed in Appendix C of the FFA.

Also in the vicinity of Bldg. K-1220 was the T-27/T-5 Pipe Welding Shop. T-27 was constructed in 1943 or 1944 and is thought to have included a welding shop and cadmium spray booth for coating or metalizing uranium enrichment cascade traps and cylinders. In 1945, it was redesignated T-5. In 1947, it was dismantled and fabricated into two buildings that were used as voting booths through 1954 and then dismantled. The southern part of the foundation was part of the K-1066-B Drum Storage Yard that opened in 1950 and closed in 1960. The foundation was idle from the 1960s through the early 1970s when the area was again used as a material storage area during the construction of the K-1200 and K-1210 buildings. In the early 1980s, the construction of K-1220 covered the former T-27/T-5 site. The former site of the T-27/T-5 building is listed in Appendix C of the FFA.

The T-17 Light Equipment Garage was located in the vicinity of the K-1008-F building to the north of K-1225. It was built in 1943 as a light equipment repair garage for cars and trucks and had a five-pump gasoline station. Historical drawings show T-17 also referred to as T-10, T-14, and K-1204. In the 1947 building list, it is designated as the K-1209 Warehouse. In 1951, K-1209 was listed as a spare parts warehouse. It was sold and dismantled in 1953. It is listed in Appendix C of the FFA.

In 1958, the K-1045-A Fire Training Tower was constructed on the north end of the concrete pad that remained after Bldg. K-1209 was dismantled. During its operation from the 1950s to 1970s, the tower was used by the site fire department to train fire responders. The K-1045-A Waste Oil Burning Pit was associated with K-1045-A. The oil-burning pit was built in the early 1950s and operated in conjunction with the K-1045-A Fire Training Tower through the 1950s and 1960s for fire training. Oil was burned in this 11-ft long × 19-ft wide × 3-ft deep pit for fire training. There was a drain in the bottom of the pit that drained to an existing 24-in. drain line that probably discharged to the K-1007-P1 Pond. Initially, clean oil was burned, but as time passed, other facilities began disposing of oil by leaving unknown types of oil in unlabeled drums at the burn pit. This practice was stopped when it was determined that the waste oil could contain hazardous substances. The pit was closed and filled in the 1960s. The oil pit is listed as a Solid Waste Management Unit (SWMU) under RCRA and in Appendix C of the FFA. The K-1045-A Tower was dismantled in 1977 and moved to another location east of Bldg. K-1423.

North of Bldg. K-1008-F is the site of the T-21 Oil/Grease Station (also designated T-12). This facility was built in 1943 as a temporary oil and lubricant storage building. The building designation was changed to the K-1214 Acid Storage building in 1947. Drum quantities of acids and trichloroethylene are thought to have been stored here. The building had been demolished by 1958. The former location of T-21 is listed in Appendix C of the FFA.

4.2.2 Existing Adjacent Facilities

Most of the other structures adjacent to K-1225 were constructed in the early 1970s as part of the GCP. Construction of the complex began in the 1960s with the expansion of the K-1004-J building. The K-1010 Laboratory Receiving and Handling and the K-1023 Laboratory were added in 1970. The K-1052 Advanced Machine Development Laboratory and the K-1200 Component Preparation Laboratory were added in 1974, the K-1210 Component Test Facility was added in 1976, the K-1210-A Advanced Equipment Test Facility was added in 1978, and the K-1220 Centrifuge Plant Demonstration Facility was added in 1982. These buildings form a semi-circle that surrounds a paved area to the north of K-1225 (seen in Fig. 1.3). When GCP was operational, activities in these buildings included development and manufacturing of centrifuges; reliability and operability testing of prototype centrifuges; a pilot plant for testing feed, withdrawal, and UF_6 transfer systems; and test gas centrifuge plant subsystems such as the centrifuge mounts, service module, and machine isolation valves. Buildings K-1010, K-1052, K-1023, K-1200, and K-1220 are listed in the Reindustrialization section of Appendix C of the FFA, which shows them as leased facilities. Buildings K-1210 and K-1210-A are listed as Characterization Areas in Appendix C.

Building K-1045 was originally built in 1943 as temporary Bldg. T-33-2 and was part of the Ford, Bacon, and Davis Construction Support Area. By early 1947, the building had been renumbered T-8 and converted to an incinerator. It was located on the south end of the K-1209 Warehouse (discussed above). In 1947, it was again renumbered to Bldg. K-1045. The building was used as an incinerator through 1953. Building directories from 1954 through 1978 list K-1045 as a storage building. In 1982, it was converted into a valve certification laboratory associated with the centrifuge project. A restroom was added to the west end of the building in 1982. It was then used as a storage facility for 15-in. reels of magnetic media for the Enrichment Business Services Department. In 1987, K-1045 began to be used as an office and break area for carpenters. The magnetic tapes were removed in the early 1990s. The building is currently used for storage of janitorial equipment (i.e., vacuum cleaners and floor buffers). K-1045 is located across 5th Street, north of K-1225, and is listed in Appendix C of the FFA.

In 1978, Bldg. K-1008-E was built as a change house for personnel working on the GCP. In 1980, Bldg. K-1008-F was built immediately south of K-1008-E to expand the change house facilities. In 1989, K-1008-E and K-1008-F were combined and renovated to house two research laboratories (luminescent measurement and laser technology) and various offices. The building was designated K-1008-F. In the late 1990s, the labs were closed, and Bldg. K-1008-F was renovated into offices that are presently used by the maintenance department. K-1008-F is located across 5th Street north of K-1225.

The K-1004-L Pilot Plant is located 50 ft to the southwest of K-1225. It was built in 1953 and operated continuously until it was shut down in 1984. The function of the plant was to demonstrate improvements in the quality of the gaseous diffusion barrier that could result in an increase in production capacity of the gaseous diffusion plants. The floors are poured concrete and the walls are concrete block. The pilot plant consists of six cells that extend from the first floor into the mezzanine level. The motor alleys that separate the cells contain the stage motor compressor sets for the adjacent cells. Supporting oil, coolant, evacuation, and some gas sampling systems are located at the cell's perimeter on the mezzanine floor. K-1004-L is listed in Appendix C of the FFA.

The K-1004-J Underground Tank was a 5500-gal tank used to store low-level radioactive waste. It is located outside the southwest corner of K-1004-J, west of K-1225, at the corner of Avenue D and 5th Street. The drains from K-1004-J were tied into a drain system that included a 750-gal tank in a vault and a 5500-gal tank due south of the K-1004-J entrance. The 750-gal tank was removed (date unknown). The 5500-gal tank was flushed and decontaminated. It was decided to weld caps or flanges to its access lines and leave it buried. In 1980, the tank was partially uncovered during excavation for a road. The tank was filled with sand, the openings welded shut, and the tank covered with fill. The area is posted as an underground radiological area and listed as a SWMU in Appendix C of the FFA.

The K-1004-J Vaults are located in the K-1004-J Laboratory Complex and consist of six vaults of approximately 30-in.-diam by 8-ft-deep concrete pipe. Radioactive materials from K-1004-J laboratories were conveyed to the storage vaults in lead-shielded containers and covered with sand. Some of the material stored in the vaults was high in cesium. Apparently, the material was discarded in the vaults and not intended for later retrieval. In November 1961, the centrifuge project took over the laboratory, and in 1962–63, a concrete pad was poured over the site of the vaults as part of a building expansion. It is assumed that the vaults remained. The contents of the vaults may have been removed to the Oak Ridge National Laboratory (ORNL), although this has not been confirmed. This area is located to the west of the study area at the corner of Avenue D and 5th Street and is listed in Appendix C of the FFA.

Baseline Environmental Analysis Reports have been published for a number of facilities and areas in the vicinity of K-1225. These include:

Building	Document Number	Date Published
K-1200	K/EM-531 and 532	August 1997
K-1052-B	K/EM-537 and 538	August 1997
K-1052	K/EM-539 and 540	August 1997
K-1200 External Laydown Areas	K/EM-550	November 1997
Roads and Grounds Phase I	K/EM-579	February 1998
K-1023	BJC/OR-26	June 1998
K-1005	BJC/OR-30	June 1998
K-1310-H/K	BJC/OR-31	June 1998
K-1220	BJC/OR-74	December 1998
K-1200 Access and Laydown Area	BJC/OR-437	November 1999
K-1008-F and K-1045	BJC/OR-723	October 2000

4.3 HYDROGEOLOGIC ENVIRONMENT

This information is being presented to lay the basis for evaluation of potential vapor intrusion. Based on the information presented, vapor intrusion information is a data gap and will be addressed in a future version of this document.

Building K-1225 is located in the southern portion of ETTP, which is underlain by bedrock of the Chickamauga Supergroup. Although less prone to karst development than the Knox Group rocks in the vicinity of the ETTP, the Chickamauga formations are nevertheless subject to the development of karst. Solutionally enlarged fractures, joints, and bedding planes are common in exposures of Chickamauga rocks in the vicinity of ETTP. Structurally these formations have been folded into an anticline (convex upward fold) in the vicinity of Bldg. K-1225 with the axis of this structure located approximately along the south side of the building and trending northeast to southwest. Bedding in the Chickamauga generally dips northwestward on the north side of this axis and southeastward on the south side of this axis. Building K-1225 is located slightly north of the mapped anticline axis; thus, bedding is expected to dip primarily to the northwest. The approximate location of the axis of this fold is indicated on Fig. 4.1. In addition to providing an indication of the direction of dip of bedding, the axis may also represent a zone of increased fracturing; thus, providing potential pathways for groundwater movement.

The bedrock formations underlying K-1225 are mapped as belonging to the Carters Limestone[7] and generally consist of thick to massive beds of limestone with some thin to medium beds and occasional interbedded argillaceous limestone. Some pods and lenses of chert are present in the lower and middle parts of the Carters Limestone. Although exposures were not observed during the geologic mapping of the ETTP, the middle part of the Carters Limestone also contains two distinctive metabentonite beds, which range from 1 to 3 ft in thickness. The Carters Limestone is subject to karst development due to the high carbonate content and thickness of beds. Evidence of karst development in the Carters Limestone includes cavities encountered in drilling at ETTP. Approximately 30% of the monitoring wells that have been completed in the Carters Limestone at ETTP encountered cavities ranging in size from a few inches up to 7 ft. Although pre-construction topographic maps do not indicate the occurrence of sinkholes in the immediate vicinity of Bldg. K-1225, sinkholes have been identified from pre-construction maps and aerial photographs within the Carters Limestone along a strike to the southwest of Bldg. K-1225. Groundwater flowpaths in bedrock are a key uncertainty in the conceptual model of ETTP, but fractures, bedding planes, and hydraulic gradient are expected to be the primary controlling factors.

Hydrogeologic characterization data for K-1225 are limited because, currently, no groundwater monitoring wells exist in the immediate vicinity of the building. However, four bedrock monitoring wells have been installed within 300 ft of Bldg. K-1225. The hydrogeologic characterization data presented below for K-1225 are based on the data from these wells and on interpolation from other available ETTP sitewide information.

Because no monitoring points exist in the immediate vicinity of K-1225, depth to bedrock and depth to groundwater can only be interpolated from nearby wells. Comparison of pre-construction topographic maps to present day topography suggest the possibility that up to 5 ft of fill material may have been placed in the area occupied by the southwest corner of Bldg. K-1225 during construction of ETTP. Depth to bedrock, interpolated from data in the general vicinity of K-1225, is expected to be from 5 to 22 ft below ground surface (bgs). Bedrock was encountered at depths of 21.5 and 19 ft bgs at wells BRW-050 and BRW-051, respectively, which are the wells located nearest to Bldg. K-1225 (approximately 200 ft northwest). Bedrock outcrops are present approximately 600 ft east of Bldg. K-1225. The depth to groundwater, interpolated from the ETTP site-wide potentiometric map, is expected to range from 8 to 12 ft bgs. Shallow groundwater flow is anticipated to be to the southwest toward the shallow ponds to the south of ETTP. Hydrologic parameters, such as hydraulic conductivity and hydraulic gradient, are also estimated for K-1225 using available data. Hydraulic conductivity for the Chickamauga bedrock and overburden materials, as determined from slug tests conducted in numerous monitoring wells throughout ETTP, is presented in Table 4.1 with additional hydrogeologic characterization parameters for K-1225.

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[7]P. J. Lemiszki, 1994. *Geological Mapping of the Oak Ridge K-25 Site, Oak Ridge, Tennessee,* K/ER-11.

Table 4.1. Summary of hydrogeologic conditions at Bldg. K-1225

Parameter	Site conditions
Is a groundwater plume present beneath K-1225?	None identified
Distance from facility to nearest upgradient plume (ft)	50[a]
Is karst present?	Yes
Depth to bedrock (ft)	5-22[b]
Depth to groundwater (ft)	8-12[b]
Are fill materials present at K-1225?	minimal
Composition of overburden materials present.	silty clay[b]
Shallow groundwater flow direction	southwest
Hydraulic conductivity of overburden materials (cm/s)	1.15E-03[c]
Hydraulic conductivity of bedrock (cm/s)	4.08E-03[d]
Hydraulic gradient at the site (ft/ft)	0.02-0.025[b]
Is a perched water table present at K-1225?	unknown

[a]Represents bedrock plume located lateral to hydraulic gradient, based on the potentiometric map, in the vicinity of K-1225.

[b]Represents interpolated value based on available data.

[c]Represents average hydraulic conductivity of unconsolidated zone materials at East Tennessee Technology Park (ETTP) based on slug tests of wells completed in overburden developed above Chickamauga bedrock.

[d]Represents average hydraulic conductivity based on slug tests of ETTP wells completed in bedrock of the Chickamauga Supergroup.

Current groundwater plume maps indicate the potential presence of volatile organic compounds (VOCs) in groundwater within 50 ft to the west of K-1225. Due to the shallow nature of bedrock in this area of ETTP, the plume adjacent to K-1225 represents a bedrock groundwater plume. Although hydraulic gradients indicate shallow groundwater flow is to the southwest; thus, this plume is located laterally to the gradient, groundwater flowpaths in bedrock are a significant unknown due to the complex geology and geologic structure underlying ETTP. The possibility of transport of the VOC plume through bedrock flowpaths beneath K-1225, although unlikely, cannot be discounted based on available data.

Table 4.2 summarizes the analytical results for the VOCs detected in groundwater samples collected from the four bedrock monitoring wells (BRW-038, BRW-050, BRW-051, BRW-052) located west of K-1225 and two unconsolidated zone wells (UNW-126 and UNW-127) located north of K-1225 (see Fig. 4.2). Monitoring well BRW-050 is the only bedrock well in this group that has been sampled since 1998. Well BRW-038 has not been sampled since 1995 and the remaining bedrock wells have not been sampled since 1998. The unconsolidated zone wells have been sampled semiannually since being completed in 1998. It should be noted that the concentrations in Table 4.2 might not be representative of groundwater beneath Bldg. K-1225, but represent concentrations within the known plume nearest to the building. In addition, VOCs are present in groundwater on the north side of Bldg. K-1200, which is located approximately 700 ft north of K-1225. The VOCs detected in the vicinity of Bldg. K-1200 likely represent the upgradient portion of the plume that extends into the area west of Bldg. K-1225. Table 4.3

Table 4.2. Summary of VOCs detected in groundwater samples from bedrock monitoring wells located west of K-1225

Analyte (µg/L)	MCL	BRW-038			BRW-050								
		Oct-94	Mar-95	Oct-95	Oct-94	Mar-95	Sep-95	Jun-98	Aug-98	May-01	Sep-01	Mar-02	Aug-02
1,1,1-Trichloroethane	200	100 U	14	25 U	5 U	5 U	5 U	5 U	5 U	2 U	2 U	2 U	2 U
1,1-Dichloroethane	NA	100 U	10 U	25 U	5 U	5 U	5 U	5 U	1 J	2 U	2 U	2 U	2
1,2-Dichloroethene	70[a]	49 J	6 J	33	3 J	3 J	4J	5 U	2 J	2 U	2 U	2 U	2 U
Chloroform	100[b]	100 U	10 U	25 U	5 U	5 U	5 U	5 U	5 U	2 U	2 U	2 U	2 U
Tetrachloroethene	5	36 J	3 J	17 J	5 U	5 U	5 U	5 U	5 U	2 U	2 U	2 U	2 U
Trichloroethene	5	170	35	120	5 U	6	5 U	3 J	3 J	3	3	7	3

Analyte (µg/L)	MCL	BRW-051					BRW-052				
		Oct-94	Mar-95	Sep-95	Jun-98	Aug-98	Oct-94	Mar-95	Sep-95	Jun-98	Aug-98
1,1,1-Trichloroethane	200	5 U	5 U	5 U	5 U	2 J	5 U	5 U	5 U	5 U	2 U
1,1-Dichloroethane	NA	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloroethene	70[a]	18	39	33	9 J	14 J	2 J	3 J	5 U	1 J	1 J
Chloroform	100[b]	1 J	5 U	1 J	5 U	5 U	1 J	5 U	5 U	5 U	5 U
Tetrachloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5	41	33	36	16 J	18 J	4 J	5 U	5 U	2 J	2 J

[a]Represents maximum contaminant level (MCL) for the *cis*-1,2-dichloroethene isomer.
[b]Represents MCL for total trihalomethanes.
J = estimated concentration.
MCL = maximum contaminant level.
U = analyte not detected at indicated concentration.
VOC = volatile organic compound.

Table 4.3. Summary of VOCs detected in monitoring wells located 700 ft north of K-1225

Analyte (µg/L)	MCL	UNW-126									
		Apr-99	Sep-99	Mar-00	Aug-00	May-01	Sep-01	Mar-02	Sep-02	Mar-03	Sep-03
1,1-Dichloroethene	7	5 U	50	20 U	400 U	46	200 U	86	200 U	200 U	200 U
1,2-Dichloroethene	70[a]	3 J	4 J	20 U	4	5 U	200 U	20 U	200 U	200 U	200 U
2-Butanone	NA	10 U	10 U	500 U	50 U	500 U	5000 U	500 U	5000 U	5000 U	5000 U
Acetone	NA	10 U	10 U	610	10000 U	500 U	5000 U	1800 J	5000 U	5000 U	5000 U
Chloroform	100[b]	5 J	9	20 U	6	20 U	200 U	20 U	200 U	200 U	200 U
Methylene chloride	5	8 U	5 U	54	2 U	26	200 U	20 U	200 U	200 U	200 U
Tetrachloroethene	5	5000	2700 U	6300	6600	6100	5800	6700	5100	5600	5100
Trichloroethene	5	770	460	860	840	900	610	740	580	550	530

Analyte (µg/L)	MCL	UNW-127										
		Apr-98	Apr-99	Sep 99	Mar-00	Aug-00	May-01	Sep-01	Mar-02	Sep-02	Mar-03	Sep-03
1,1-Dichloroethene	7	620 U	5 U	5 U	24	20 U	20 J	200 U	72	200 U	200 U	200 U
1,2-Dichloroethene	70[a]	620 U	30	29	23	25	29	200 U	20 U	200 U	200 U	200 U
2-Butanone	NA	NA	10 U	2 J	500 U	50 U	500 U	5000 U	500 U	5000 U	5000 U	5000 U
Acetone	NA	1200 U	15 U	9 J	500 U	500 U	500 U	5000 U	1600 J	5000 U	5000 U	5000 U
Chloroform	100[b]	620 U	5 U	5 U	20 U	2 U	20 U	200 U	20 U	200 U	200 U	200 U
Methylene chloride	5	620 U	11 U	5 J	20 U	2 U	20 U	200 U	20 U	200 U	200 U	200 U
Tetrachloroethene	5	490 J	1100	1000 J	1000	820	970	1600	1400	1200	1400	1400
Trichloroethene	5	1900	55	49	50	36	47	200 U	50	200 U	200 U	200 U

[a]Represents maximum contaminant level (MCL) for the *cis*-1,2-dichloroethene isomer.
[b]Represents MCL for total trihalomethanes.
J = estimated concentration.
MCL = maximum contaminant level.
U = analyte not detected at indicated concentration.

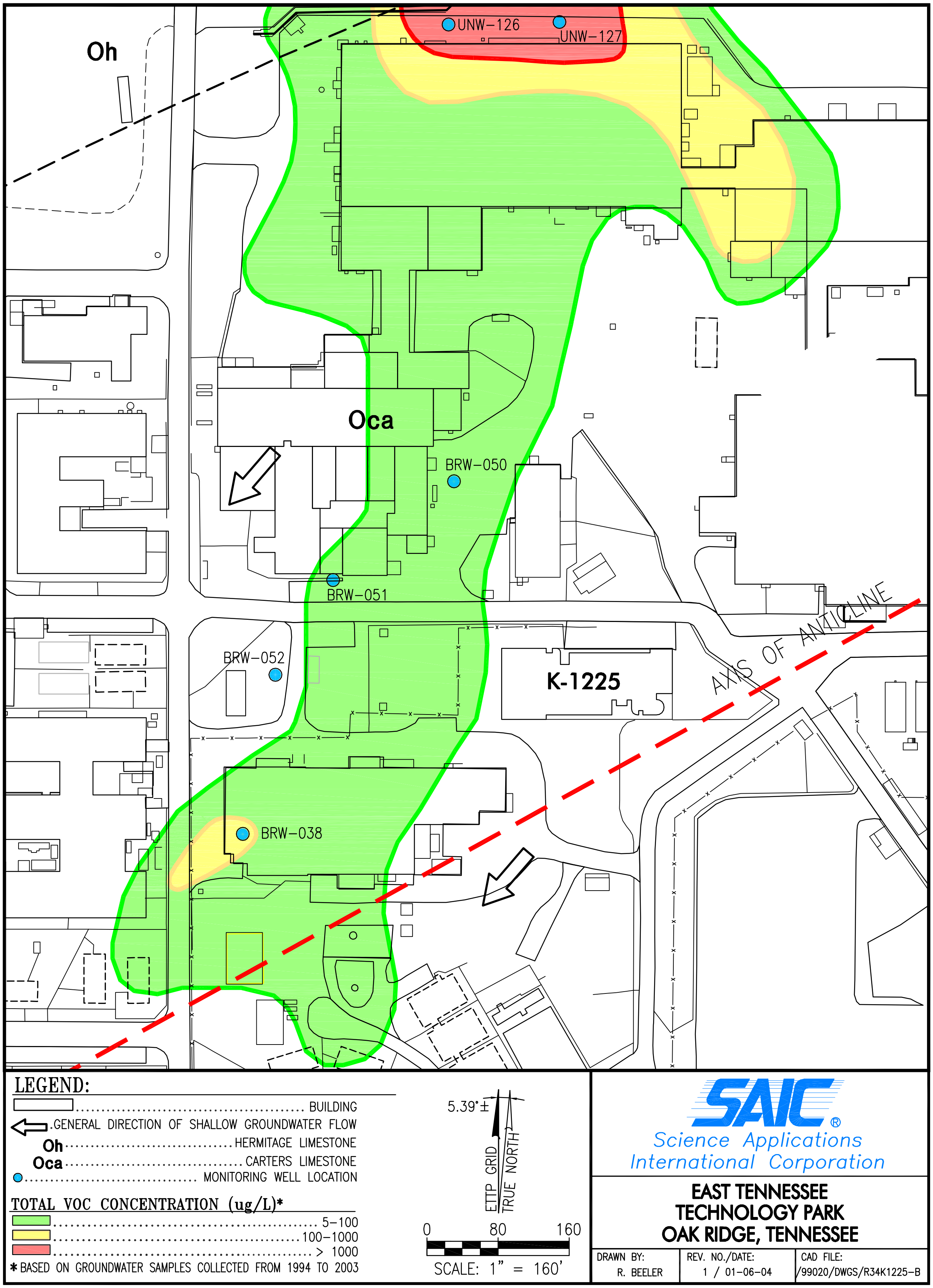

Fig. 4.2. Groundwater VOC concentrations in the vicinity of K-1225.

summarizes the primary VOCs detected at the unconsolidated zone monitoring wells located adjacent to the north side of Bldg. K-1200. The only VOC that has been detected above a federal primary drinking water maximum contaminant level (MCL) in the monitoring wells located nearest to Bldg. K-1225 is trichloroethene (see Table 4.2).

Concentrations of VOCs have generally been declining over recent years at some of these wells (i.e., BRW-038 and BRW-051). Concentrations at BRW-050 and BRW-052 have remained relatively steady but generally do not exceed an MCL. Concentrations of VOCs in unconsolidated zone wells located north of K-1200 have also remained relatively steady over recent sampling events. Given the suspected age of the original releases (disposals stopped in 1989 at K-1070-C/D) and the available concentration data, it appears that VOC concentrations in the plume nearest to K-1225 have reached a steady state in the area near the suspected source (north of K-1200) and are generally declining in the distal portions of the plume (e.g., BRW-051). Concentrations of TCE decrease from 580 μg/L at UNW-126 to 3 μg/L at BRW-050, which is located approximately 500 ft south and downgradient of UNW-126. Although high concentrations of tetrachloroethene are present at UNW-126 (5100 μg/L), natural attenuation effects may explain why this compound has not been detected in downgradient monitoring wells such as those located in the vicinity of K-1225.

Although, as stated previously, groundwater flow in the bedrock at ETTP cannot be reliably predicted; based on observed concentration trends, age of the original source releases, and natural attenuation effects, it appears unlikely that concentrations of TCE in groundwater at K-1225, if transported to this area, would exceed those observed at BRW-051. Concentrations of TCE at this well have decreased from 41 μg/L in 1994 to an estimated concentration of 18 μg/L in 1998 (Table 4.2); however, this concentration still exceeds the federal primary drinking water MCL for TCE of 5 μg/L.

4.4 EVALUATION OF POTENTIAL VAPOR INTRUSION EXPOSURE PATHWAY

EPA issued the *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Draft Vapor Intrusion Guidance)*, EPA530-F-052, in November 2002. This guidance is intended to help determine if the vapor intrusion exposure pathway poses a significant risk to human health; it was originally written in support of the environmental indicators program. Vapor intrusion is the migration of VOCs in contaminated groundwater and/or soil to indoor air. According to the Draft Vapor Intrusion Guidance, in extreme cases, the vapors may accumulate in occupied buildings to levels that may pose safety hazards and/or adverse health effects. Typically, however, the chemical concentration levels are low or, depending on site-specific conditions, vapors may not be present at detectable concentrations. Due to the occurrence of VOCs in shallow groundwater in some areas at ETTP and because a Covenant Deferral approach under CERCLA Sect. 120(h) will be used to support the transfers, EPA Region 4 recommended investigation of the vapor intrusion pathway for ETTP facilities that are targeted for transfer to CROET or other qualified parties.

In accordance with the Draft Vapor Intrusion Guidance, and through consultation with representatives from EPA Region 4, DOE Oak Ridge Operations (ORO) has developed a process to evaluate the potential for vapor intrusion at existing ETTP facilities to be transferred to the private sector under a CERCLA Sect. 120(h) Covenant Deferral Request (CDR). The following outlines that process with a focus on the first group of buildings scheduled for transfer to CROET in May 2004. This first group consists of five office buildings designated as K-1007, K-1225, K-1330, K-1400, and K-1580. Two of these buildings (i.e., K-1400 and K-1225) are located within 100 ft of a VOC-contaminated groundwater plume, while the other three (K-1007, K-1330, and K-1580) are not in close proximity (more than 100 ft) and generally down or side gradient from a plume.

ORO, EPA Region 4, and TDEC agree that vapor intrusion will be addressed in the ETTP site-wide groundwater Record of Decision (ROD). The groundwater ROD is currently scheduled to be signed by 2006. Until that time, ORO will take the following actions to ensure that transfer of these buildings is protective of human health.

1. ORO will collect building sub-slab soil-vapor samples in these five buildings and will proceed as follows:

   a) EPA will review the soil-vapor sampling plans prior to implementation (see Appendix C).

   b) Samples will be collected during the winter months prior to transfer.

   c) Individual sample results will be compared to pre-established trigger levels for soil vapor that will be developed using a Hazard Index of 0.1 and a risk value of 10^{-5}.

   d) If the soil vapor analytical results are below the trigger levels, then no further action in the building will be necessary unless site (i.e., groundwater) or building conditions change (see below for further details).

   e) If the soil vapor analytical results are above the trigger levels, discussions will be held with EPA to determine if indoor samples should be collected to determine whether the vapor intrusion pathway is complete. Factors that will be considered to determine if air sampling is necessary will include the contaminant and how significant the exceedance is (i.e., whether the risk from the vapor intrusion pathway is greater than 10^{-4}).

   f) If air samples are collected, the results will be compared to the 25-year industrial preliminary remediation goals (PRGs). If the results yield unacceptable risks (i.e., the PRGs are exceeded), the vapor intrusion pathway will be considered complete and ORO will consult with the transferee (e.g., CROET) to determine if they are still interested in transfer of the building. If the transferee desires the building, it will be retrofitted as necessary to eliminate or reduce the risk to acceptable levels, and confirmatory sampling will be conducted.

   g) If the indoor air samples do not result in an unacceptable risk (i.e., the PRGs are not exceeded), the building will be transferred, and annual indoor air sampling will be conducted to ensure that the vapor intrusion pathway has not become complete due to any changed conditions in the integrity of the building structure.

   h) ORO will conduct a follow-up sub-slab sampling event for these five buildings in the summer of 2004 to confirm protectiveness after transfer. The same process will be followed as described above. If the results of the evaluation indicate that vapor intrusion poses an unacceptable risk to human health, ORO will take the necessary actions to ensure protectiveness.

   i) After the follow-up summer sampling, and in accordance with CERCLA, together with EPA's Draft Vapor Intrusion guidance, and/or other appropriate EPA guidance, re-evaluation of the vapor intrusion pathway will be conducted only if site conditions (i.e., groundwater) and/or building use changes. The ETTP site-specific groundwater data (gathered over the past 10+ years) show stable conditions and a decreasing trend in VOC concentrations. As part of a site-wide groundwater monitoring program, ORO collects samples on an annual basis. Data from the annual monitoring will be used to determine if site conditions change. Specifically, a sample from the active groundwater monitoring well nearest to the building being evaluated and downgradient from the nearest plume will be collected annually. If more than one active well exists, then the one with the highest average concentration of TCE will be used for sampling. An initial sample from this well will be collected to establish current conditions. In the absence of a suitable well nearby to accurately monitor the groundwater conditions, the FFA parties will determine the best approach to evaluate changes. *(The specific manner in which groundwater data will be used to monitor the stability of site conditions is still being negotiated between ORO and EPA Region 4 and negotiations are expected to close in February 2004, after additional information on the DOE proposed approach is provided to EPA and before the final CDR is submitted for EPA approval.)* If the groundwater conditions change in a way that might create an unacceptable risk of exposure through the vapor intrusion pathway, ORO will conduct a re-evaluation of the building. Additionally, comprehensive changes to the building structure of infrastructure (e.g., replacement of the heating ventilation and air conditioning system) that have the potential to alter previous conclusions may require re-evaluation. If such changes are made, the transferee (i.e., CROET) will notify DOE and, if necessary, DOE will re-evaluate to ensure that the pre-transfer determination has not changed. It should be noted that the buildings will continue to be used for occupational purposes in accordance with deed restrictions.

j) A re-evaluation will consist of additional soil-vapor sampling and, if necessary, indoor-air sampling. If the results of the re-evaluation indicate that vapor intrusion poses a significant risk to human health, ORO will take necessary actions to ensure protectiveness.

2. The transfer process for these facilities will proceed concurrent with the process laid out above. EPA's approval of the CDR will be pending until completion of the first sampling activity (i.e., winter) and evaluation of the data to ensure protectiveness.

3. The CDR package will be issued for the required 30-day public comment period prior to completion of the winter sampling. The data from this sampling, as well as the data collected in the summer, will be made available to the public by posting them on a web site. When the data are posted, announcements will be made regarding their availability.

4. All other building and land parcels will be considered for evaluation on a case-by-case basis. However, it should be noted that sampling is not planned for facilities not intended for occupancy (e.g., telecommunication/utility buildings and the railroad).

5. RESULTS OF VISUAL AND PHYSICAL INSPECTIONS

5.1 VISUAL AND PHYSICAL INSPECTIONS OF THE PROPERTY PROPOSED FOR TRANSFER

In December 2002, a walkdown of the K-1225 building was conducted by representatives from Science Applications International Corporation and BJC to observe the physical condition of the building. This chapter documents the observations of this inspection.

The first and second floor plans for Bldg. K-1225 are shown in Fig. 5.1. There is approximately 11,750 ft^2 of floor space on each level for a total of 23,500 ft^2. The building is a rectangular-shaped, two-story structure constructed primarily of concrete that is used for office space. The building exterior is a pre-cast modular composite material supported on a superstructure, and the interior walls are drywall. The roof is of built-up protective membrane construction. The gravel from the roof was removed in 2000, and a synthetic layered membrane was applied.[8] Most of the interior offices are modular cubicles with the exterior offices being fully enclosed. The first floor has an entrance foyer with a receptionist desk at the south side entrance. The building is divided into a western and eastern section. Each section of the building is designed as an atrium with an open court area extending to the roof where there are skylights. A conference room is located in the southeast corner of each floor, and a larger conference room is located on the east end of the first floor. The restrooms are located in the center of the building near the elevator equipment rooms. A stairway is located in the southeast corner and on the north side of the building. In the center of the first and second floors are vaults for the storage of sensitive documents.

The flooring materials in the building are carpet, ceramic tile, and concrete. The offices and common areas are carpeted. The restrooms have ceramic floor tile, and the stairwells are a combination of rubber matting and vinyl floor tiles. The ceilings are suspended, man-made mineral fiber panels with fluorescent light fixture insets. Due to the recent construction of the building, it is not suspected that these light fixtures contain polychlorinated biphenyls (PCBs) in the ballasts. All insulation in the building is man-made mineral fiber. In 1995, an asbestos survey[9] of the K-1225 building reported there are 318 ft^2 of assumed asbestos-containing material (ACM) in the mastic (adhesive) for the stair treads. Asbestos was found in the black tar joint compound in 257 heating, ventilating, and air-conditioning duct joints throughout the building. The assumed ACMs (the duct joints and stair treads) have not been replaced and are in good condition. Due to the fact that the building was built in 1980, it is improbable that lead-based paint exists in the building.

There have been no chemical sampling events in the interior of the building to evaluate potential chemical contamination inside the building. Given the use of the facility as an office building since its construction, no sampling was deemed necessary.

Access to Bldg. K-1225 is controlled by badge readers to prevent entry by unauthorized personnel. There are badge readers at the north and south entrances of the first floor. The door on the east side of the first floor is for emergency exit only.

Building K-1225 is cooled by roof-mounted, air-conditioning units. Heating is accomplished by a hot water circulating heating system located in the Mechanical Room (Room 129) located on the first floor. Steam generated by the K-1501 Steam Plant supplies the heat for the hot water system.

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[8]Approved *Preliminary Hazard Screening (PHS) Document for K-1225*, PHS/K-1225/PK/4.0/5-20-91, July 1991.
[9]Radian Corporation 1995. *Oak Ridge K-25 Site Building K-1225 Asbestos Survey*, March.

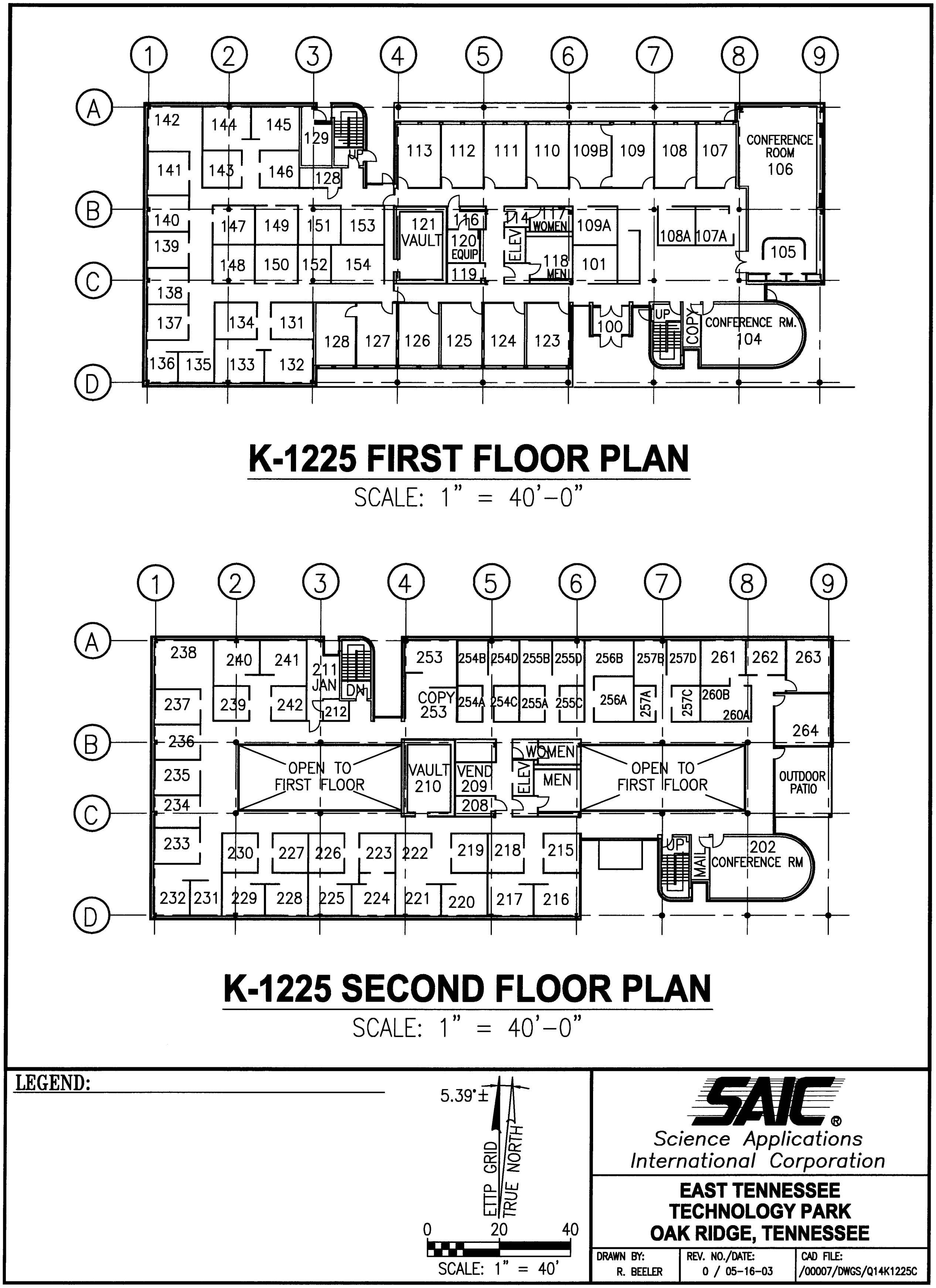

Fig. 5.1. Building K-1225 first and second floor plans.

Emergency lighting is provided by lights that are mounted on walls throughout the building. Each is powered by a lead-acid battery. The only other chemicals that are stored in the building are janitorial supplies and the hydraulic fluid for the elevator.

Also included in the study area is a 13.8-kV electrical transformer located on the north side of the building (see Fig. 5.1). This is a dry-type transformer and does not contain oil.

5.2 VISUAL AND PHYSICAL INSPECTION OF ADJACENT PROPERTY

The adjacent areas are owned by DOE, and an assessment (review of records, reports, and data) determined that there is the potential for releases of hazardous substances or petroleum products to have occurred. Information about each of the adjacent areas that may contain contamination is documented in Sect. 4.2.

Fifth Street extends from east to west on the north side of K-1225. Across 5th Street is the K-1045 Valve Shop and K-1008-F Office Building. Further to the north, extending from the northwest to the northeast, is the GCP complex. Portions of the complex are leased to the Community Reuse Organization of East Tennessee. The K-1200 area is currently subleased to a company that operates a licensed and permitted hazardous waste treatment facility.

K-1004-L is to the southeast and is surrounded by a chain-link fence. The fence has been used in the past to restrict access to the K-1004-L building, but currently the gates are open allowing access to the exterior of the building. Access to the interior of the building is controlled by a badge reader.

To the southeast, outside the ETTP perimeter fence, is the K-1240-3A Parking Lot. Access to K-1225 is through Portal 3. This is a pedestrian/vehicular portal that is currently used only for pedestrian ingress/egress into ETTP.

6. SAMPLING RESULTS

6.1 DESCRIPTION OF BUILDING K-1225

The area proposed for title transfer includes the K-1225 building, an electrical transformer, and the underlying property, also known as the underlying fee. No exterior laydown, parking, or soil areas are associated with the title transfer footprint other than the exterior sidewalks. The K-1225 building has been used for office space since its construction in 1980 and has two floors.

6.2 CHEMICAL AND RADIOLOGICAL SAMPLING

Based on discussions with EPA, it has been agreed that the need to collect soil samples to support title transfer activities will be determined on a case-by-case basis. Factors such as a facility's past operational history and geographic location will be considered. In addition, the history and knowledge of activities at adjacent properties are evaluated.

Document reviews of the K-1225 property and adjacent areas indicate that there are locations of potential concern related to operations that took place in the area from 1944 through the 1980s. Information was gathered on these facilities from previously published reports. These included site historical investigations, the K-25 Site Access and K-25 Site Decontamination and Decommissioning Facility databases, and the *Site Descriptions of Environmental Restoration Units at the Oak Ridge K-25 Site* (Energy Systems 1995a) document previously discussed in Sect. 4.2. Former facilities that have since been demolished include the K-1236 Paint Shop, the T-27/T-5 Pipe Welding Shop, the T-17 Light Equipment Garage, the K-1045-A Waste Oil Burning Pit, the K-1044 Heavy Equipment Repair Shop, and the T-21 Oil/Grease Station (see Fig. 4.1 for locations). Facilities that are still present are the K-1045 Valve Shop, the K-1004-J Vaults, the K1004-J Underground Tank, and the K-1004-L Pilot Plant.

6.2.1 Former Facilities Within the K-1225 Footprint

Only one former facility, the K-1044 Heavy Equipment Repair Shop, was located within the K-1225 footprint. The building operations are described in Sect. 4.1. This former facility is listed in *Site Descriptions of Environmental Restoration Units at the Oak Ridge K-25 Site* (Energy Systems 1995a) as a potential environmental restoration unit in the Environmental Restoration Program. It is also included in Appendix C of the FFA. During the construction of K-1225, the removal of the foundation and site preparation redistributed the soils that would be associated with the former activities of K-1044.

6.2.2 Former Facilities in Adjacent Areas to K-1225

The former facilities that are in areas adjacent to K-1225, but not within the underlying fee, are the K-1236 Paint Shop, the T-27/T-5 Pipe Welding Shop, the K-1045-A Waste Oil Burning Pit, the T-21 Oil/Grease Station, and the K-17 Light Equipment Garage. The activities in these facilities have been identified as potential sources of contamination and, therefore, are listed in the FFA for further characterization and evaluation. These facilities are discussed in Sect. 4.2.

The sites of the former K-1236 Paint Shop and the T-27/T-5 Pipe Welding Shop are currently located within the footprint of the K-1220 building west of K-1225.

The T-21 Oil/Grease Station and the K-1045-A Waste Oil Burning Pit are located approximately 300 ft north of Bldg. K-1225.

The T-21 Light Equipment Garage is within the footprint of K-1008-F immediately north of K-1225.

6.2.3 Existing Facilities in Adjacent Areas to K-1225

Several existing facilities located in the adjacent areas of K-1225 are listed in *Site Descriptions of Environmental Restoration Units at the Oak Ridge K-25 Site* (Energy Systems 1995a) and in Appendix C of the FFA. These include the K-1045 Valve Shop, the K-1004-L Pilot Plant, the K-1004-J Vaults, and the K-1004-J Underground Tank. These facilities are also discussed in Sect. 4.2.

The K-1045 Valve Shop is located immediately across 5th Street north of K-1225. The K-1004-J Vaults and Underground Tank are located approximately 250 ft to the west of K-1225.

6.2.4 Historical Sampling in the K-1225 Area

In conjunction with numerous sampling events, surface soil, subsurface soil, and groundwater samples have been collected from several of the areas adjacent to K-1225. In the mid-1990s, a site-wide remedial investigation (RI)[10] for ETTP was conducted that included surface soil, subsurface soil, and groundwater samples from identified areas of concern in the K-1225 area, including the K-1044 Heavy Equipment Repair Shop, the K-1004-J Underground Tank, the K-1045-A Waste Oil Burning Pit, and the T-21 Oil/Grease Station. In the 1990s, radiological walkover surveys were conducted that included surface and subsurface soil sampling. In 2000, surface and subsurface samples were collected in the vicinity of K-1008-F and K-1045 to support lease of these facilities. The results of these sampling events are presented below as an indication of the extent of potential contamination in the area of K-1225.

6.2.4.1 K-1044 Heavy Equipment Repair Shop

During the RI, the K-1044 area was investigated with three soil borings. Samples were collected from the borings from depths of 2 to 4 ft. These samples were analyzed for inorganic elements and semivolatile organic compounds (SVOCs). SVOCs were detected in a sample from only one of the borings. From this, it was concluded that there was no subsurface contamination as a result of former activities in the K-1044 facility.

There is an identified VOC groundwater plume in the K-1200 area that emanates from the K-1070-C/D area, but based on available data, this plume is not expected to extend under the former K-1044 site or K-1225.

6.2.4.2 K-1004-J Underground Tank

Residual contamination in soils resulting from former use of the K-1004-J Tank was investigated by evaluating data from soil samples collected from two borings installed for the RI and surface soil data from the radiological walkover survey (Energy Systems 1995b, 1996). Groundwater was investigated by collecting a water sample from each of the RI borings and by evaluating historical data from two nearby monitoring wells.

Surface soil contamination by the radionuclides ^{137}Cs, $^{239/240}Pu$, ^{99}Tc, $^{233/234}U$, and ^{238}U is documented in data from the 1994 radiological walkover survey (Energy Systems 1995b). The results from five

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[10]DOE 1999. *Remedial Investigation Report for the East Tennessee Technology Park, Oak Ridge, Tennessee*, DOE/OR/01-1778/V1&D1, U. S. Department of Energy, Oak Ridge, TN, January.

subsurface soil samples ranged from 10.5 to 49.6 picocuries per gram (pCi/g) for ^{137}Cs, from 0.15 to 0.41 pCi/g for $^{239/240}$Pu, 3.95 pCi/g for ^{99}Tc, from 2.54 to 4.60 pCi/g for $^{233/234}$U, and from 2.41 to 7.0 pCi/g for ^{238}U (all exceeded their respective background criteria). The subsurface samples collected from the borings showed that no radiological contamination was detected in the subsurface soils. In addition to radionuclides, inorganic elements and VOCs were also analyzed for. The results showed that calcium and selenium are major inorganic site-related chemicals whose concentrations exceeded their background criteria by several times. Calcium was detected in one sample at 13,300 mg/kg (background criteria is 3320 mg/kg), and selenium was detected in three samples ranging from 1.3 to 2.5 mg/kg (background criteria is 1.1 mg/kg). Two common laboratory contaminant VOCs, acetone (19 to 830 μg/kg) and toluene (5 to 24 μg/kg), were detected in the subsurface RI soil samples. Trichloroethylene (TCE) was detected at low concentrations (2 to 3 μg/kg); all results were J-qualified (estimated results).

Although radionuclides have not been analyzed for in the historical monitoring well samples taken from the K-1004-J Tank area, the measured gross radiological parameters show that radioactivity does not constitute a groundwater problem at this location. Historical monitoring well results indicate that Freon-113, 1,2-dichloroethylene (DCE), benzene, chloroform, toluene, and TCE have been detected. The detection of these VOCs in bedrock groundwater may be attributable to the K-1070-C/D area plume since the water samples from the borings, located downgradient of the K-1004-J Tank, detected only acetone (150 μg/L). The plume emanating from the K-1070-C/D area is not expected to extend under the footprint of K-1225.

Combined historical and site-wide RI data for soils and groundwater were interpreted to indicate that there is no residual contamination in groundwater and subsurface soils as a result of former use of the K-1004-J Tank. However, data from the radiological walkover survey (Energy Systems 1995b) show that surface soils in the vicinity of the tank are contaminated with ^{137}Cs and ^{238}U. The presence of surface contamination in the absence of subsurface contamination indicates that it resulted from a surface spill as opposed to a subsurface leak from the tanks. The tank is approximately 250 ft west of K-1225.

6.2.4.3 K-1045-A Waste Oil Burning Pit and T-21 Oil/Grease Station

There are no historical surface or subsurface soil samples from the K-1045-A/T-21 area. However, five surface soil samples were collected in the K-1008-F/K-1045 area, 150 ft to the south of K-1045-A/T-21, in 2000. One sample was analyzed for radiological constituents, two were analyzed for VOCs, and two were analyzed for SVOCs, PCBs, and metals. PCBs were detected in only one sample at a concentration of 63 μg/kg. No SVOCs or VOCs were detected. Calcium, magnesium, and cadmium (39,600 mg/kg, 13,900 mg/kg, and 0.68 mg/kg, respectively) were the only metals detected above background levels. All radiological results were below site reference levels.

Possible impacts to groundwater from former operations of K-1045-A and T-21 were assessed by evaluating historical data and a drive point sample collected for the site-wide RI (DOE 1999). The results show that dimethylbenzene (55 μg/L), benzene (67 μg/L), toluene (7.3 μg/L), DCE (324 μg/L), TCE (55 μg/L), chloroform (432 μg/L), and tetrachloroethylene (PCE) [9.4 μg/L] are present in the groundwater. Although the detection of benzene, toluene, ethylbenzene, and xylene compounds at this location may be from the plume emanating from the K-1070-C/D area, it cannot be discounted that these two facilities themselves are possible contributors to the southern extension of the K-1070-C/D plume. SVOCs detected during historical sampling are typical of SVOCs in sitewide groundwater. They include bis(2-ethylhexyl)phthalate (120 μg/L), diethyl phthalate (2 μg/L, estimated), di-*n*-butyl phthalate (10 μg/L, estimated), and butyl benzyl phthalate (10 μg/L, estimated).

6.2.4.4 K-1220 Area

Two soil samples was collected to the west of K-1220 in 2000. One sample was analyzed for VOCs (none were detected) and the other for VOCs, SVOCs, PCBs, and metals. This sample had two VOC results, 2.1 µg/kg of carbon disulfide and 1.3 µg/kg of benzene. Since benzene and carbon disulfide are solvents commonly used in analytical laboratories, their presence at these low concentrations may be due to contamination of the sample during laboratory analysis and is not necessarily an indication of subsurface soil VOC contamination. There was also one metal result, aluminum (58,800 mg/kg), that was above the ORR background concentration of 43,000 mg/kg (DOE 1993).

6.2.5 Risk Screen

Any potential risk that a future occupant may be exposed to by occupying space in K-1225 and at ETTP is evaluated in *Risk Screen to Support the Title Transfer of the K-1225 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee*, BJC/OR-1410 (BJC 2004).

6.3 RADIOLOGICAL SURVEYS

Radiological surveys were conducted on the interior and exterior surfaces of K-1225, the building contents, the exterior sidewalks, and the electrical transformer on the northern side of the building. See Figs. 6.1 and 6.2 for the interior and exterior survey areas, respectively. (*Note:* Fig. 6.1 shows ISU-10 as Rooms 109A and 101. However, the building contains only one room in this space, which is labeled Room 100. This room was surveyed as ISU-10.) This section presents and discusses the current radiological survey data that have been collected and reported in ETTP/PEM- 0224, *Radiological Survey Report for the Transfer of the K-1225 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee, to the Community Reuse Organization of East Tennessee* (BJC 2003). A discussion of the historical survey data is presented (Sect. 6.3.1), followed by a discussion of the current survey plan, results, and quality assurance/quality control (QA/QC) of the data (Sect. 6.3.2). The final subsection (Sect. 6.3.3) presents a summary of the data review and results of the statistical analysis of the survey data set for the area.

Process history of the ETTP site indicates that uranium (whether natural, depleted, or enriched) would be the most prominent radiological contaminant potentially present in the K-1225 building due to tracking of contamination from other on-site buildings. Uranium-235 enrichment levels expected from operations since the early 1960s would be anticipated to range between 0.2 to 5.0%. Most facilities potentially would be contaminated via track-in and have enrichments of less than 3%.[11] As K-1225 has been an administrative building throughout its history, it is assumed that the uranium would be from natural sources and that the enrichment is approximately that of natural uranium, which is 0.72%.

Other radionuclides (^{60}Co, ^{137}Cs, $^{89/90}$Sr, ^{237}Np, ^{99}Tc, and $^{238/239/240}$Pu) also have been detected on-site at ETTP. These other radionuclides originated from the introduction of contaminated materials from ORNL or from the Hanford and Savannah River reactor returns uranium reprocessing program; however, these radionuclides are expected to be found in much lower quantities than uranium and to be undetectable in this area, based upon its operational history as an administrative facility. If they were

[11]Contracted Health Physics Technician Training handouts, K-25, 1993.

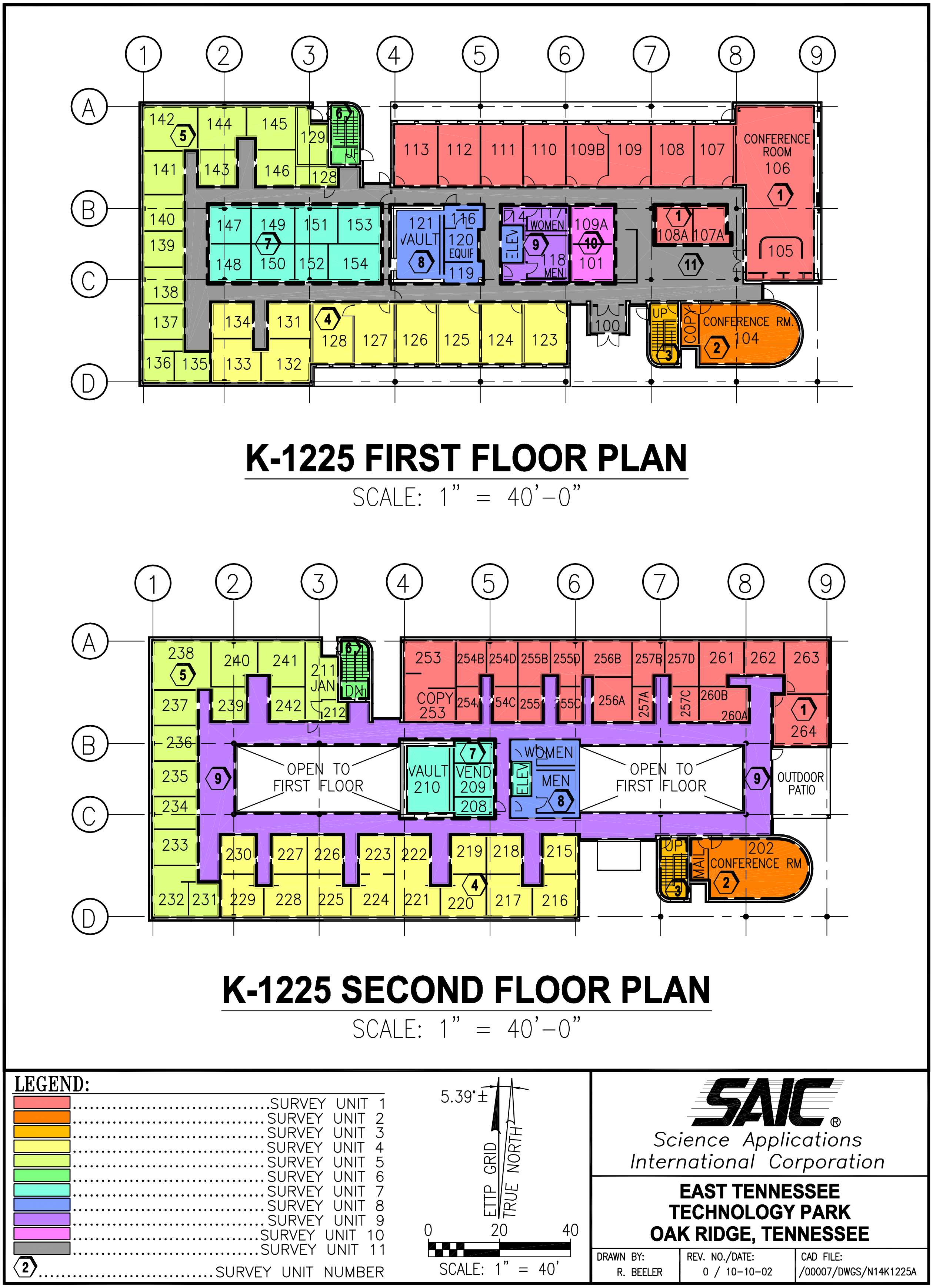

Fig. 6.1. K-1225 interior survey units.

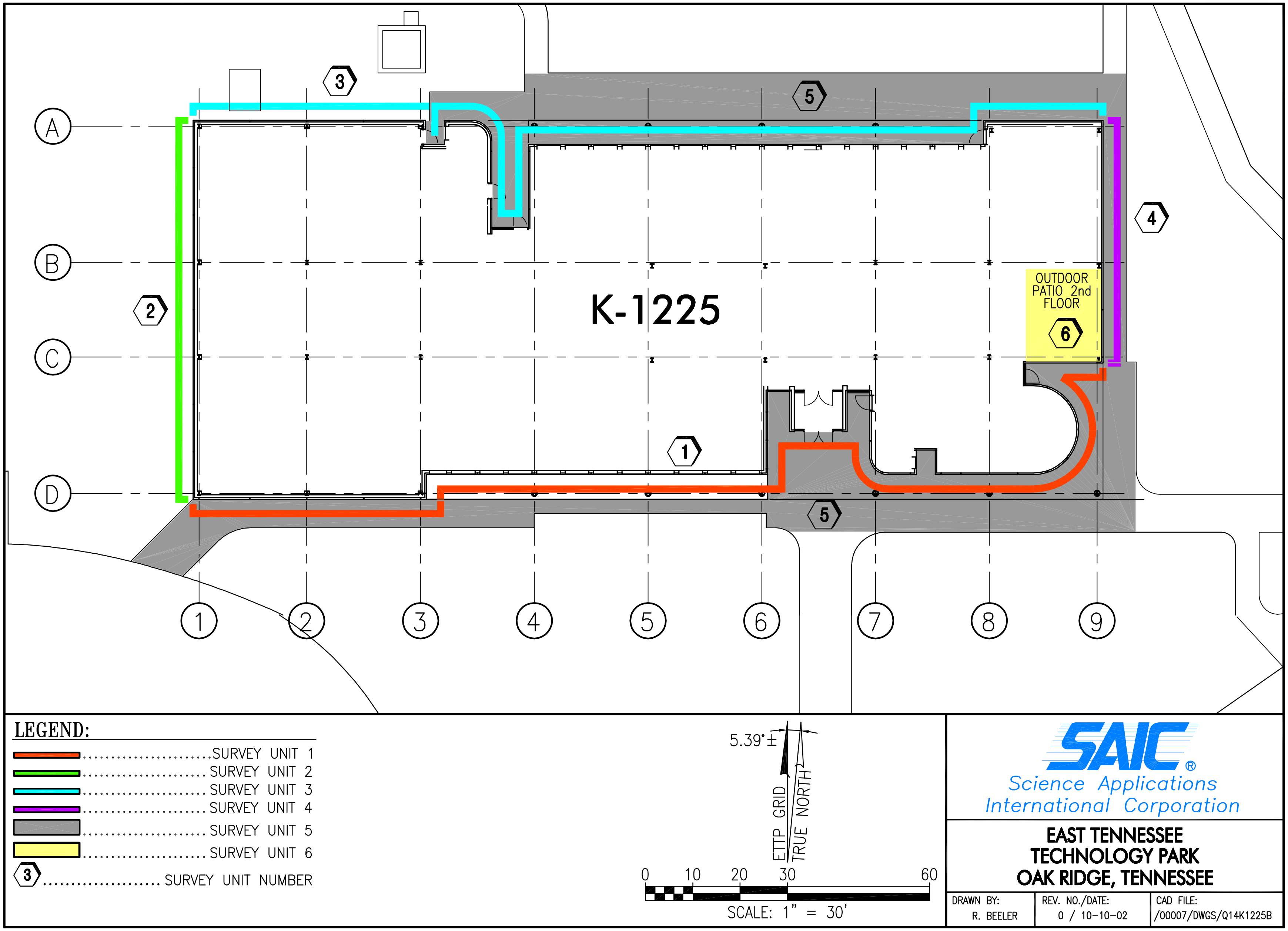

Fig. 6.2. K-1225 exterior survey units.

present, it is assumed that they would be present at ratios of 1140:1 for uranium to transuranic (U:TRU) and 350:1 for uranium to technetium-99 ($U:^{99}Tc$) [both ratios are process buildings weighted averages].[12]

6.3.1 Historical Surveys

A search of the BJC Radiation Control (RADCON) electronic survey data collected since 1996 (BJC 1996) indicated that a total of 43 surveys were performed in the building, including one that had elevated beta-gamma readings. The elevated readings, however, were taken in the restroom on ceramic floor tiles, which have naturally occurring radioactive material (NORM) in their matrices. All other survey readings (of the 43 surveys) were below background levels. A review of these surveys provided some information for the survey classification of the individual survey units.

Sixteen equipment surveys were conducted in the building, consisting of surveys of office equipment, computers, and other miscellaneous materials. No elevated activity above background levels was detected, except for computer monitors, which have a NORM in the phosphorus contained in the monitor screen.

6.3.2 Current Surveys

A total of 48 surveys (including all associated QA/QC surveys) were conducted in the study area (Table 6.1). See Fig. 6.1 for the locations of the first and second floor interior survey units (ISUs) and Fig. 6.2 for the exterior survey units (ESUs). These surveys were performed from November 19 to November 27, 2002, in accordance with ETTP RADCON procedures,[13] the survey design document[14] (hereafter referred to as the "design document"), and the survey plan (see Appendix D). In addition, a supplemental survey of ancillary equipment (transformer), located on the exterior of K-1225 that supports the operation of the building, was performed on December 23, 2002 (see Table 6.1).

Table 6.1. ETTP current radiological survey numbers

20021119KA36145003	20021122PA01388003	20021126PA01388002	200211190020826002
20021119KA36145004	20021122XA50370002	20021126PA01388003	200211190020826001
20021119PA01388001	20021122XA50370003	20021126PA01388004	200211200020826001
20021119PA01388002	20021123KA36155001	20021126XA50370001	200211200020826002
20021120PA01388001	20021123KA36155002	20021126XA50370002	200211200020826003
20021120PA01388002	20021125KA36145001	20021127PA01388002	200211220020826001
20021120PA01388003	20021125PA01388001	20021127KA36155001	200211220020826002
20021121KA36155001	20021125XA50370001	20021127PA01388001	200211220020826003
20021121PA01388001	20021126KA36145001	20021119KA36155002	200211230020826002
20021121PA01388002	20021126KA36155001	20021119KA36155001	200211230020826003
20021122PA01388001	20021126KA36155002	200211230020826005	200211230020826004
20021122PA01388002	20021126PA01388001	200211230020826006	200211230020826001
20021223KA36145002			

[12]*Isotopic Distribution of Contamination Found at the U. S. Department of Energy Gaseous Diffusion Plants*, Science Applications International Corporation (SAIC) report delivered to Bechtel Jacobs Company LLC, SAIC document number 143.19991103.002, October 1999.

[13]Primarily SH-B-4012, "Radioactive Contamination Control and Monitoring," found in BJC-SH-04, Vol. I, *Radiation Protection Program.*

[14]BJC 2000. *Design of Radiological Surveys of Potential Lease Space at East Tennessee Technology Park, Oak Ridge, Tennessee*, BJC/OR-554, Bechtel Jacobs Company LLC, Oak Ridge, TN, March.

Radiological survey procedures and area survey units are described in the survey plan presented in Appendix D. Each area was classified as either a Class 3, 2, or 1 survey unit based upon historical data and process knowledge, as described in the design document.

Hand-held meter survey results were taken and compared to the following values (Table 6.2), which are the appropriate 10 *Code of Federal Regulations* (*CFR*) 835[15] and DOE Order 5400.5[16] surface contamination gross alpha or gross beta criteria, which are referred to as derived concentration guideline levels (DCGLs) in the design document, for the survey area:

Table 6.2. Contamination limits (DCGLs) for all survey units

	DCGL ($dpm/100 cm^2$)	Class 3, 25% of DCGL ($dpm/100 cm^2$)	$DCGL_{EMC}$ (dpm/area)
Total alpha	5000	1250	15,000
Removable alpha	1000	250	N/A
Total beta-gamma	5000	1250	15,000
Removable beta-gamma	1000	250	N/A

DCGL = derived concentration guideline level.
$DCGL_{EMC}$ = derived concentration guideline $level_{elevated\ measurement\ comparison}$.
dpm = disintegrations per minute.
N/A = not applicable.

Each survey unit data set was first evaluated by comparing the maximum result after subtracting background to the screening level for the survey unit classification. If the net maximum survey result was less than the screening level for the specific survey unit (e.g., 25% DCGL limits for Class 3 survey units), then the unit was said to pass and have rejected the null hypothesis, (H_o). The null hypothesis specifies that the residual contamination in each of the individual survey units exceeds the survey unit DCGL. If the net maximum result was greater than the screening level for any single reading, further readings were obtained in the 1 m^2 area in order to determine the average for the square meter. If the net average reading for the square meter was greater than the screening level for the specific survey unit, then Class 3 and 2 survey units were reclassified and resurveyed under the protocol of the new classification. If the net maximum result was greater than the DCGL for Class 1 units, the non-parametrical statistical Sign test was used to evaluate the data as outlined in the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) [NRC 1997].

6.3.2.1 Interior survey units

All ISUs of the K-1225 building were classified as Class 3. Per the design document, Class 3 survey units have an upper limit of 25% of the DCGL [i.e., 1250 disintegrations per minute (dpm)/100 cm^2 alpha or beta activity]. The Class 3 survey criteria for ISUs were the following: 10% scan of the primary traffic areas and work surfaces with floor monitors and hand-held meters (including use of a floor monitor probe set up as a hand-held probe and calibrated to detect alpha and beta-gamma contamination for large area scans of non-floor surfaces), as appropriate; any location on the walls or ceiling that, using professional judgment, potentially could have residual radioactivity present was to be scanned over the suspected area and documented; no removal of suspended ceiling tiles or floor panels was required for this survey; 11 measurements of total and removable contamination, at a minimum, were recorded within each survey unit at locations determined during the scan survey to have the highest activity; a general dose rate walkover

[15] *CFR* 1999. 10 *Code of Federal Regulations* 835, *Occupational Radiation Protection*; the values are taken from Appendix D, "Surface Radioactivity Values."

[16] DOE 1990. *Radiation Protection of the Public and Environment*, DOE Order 5400.5, Fig. IV-1, "Surface Contamination Guidelines," p. IV-6, U. S. Department of Energy, February 8.

survey of each survey unit, using a Bicron MicroRem® meter,[17] was performed to determine if any variations exist in the penetrating radiation dose rate; and dose rate measurements were obtained at a minimum of every 20 ft in hallways and large rooms. Several of the survey units have more than the minimum number of data points (11); the critical value for the Sign Test was determined using the actual number of data points for each survey unit and an alpha error (Type I error) of 0.05.

No ISU had any result above 25% of the DCGL. Since all results were less than the screening level for Class 3 units, no further statistical analysis was performed. From an inspection of the individual surveys, all total activities were less than 89 dpm/100 cm^2 total alpha and 883 dpm/100 cm^2 total beta-gamma, with all removable contamination results less than 8.1 dpm/100 cm^2 removable alpha and 41.6 dpm/100 cm^2 removable beta-gamma. The maximum tissue-equivalent dose rate was 8 μrem/h (microrem/h). See Table 6.3 for the summary of the survey results for all ISUs.

6.3.2.2 Exterior survey units

All exterior areas were classified as Class 3 and surveyed up to a minimum height of 8 ft with hand-held meters or with a gas-proportional probe, with an emphasis on air intakes and vents, windowsills, gutter downspouts, and any other area that the survey technician's professional judgment would indicate a higher probability of finding elevated readings. Ten percent of the building exterior walls and roof were surveyed. In addition, there is one piece of ancillary equipment located on the exterior of K-1225 that supports the operation of the building and will be included in the title transfer. This equipment, an electrical transformer, was included in a supplemental survey conducted in December 2002 and will be designated as ESU-Transformer. All Class 3 ESUs were scan surveyed over a minimum of 10% of the accessible area, with 11 measurements of total and removable activity taken (alpha and beta-gamma) at locations having the highest activities, as determined during the scan survey. No tissue-equivalent dose rates were required per the survey plan. However, at the discretion of the technician, some were taken anyway. As with the ISUs, several of the survey units have more than the minimum number of data points (11); the critical value for the Sign Test was determined using the actual number of data points for each survey unit and an alpha error (Type I error) of 0.05. See Fig. 6.2 for the ESUs.

Most beta-gamma readings taken on the exterior of the building were less than 1250 dpm/100 cm^2 total activity. However, there was one location on the roof that had a total beta/gamma activity that exceeded 1250 dpm/100 cm^2 (1552). There was also one QA/QC survey result from the roof that exceeded 1250 dpm/100 cm^2 (1453). The roof is covered with gravel, which contains NORM. The survey plan allowed for up to 2800 dpm/100 cm^2 total beta-gamma activity on red clay bricks. No results exceed 2800 dpm/100 cm^2. Although the NORM concentration in rocks may not be the same as bricks, it is believed that the elevated readings are due to the NORM material in the rocks and are consistent with a background screening level for the gravel. Since all results were less than the screening level for Class 3 units, no further statistical analysis was performed. From an inspection of the individual surveys, all total activities were less than 187 dpm/100 cm^2 total alpha and 1552 dpm/100 cm^2 total beta-gamma, with all removable contamination results less than 11 dpm/100 cm^2 removable alpha (from a QA/QC measurement) and 45 dpm/100 cm^2 removable beta-gamma. The maximum tissue-equivalent dose rate was 6 μrem/h (microrem/h). See Table 6.3 for the summary of the survey results for all ESUs.

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[17]Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof.

Table 6.3. Summary of contamination and dose rates for the K-1225 study area

Location	Alpha total[a] dpm/100 cm²		Alpha removable[a] dpm/100 cm²		Beta-gamma total[a] dpm/100 cm²		Beta-gamma removable[a] dpm/100 cm²		Dose equivalent rate (mrem/h)
	Min	Max	Min	Max	Min	Max	Min	Max	
					Interior survey units				
ISU 1	< 0	59	< -2.69	< 8	< -555.05	< 0	< -38.78	41.55	.003 – .008
ISU 2	< -29.3	14.65	< -2.69	< 0	< -816.25	< -32.65	< -47.09	24.93	.004 – .005
ISU 3	< 0	73	< -8.07	< 0	< -750.95	< -32.65	< -16.62	36.01	.005 – .006
ISU 4	< -29.3	29.3	< -8.69	< 0	< -32.65	522	< -27.7	11.08	.003 – .006
ISU 5	< 0	44	< -8.07	< -5.38	< -97.95	490	< -36.01	5.54	.003 – .006
ISU 6	14.65	73.25	< -8.07	< 0	< -424.45	359.15	< -24.93	24.93	005 – .006
ISU 7	< 0	88	< -2.69	2.69	< -163.25	359.15	< -33.24	36.01	.004 – .005
ISU 8	14.65	88	< -5.38	< 0	< -261.2	653	< -49.86	< -2.77	.003 – .005
ISU 9	< -43.95	< 0	< - 22.16	< 0	< -1012.15	882	< -13.85	24.93	004 – .005
ISU 10	< 0	29.3	< -2.69	2.69	< -522.4	588	< -52.63	11.08	004 – .005
ISU 11	< 0	87.9	< -2.69	2.69	< -979.5	< -163.25	< -66.48	< -11.08	.003 – .005
ISU 12	< -15.54	62.16	< -2.69	2.69	< -341.33	434.42	< -41.55	13.85	.003 – .005
ISU 13	< -15.54	62.16	< -2.69	5.38	< -155.15	279.27	< -55.4	13.85	.004
ISU 14	< -15.54	62.16	< -2.69	< 0	< -558.54	62.06	< -44.32	8.31	.003 – .005
ISU 15	< -15.54	62	< -2.69	2.69	< -589.57	372.36	< -36.01	13.85	.003 – .005
ISU 16	< -15.54	62	< -2.69	2.69	< -527.51	403.39	< -33.24	13.85	004 – .005
ISU 17	< -31.08	31.08	< -2.69	2.69	< -651.62	558.54	< -27.17	13.85	004 – .005
ISU 18	< -31.08	31.08	< -2.69	< 0	< -186.18	279.27	< -27.7	22.16	004 – .005
					Exterior survey units				
ESU 1	< -14.65	29.3	< -2.69	< 0	< -1012.15	718	< -8.31	22.16	.004 – .005
ESU 2	< -29.3	< 0	< -2.69	2.69	< 0	686	< -24.93	36.01	.004 – .006
ESU 3	< 0	58.6	< -2.69	8.07	< -293.05	195.9	< -8.31	38.78	.004 – .005
ESU 4	< -14.65	14.65	< -2.69	2.69	< -163.25	391.8	< -16.62	16.62	.004 – .005
ESU 5	< 0	73.25	< -2.69	2.69	< -130.6	522.4	< -16.62	24.93	.003 – .005
ESU 6	< -31.08	31.08	< -2.69	< 0	< -465.45	186.18	< -11.08	24.93	.004
ESU – Roof	15.54	186.48	< -2.69	2.69	< -868.84	1551.5	< -8.31	44.32	.003 – .006
ESU – Transformer	< 0	43.95	< -2.69	5.38	< -620.35	205.44	< -30.47	44.32	.003 – .004
					Furnishings survey units – Class 3				
FSU 2 – first and second floors	-15.1	30	-2.69	5.38	-442.26	442	-58.17	24.93	NR
FSU C3 – Unit 1	0	117.6	-2.43	2.43	-477.15	159.05	-47.84	-5.98	NR
FSU C3 – Unit 2	0	45.3	-2.69	2.69	-379.08	-31.59	-49.86	-5.54	NR

Table 6.3. Summary of contamination and dose rates for the K-1225 study area (continued)

Location	Alpha total[a] dpm/100 cm^2		Alpha removable[a] dpm/100 cm^2		Beta-gamma total[a] dpm/100 cm^2		Beta-gamma removable[a] dpm/100 cm^2		Dose equivalent rate (mrem/h)
	Min	Max	Min	Max	Min	Max	Min	Max	
FSU C3 – Unit 4	-15.1	30.2	-8.07	-2.69	-374.76	93.69	-41.55	8.31	NR
FSU C3 – Unit 5	-15.1	30.2	-8.07	0	-405.99	93.69	-38.78	11.08	NR
FSU C3 – Unit 7	-15.1	30.2	-8.07	0	-343.53	374.76	-58.17	27.7	NR
FSU C3 – Unit 8	-15.1	45	-8.07	0	-780.75	-62.46	-22.16	22.16	NR
FSU C3 – Unit 10	0	73.5	-2.43	2.43	-349.91	190.86	-71.76	5.92	NR
FSU C3 – Unit 11	-29.4	58.8	-2.43	2.43	-159.05	508.96	-62.79	5.98	NR
FSU C3 – Unit 12	-26.52	39.78	-2.69	5	-650.56	376.64	-55.4	30.47	NR
FSU C3 – Unit 13	-13.26	53	-2.69	5	-684.8	136.96	-41.55	30.47	NR
FSU C3 – Unit 14	-13.26	53.04	-2.69	2.69	-136.96	513.6	-44.32	24.93	NR
FSU C3 – Unit 15	-30.2	30.2	-2.69	0	-537.03	189.54	-38.78	-5.54	NR
FSU C3 – Unit 16	-30.2	0	-2.69	0	-410.67	221.13	-63.71	2.77	NR
FSU C3 – Unit 18	-15.1	135.9	-2.69	5.38	-315.9	252.72	-41.55	11.08	NR
DOE limits	5000		1000		5000		1000		20

Notes: [a]All readings are in units of disintegrations per minute (dpm)/100 cm^2.
A "<" preceding a value indicates that the result cannot be distinguished from background at the 95% confidence level (recorded for ISUs and ESUs).
DOE = U. S. Department of Energy.
ESU = exterior survey unit.
FSU = furnishings survey unit.
ISU = interior survey unit.
NA = not applicable.
NR = no reading (was taken).

6.3.2.3 Furnishings survey units

All furnishings survey units (FSUs) were classified as either Class 3 or Class 2, based upon their as-found condition, process knowledge, and historical data, if available. Furnishings are defined as any item typical of an office, such as desks, chairs, tables, bookcases, or trash cans. Class 3 FSUs consist of the newer furnishings and were scanned over 10% of all accessible areas, with a maximum surface area not to exceed 5000 m^2. Class 2 FSUs consist of the older furnishings and were scan surveyed over 10% of their accessible surfaces, with a maximum FSU area of 1000 m^2. Because of the low volume of Class 2 furnishings, all Class 2 furnishings on the first and second floors were combined into 1 Class 2 FSU. A minimum of 11 data points were collected from each FSU at the areas of the highest activity, as determined during the scan survey. No dose rates were required per the survey plan for furnishings.

No FSU had any result above 25% of the DCGL. Since all results were less than the screening level for Class 3 units, no further statistical analysis was performed. Activities were less than 136 dpm/100 cm^2 total alpha and 514 dpm/100 cm^2 total beta-gamma, with all removable contamination results less than 5.4 dpm/100 cm^2 removable alpha and 30.5 dpm/100 cm^2 removable beta-gamma. See Table 6.3 for the summary of the survey results for all FSUs.

6.3.2.4 Quality assurance/quality control surveys

A 5% verification survey of the data gathered from each survey unit was performed in each survey unit for QA/QC. All QA/QC survey data gathered were in agreement with the initial survey unit data.

6.3.3 Survey Data Review and Analysis

All of these survey data were reviewed by a health physicist prior to use in this report. All surveys were conducted in accordance with the survey plan per the BJC team health physicist (including the correct number of survey units, data points per survey unit, instrumentation data, and performance of QA/QC survey). The results of the QA/QC survey were judged to be consistent with the original survey results within the uncertainty of the measurements.

Results of the surveys performed in the study area and the statistical test performed on the data gathered in each survey unit indicate that the interior, exterior, and present furnishings are below the DOE surface contamination limits and within the acceptable dose equivalent rate range for building interiors. The null hypothesis was rejected for each survey unit. Therefore, the alternative hypothesis (H_a) was accepted, which states that the residual radioactivity in each of the survey units does not exceed the DCGL and, therefore, can be released without radiological restrictions.

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APPENDIX A

REAL ESTATE LETTER

PROPOSED TRANSFER OF ETTP BUILDINGS
OAK RIDGE RESERVATION, TN

FILES RESEARCH FOR HAZARDOUS SUBSTANCE ACTIVITY

The following statement is provided in support of guidance promulgated under Section 120(h) of the Comprehensive Environmental Response, Liability, and Compensation Act, as amended (CERCLA) 42 U.S.C. 9620(h) and in support of regulations issued by the Environmental Protection Agency at 40 CFR part 373.

The undersigned has made a complete search of existing and available Department of Energy (DOE) records, documentation, and data within the real estate files relating to the property that is subject to the proposed fee transfer action of Buildings K-1007, K-1035, K-1036, K-1225, K-1330, K-1400 and K-1580 at the East Tennessee Technology Park within the Oak Ridge Reservation, Tennessee. The proposed action would result in transfer to the Community Reuse Organization of East Tennessee (CROET) under a 10 CFR 770 Proposal. The search conducted was considered reasonable with a good faith effort expended to identify whether any hazardous substances were stored for one year or more, released, or disposed of on the property. The available real estate records of this office do not reflect any determinable reference that hazardous substance activity as defined by Section 101(14) of CERCLA took place on or in the property during the time the property was owned by the United States of America.

Lands affected by this action are identified as portions of the following original acquisition tracts in which the United States of America acquired title, (having been acquired for the Atomic Energy Commission as a forerunner of the Department of Energy) by Civil Action No. 429 filed in the United States District Court for the Eastern District of Tennessee, Northern Division:

a. Buildings K-1035, K-1036, and K-1400 are located on a portion of **Tract H-719**. Title to this land was vested in the United States of America by Declaration of Taking No. 26 dated March 19, 1943. Judgment on Declaration of Taking was filed for public record on March 30, 1943 in Vol. Y-5, page 515 in the Roane County Register's Office, Tennessee.

b. Buildings K-1225, K-1330, and K-1580 are located on a portion of **Tract H-720**; and Building K-1007 is located on a portion of **Tract H-731**. Title to this land was vested in the United States of America by Declaration of Taking No. 19 dated February 8, 1943. Judgment on Declaration of Taking was filed for public record on February 23, 1943 in Vol. Y-5, page 136 in the Roane County Register's Office, Tennessee.

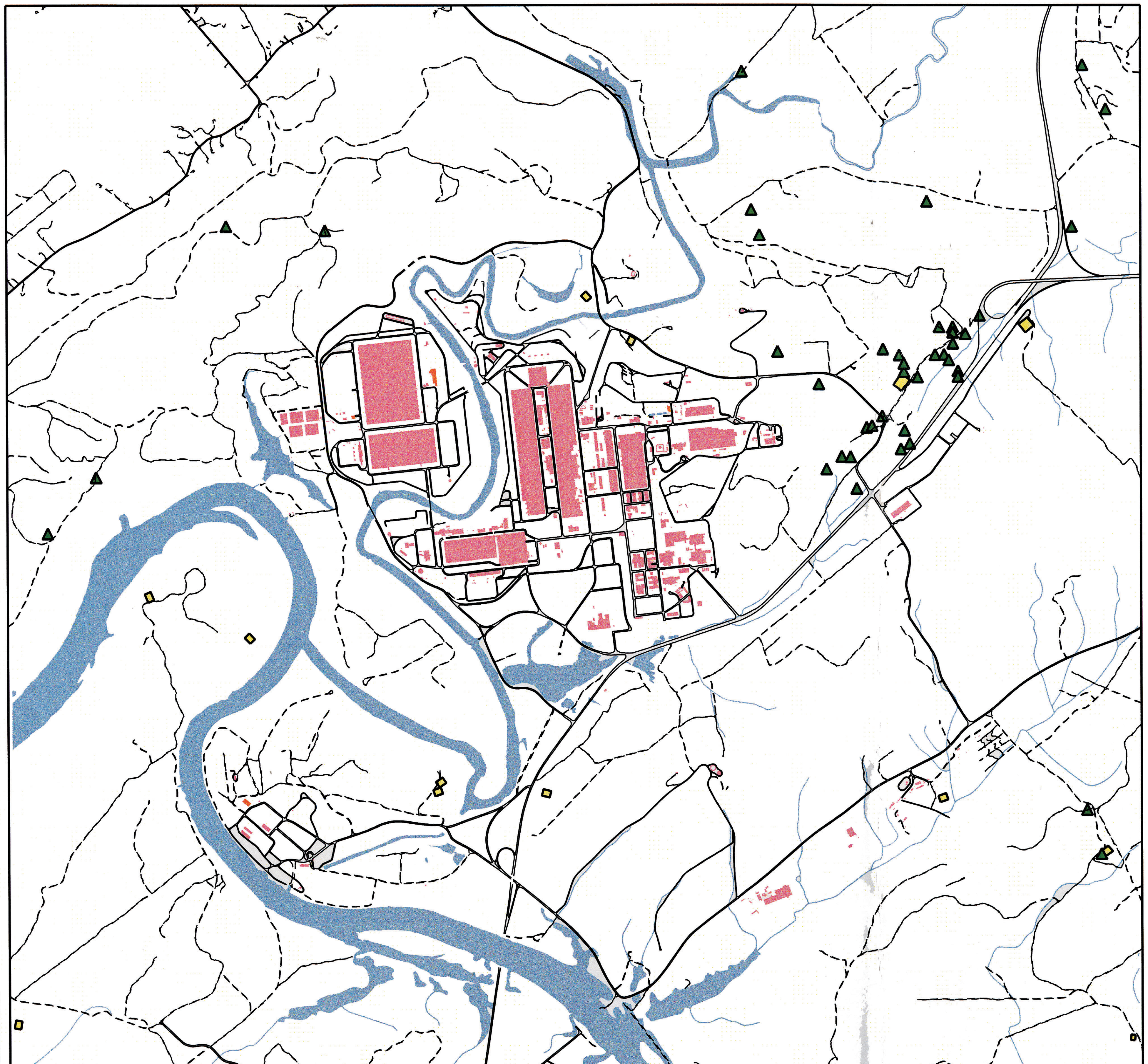
This record shall be made a part of the CERCLA report currently being prepared.

Katy Kates, Realty Officer
Oak Ridge Operations Office
Department of Energy
August 8, 2003

Attachment-Plat Exhibit

APPENDIX B

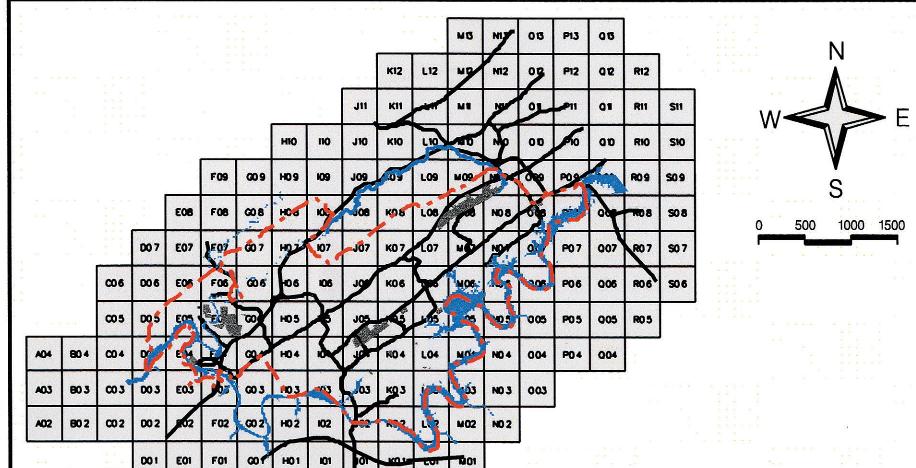
STUDY AREA MAPS FROM RECORDS SEARCH



Location of Pre–World War II Structures and Cemeteries in or near the East Tennessee Technology Park

LEGEND

- Pre–World War II Structures
- Cemeteries
- Buildings
- Roads
- Water Bodies
- Streams



DATA COMPLIED BY GRID IS NAD 83 FEET
ER REMOTE SENSING PROGRAM
ENVIRONMENTAL INFORMATION MANAGEMENT PROGRAM
GEOGRAPHIC INFORMATION SCIENCES AND TECHNOLOGY GROUP
ORIGINAL BY: BARGE, WAGGONER, SUMNER AND CANNON, INC.
REVISED BY: TETRA TECH, INC. 2/10/01

KMAPS ORO HISTORIC MAP GSL

APPENDIX C

SAMPLING AND ANALYSIS PLAN FOR THE K-1225 BUILDING

Sampling and Analysis Plan for Collection of Groundwater, Air, and Soil Vapor Samples for the K-1225 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

BJC/OR-1712

Sampling and Analysis Plan for Collection of Groundwater, Air, and Soil Vapor Samples for the K-1225 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee

Date Issued—January 2004

Prepared for the
U. S. Department of Energy
Assets Utilization

BECHTEL JACOBS COMPANY LLC
managing the
Environmental Management Activities at the
East Tennessee Technology Park
Y-12 National Security Complex   Oak Ridge National Laboratory
Paducah Gaseous Diffusion Plant   Portsmouth Gaseous Diffusion Plant
under contract DE-AC05-98OR22700
for the
U. S. DEPARTMENT OF ENERGY

03-066(doc)/011004

CONTENTS

FIGURES

TABLES

ACRONYMS

bgs	below ground surface
COPC	chemical of potential concern
DCE	dichloroethene
DOE	U. S. Department of Energy
ELCR	excess lifetime cancer risk
EPA	U. S. Environmental Protection Agency
ETTP	East Tennessee Technology Park
FFA	Federal Facility Agreement
GC/MS	gas chromatography/mass spectrometry
ORR	Oak Ridge Reservation
PCE	tetrachloroethene
PRG	preliminary remediation goal
PSS	Park Shift Superintendent
SAP	Sampling and Analysis Plan
SOP	standard operating procedure
SSC	sampling subcontractor
TCA	trichloroethane
TCE	trichloroethene
TIC	tentatively identified compound
UF_6	uranium hexafluoride
VOC	volatile organic compound

1. INTRODUCTION

This Sampling and Analysis Plan (SAP) describes sampling efforts to be undertaken to determine whether subsurface contamination from volatile organic compounds (VOCs) has resulted in organic vapors entering the K-1225 building. This plan was developed as part of an effort to address concerns raised by U. S. Environmental Protection Agency (EPA) Region 4 regarding the potential for vapor intrusion of VOCs from shallow groundwater into buildings at the East Tennessee Technology Park (ETTP) that are proposed for transfer.

The K-1225 building was built in 1980 to provide office space for gas centrifuge project personnel. The project was shut down in 1985, and since that time the building has been used by several organizations for offices. It is now an office facility for the U. S. Department of Energy (DOE) prime contractor at ETTP. Although there have been no industrial activities within the building since its construction, the K-1225 building is located within an area of the plant where industrial activities were formerly located.

This SAP presents the rationale and details of air sampling to be conducted in the ETTP K-1225 building. These sampling activities are being conducted to determine the potential for vapor intrusion into the building by VOCs that are present in a nearby groundwater plume. The VOCs selected for analyses are those present in the shallow bedrock groundwater plume in close proximity to the building.

2. OPERATIONS CONDUCTED WITHIN PROXIMITY OF THE K-1225 BUILDING

The K-1225 building is located in the southeastern portion of the ETTP (formerly the K-25 Site) on the Oak Ridge Reservation (ORR) in Roane County, Tennessee. Building K-1225 is within the ETTP perimeter fence. The location of the K-1225 building has been utilized for various operations to reflect the changing facility needs to support the DOE mission at ETTP.

Historic operations at or near the location of Bldg. K-1225 included a concentration of maintenance facilities known as the Ford, Davis, and Bacon Construction Support Area. From the 1940s through the late 1950s, this area was occupied by the K-1044 Heavy Equipment Repair Shop, the K-1236 Paint Shop, the T-17 Light Equipment Garage, the T-27/T-5 Pipe Welding Shop, the T-21 Oil/Grease Station, the K-1045-A Waste Oil Burning Pit, and the K-1045 Incinerator. All of these facilities, with the exception of K-1045, were demolished by the late 1950s. Most of the concrete slab foundations remained until the 1970s when the gas centrifuge program began a major expansion and construction project in the area.

The sites of six of these former facilities, K-1044, K-1236, T-27/T-5, T-21, T-17, and K-1045-A, are listed in Appendix C of the Federal Facility Agreement (FFA). The FFA is an agreement between DOE, EPA, and the state of Tennessee to integrate the requirements of the Resource Conservation and Recovery Act of 1976 corrective actions and Comprehensive Environmental Response, Compensation, and Liability Act of 1980 remedial investigations at specific sites within the ORR. The specific facilities to which the FFA applies are listed in Appendix C of the FFA. The northern section of the K-1044 Heavy Equipment Repair Shop is located within the footprint of the K-1225 building. Building K-1045 was originally built in 1943 as temporary Bldg. T-33-2 and was part of the Ford, Bacon, and Davis Construction Support Area. By early 1947, the building had been renumbered T-8 and converted to an incinerator. It was located on the south end of the K-1209 Warehouse. In 1947, it was again renumbered, this time to Bldg. K-1045. The building was used as an incinerator through 1953. Building directories from 1954 through 1978 list

K-1045 as a storage building. In 1982, it was converted into a valve certification laboratory associated with the centrifuge project. A restroom was added to the west end of the building in 1982. It was then used as a storage facility for 15-in. reels of magnetic media. In 1987, K-1045 began to be used as an office and break area for carpenters. The magnetic tapes were removed in the early 1990s. The building is currently used for storage of janitorial equipment (i.e., vacuum cleaners and floor buffers). Building K-1045 is located across 5th Street north of K-1225 and is listed in Appendix C of the FFA.

The K-1004-J Vaults are located in the K-1004-J Laboratory Complex and consist of six vaults of approximately 30-in.-diam by 8-ft-deep concrete pipe. Radioactive materials were conveyed to the storage wells in lead-shielded containers and covered with sand. Some of the material stored in the wells contained elevated levels of cesium. Apparently, the material was discarded in the wells and not intended for later retrieval. In November 1961, the centrifuge project took over the laboratory and, in 1962–63, a concrete pad was poured over the site of the wells as part of a building expansion. It is assumed the wells remained. The contents of the wells may have been removed to the Oak Ridge National Laboratory, although this has not been confirmed. This area is located to the west of the study area at the corner of Avenue D and 5th Street and is listed in Appendix C of the FFA.

The K-1004-J Underground Tank was a 5500-gal tank used to store low-level radioactive waste. It is located outside the southwest corner of K-1004-J. The drains from K-1004-J were tied into a drain system that included a 750-gal tank in a vault and a 5500-gal tank due south of the K-1004-J entrance. The 750-gal tank was removed (date unknown). The 5500-gal tank was flushed and decontaminated. It was decided to weld caps or flanges to its access lines and leave it buried. In 1980, the tank was partially uncovered during excavation for a road. The tank was filled with sand, the openings welded shut, and the tank covered with fill. The area is posted as an underground radiological area and listed as a solid waste management unit and in Appendix C of the FFA. This area is located to the west of the study area at the corner of Avenue D and 5th Street.

The K-1004-L Pilot Plant is located 50 ft to the southwest of K-1225. It was built in 1953 and operated continuously until shutdown in 1984. The function of the plant was to demonstrate improvements in the quality of the gaseous diffusion barrier that could result in an increase in production capacity of the gaseous diffusion plants. The floors are poured concrete and the walls are concrete block. The pilot plant consists of six cells that extend from the first floor into the mezzanine level. The motor alleys that separate the cells contain the stage motor compressor sets for the adjacent cells. Supporting oil, coolant, evacuation, and some gas sampling systems are located at the cell's perimeter on the mezzanine floor. K-1004-L is listed in Appendix C of the FFA.

In 1978, Bldg. K-1008-E was built as a change house for personnel working on the Gas Centrifuge Project. In 1980, Bldg. K-1008-F was built immediately south of K-1008-E to expand the change house facilities. In 1989, K-1008-E and K-1008-F were combined and renovated to house two research laboratories and various offices. The building was designated K-1008-F. In the late 1990s the laboratories were closed, and Bldg. K-1008-F was renovated into offices that are presently used by the maintenance department. Building K-1008-F is located across 5th Street north of K-1225.

Many of the existing structures in the vicinity of Bldg. K-1225 were constructed in the early 1970s as part of the Gas Centrifuge Project. Construction of the complex began in the 1960s with the expansion of the K-1004-J building. The K-1010 Laboratory Receiving and Handling and the K-1023 Laboratory were added in 1970. The K-1052 Advanced Machine Development Laboratory and the K-1200 Component Preparation Laboratory were added in 1974, the K-1210 Component Test Facility was added in 1976, the K-1210-A Advanced Equipment Test Facility was added in 1978, and the K-1220 Centrifuge Plant Demonstration Facility was added in 1982. These buildings form a semi-circle that surrounds a paved area to the north of K-1225. Buildings K-1010, K-1052, K-1023, K-1200, and K-1220 are listed in the Reindustrialization section of Appendix C of the FFA. Buildings K-1210 and K-1210-A are listed as Characterization Areas in Appendix C.

3. EXISTING/HISTORICAL DATA

Hydrogeologic characterization data for K-1225 are limited because, currently, no groundwater monitoring wells exist in the immediate vicinity of the building. However, four bedrock monitoring wells have been installed within 300 ft of Bldg. K-1225. The hydrogeologic characterization data for K-1225 are based on the data from these wells and interpolation from other ETTP site-wide information.

Because no monitoring points exist in the immediate vicinity of K-1225, depth to bedrock and depth to groundwater can only be interpolated from nearby wells. Comparison of pre-construction topographic maps to present day topography suggest the possibility that up to 5 ft of fill material may have been placed in the area occupied by the southwest corner of Bldg. K-1225 during construction of ETTP. Depth to bedrock, interpolated from data in the general vicinity of K-1225, is expected to be from 5 to 22 ft below ground surface (bgs). Bedrock was encountered at depths of 21.5 and 19 ft bgs at wells BRW-050 and BRW-051, respectively, which are the wells located nearest to Bldg. K-1225 (approximately 200 ft northwest). Bedrock outcrops are present approximately 600 ft east of Bldg. K-1225. The depth to groundwater, interpolated from the ETTP sitewide potentiometric map, is expected to range from 8 to 12 ft bgs. Shallow groundwater flow is anticipated to be to the southwest toward the shallow ponds to the south of ETTP.

Operations at ETTP have resulted in detectable VOC contamination within the groundwater near the K-1225 building. The current groundwater plume map (see Fig. 3.1) indicates the potential presence of VOCs in groundwater within 50 ft to the west of K-1225. Due to the shallow nature of bedrock in this area of ETTP, the plume adjacent to K-1225 represents a bedrock groundwater plume. Although hydraulic gradients indicate shallow groundwater flow is to the southwest, groundwater flowpaths in bedrock are a significant unknown due to the complex geology and geologic structure underlying ETTP. The possibility of transport of the VOC plume through bedrock flowpaths beneath K-1225, although unlikely, cannot be discounted based on available data.

Data concerning the VOCs present in the groundwater in the vicinity of K-1225 are obtained from sampling the four bedrock wells (BRW-038, BRW-050, BRW-051, BRW-052) located to the west of the building and the two unconsolidated zone wells (UNW-126 and UNW-127) located north of the building. Monitoring well BRW-050 is the only bedrock monitoring well in this group that has been sampled since 1998. The unconsolidated zone wells have been sampled semi-annually since their completion in 1998.

The VOCs detected in the samples from the bedrock monitoring wells include 1,1,1-trichloroethane (TCA), 1,1-dichloroethane (1,1 DCA), 1,2-dichloroethene (1,2-DCE), chloroform, tetrachloroethene (PCE) and trichloroethene (TCE). The most elevated concentrations of 1,1,1-TCA (14 μg/l), 1,2-DCE (estimated 49 μg/l), PCE (estimated 36 μg/l) and TCE (170 μg/l) from this group of bedrock wells were detected at well BRW-038 in October 1994 and March 1995. With the exception of PCE, these VOCs were also detected at well BRW-051 with their concentrations declining from 1994 to 1998. Concentrations of TCE at well BRW-051 decreased from 41 μg/l in 1994 to an estimated 18 μg/l in 1998. Concentrations of these VOCs have remained relatively constant at well BRW-050.

The VOCs detected in the samples from the unconsolidated zone wells include 1,1-DCE, 1,2-DCE, chloroform, methylene chloride, PCE, TCE, acetone and 2-butanone. The concentrations of PCE and TCE in these unconsolidated zone wells are greater than found in the bedrock monitoring wells due to their location near the suspected source (north of K-1200). Concentrations of VOCs in the unconsolidated zone

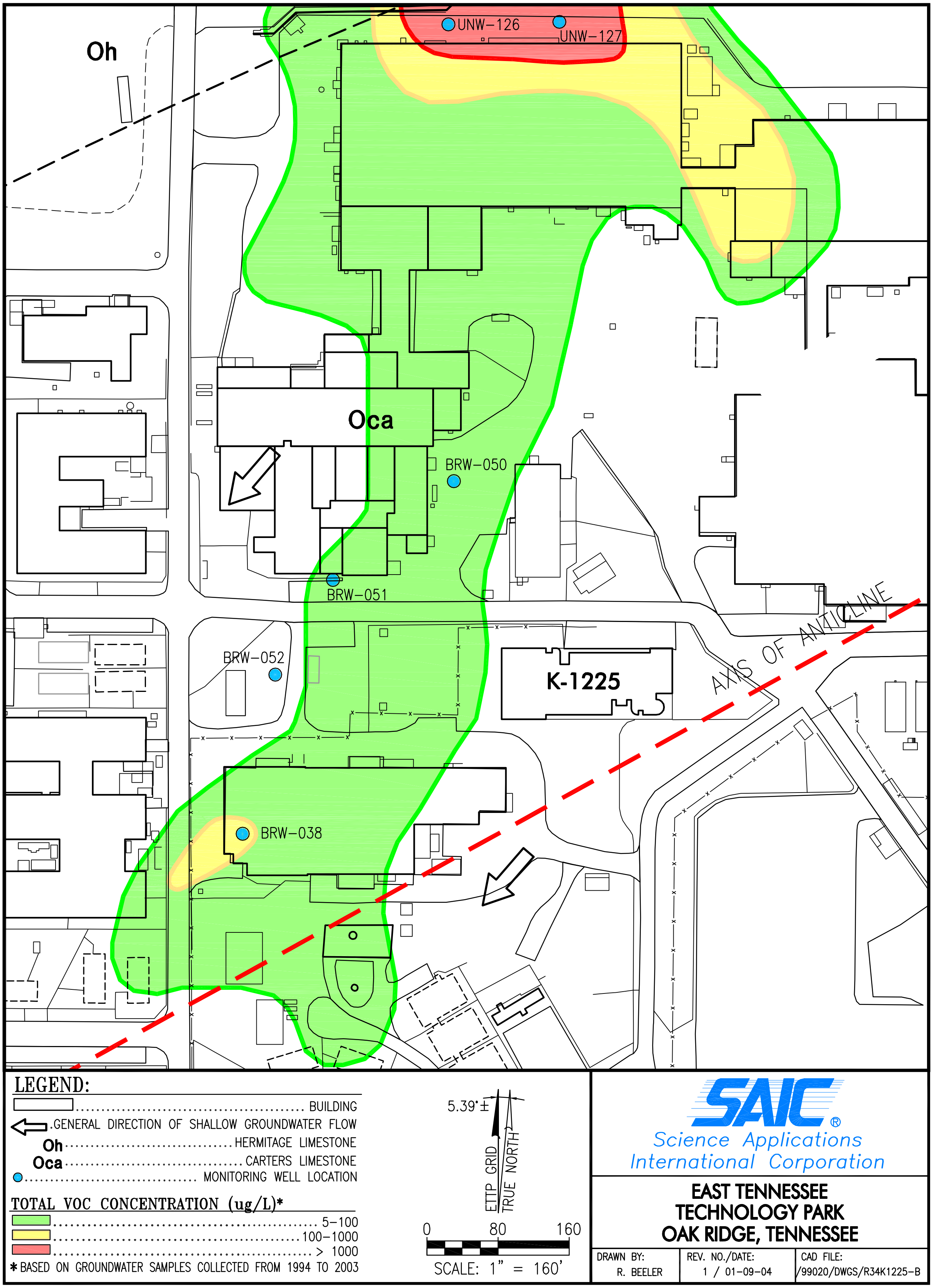


Fig. 3.1. Groundwater VOC concentrations in the vicinity of K-1225.

wells north of K-1200 have also remained steady over recent sampling events. Given the suspected age of the original releases and available data, it appears that VOC concentrations have reached steady state in the area near the source and are declining in the distal portions of the plume. Therefore, it appears unlikely that concentrations of TCE in groundwater, if transported to K-1225, would exceed those observed at monitoring well BRW-051.

4. SCOPE

The overall scope of this SAP is to determine VOC concentrations in the soil vapor directly beneath the K-1225 building slab and in the building indoor air at normal breathing zone heights to evaluate the vapor intrusion pathway. This overall objective will be met by sampling soil vapor directly beneath the slab of the lowest floor using EPA-approved methods with detection limits that are sufficient to meet the requirements of the risk assessment. If VOC concentrations in the soil vapor directly beneath the building slab exceed trigger levels specified in this SAP, indoor air samples will be collected at normal breathing zone height from within the building to determine exposure concentrations. Indoor air samples will also be collected using EPA-approved methods with detection limits that are sufficient to support the risk assessment. In addition, to assess a potential change in site conditions, an upgradient groundwater monitoring well or soil gas well will be sampled.

5. OBJECTIVES AND RATIONALE

5.1 SAMPLING OBJECTIVES

EPA recently issued *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway From Groundwater and Soils* (EPA 2002).[1] The draft guidance provides a tiered approach to determine if the vapor intrusion pathway is complete and if any exposures that occur present unacceptable risks. The three tiers in the evaluation approach are:

- Tier 1 – Primary Screening, designed to be used with general knowledge of a site and the chemicals known or reasonably suspected to be present in the subsurface;
- Tier 2 – Secondary Screening, designed to be used with some limited site-specific information about the contamination source and subsurface conditions; and
- Tier 3 – Site-Specific Pathway Assessment, which involves collecting more detailed, site-specific information and conducting confirmatory sub-slab and/or indoor air sampling.

The first tier is intended to provide a rapid screening of whether the vapor intrusion pathway is potentially complete at the site. In the Tier 1 evaluation, the user determines whether chemicals of sufficient volatility and toxicity are present in the vadose zone or groundwater at the site and if receptor locations are sufficiently close (~100 ft from the source) to present an exposure potential. If these criteria are met, the user subsequently evaluates whether conditions exist that warrant immediate action to verify whether the pathway presents unacceptable risks and, if necessary, eliminate those risks. Conditions that may warrant immediate action to verify or eliminate risks from the vapor intrusion pathway include odors within buildings, wet basements where VOCs are present in shallow groundwater, and physiological effects reported by receptors.

[1]Available on the World Wide Web at http://www.epa.gov/epaoswer/hazwaste/ca/eis/vapor/complete.pdf.

The second tier provides generic screening criteria based on an excess lifetime cancer risk (ELCR) range of 10^{-6} to 10^{-4} and conservative attenuation factors. The Tier 2 evaluation is intended to allow the user to eliminate the vapor intrusion pathway, if the generic screening criteria are not exceeded. Certain site conditions make the use of the generic screening criteria inappropriate. These conditions include:

- very shallow groundwater sources at depths of less than 5 ft below foundation level, or
- relatively shallow soil or groundwater sources (at depths of less than 15 ft below the foundation) and the presence of significant openings or preferential pathways in the building to the subsurface such as sumps, unlined crawl spaces, or utility corridors.

If the generic screening criteria are exceeded or the above conditions exist, a Tier 3 evaluation is required. In the Tier 3 evaluation, the draft guidance recommends sampling of sub-slab soil vapor and indoor air.

As previously stated, EPA Region 4 has raised concerns regarding the potential for vapor intrusion of VOCs from shallow groundwater into buildings at ETTP that are proposed for transfer. Using the draft guidance provided by EPA Region 4 personnel, it has been determined that a few buildings at ETTP that are proposed for the transfer, meet the Tier 1 criteria (presence of VOCs and proximity to source). In general, the Tier 2 criteria are not believed to be applicable to facilities being considered for transfer, because of the shallow depth to groundwater and limited depth to bedrock that exhibits karst features. Therefore, EPA has requested that soil gas samples be collected and/or that indoor air be monitored.

The draft guidance does not require the user to begin at Tier 1 and proceed stepwise through Tier 3. A site-specific Tier 3 assessment may be performed without previous evaluation. Additionally, the draft guidance allows the use of other technically sound approaches in evaluating the vapor intrusion pathway. Based on the site-specific conditions and considerations from the guidance indicated above, DOE and EPA have agreed to the following strategy for evaluation of the vapor intrusion pathway:

- DOE will sample soil vapor directly beneath the slab of the lowest floor or basement within a subject building;
- DOE will concurrently sample the groundwater monitoring well in closest proximity to the subject building that exhibited the most elevated concentrations of VOCs during the most recent sampling event to establish current conditions;
- Soil vapor concentrations of VOCs directly beneath the floor slab will be compared against site specific soil vapor trigger levels that have been agreed to by DOE and EPA Region 4;
- If the average concentrations of all VOCs in the soil vapor samples from beneath the building do not exceed their respective trigger levels, further evaluation of the vapor intrusion pathway will not be performed because the subslab concentrations are not considered to present any risk to potential receptors;
- If the average concentrations of any VOCs in the soil vapor samples from beneath the building exceed their respective trigger levels, indoor air samples will be collected at normal breathing zone height under normal working conditions from the basement or lowest floor of the subject building in order to determine if a pathway for exposure exists;
- An outdoor air sample will be obtained concurrent with the indoor air samples to identify any potential contribution of VOCs from external sources; and

- The data from the indoor air samples and outdoor air sample will be compared against 25-year industrial preliminary remediation goals (PRGs) to determine if any unacceptable risks are presented to potential receptors upon building transfer.

The overall objective of this SAP is to obtain data to assess the vapor intrusion pathway for Bldg. K-1225. In order to achieve this objective, sampling and analytical protocols followed under this Plan must ensure detection of volatile contaminants at levels at or below relevant risk screening criteria. For the groundwater sample (which is being collected to assess current conditions), the analytes that must be identified are those VOCs typically reported in the ETTP groundwater monitoring program. A preliminary set of analytes of interest for the vapor intrusion pathway for Bldg. K-1225 was identified as those VOCs historically detected in the nearby monitoring wells indicated in Fig. 3.1. This preliminary set of analytes of interest also includes the degradation (and parent) compounds of the detected VOCs. The preliminary list of analytes of interest for Bldg. K-1225 is provided in Table 5.1. Any VOCs that are currently analyzed by the groundwater program that are detected will also be reported.

Table 5.1. Preliminary analytes of interest and respective indoor air PRGs[a] for the vapor intrusion pathway at Bldg. K-1225

Chemical	Industrial PRGs[b], (mg/m^3)
Carbon tetrachloride	3.58E-04
Chloroform	1.78E-03
Chloromethane	1.31E-02
1,1-Dichloroethane	7.31E-02
1,1-Dichloroethene	8.18E-04
1,2-Dichloroethene	4.60E-03
cis – 1,2-Dichloroethene	5.11E-03
Methylene chloride	8.67E-02
1,1,1-Trichloroethane	3.21E-01
Tetrachloroethene	7.05E-02
Trichloroethene	5.83E-03
Vinyl chloride	4.65E-03
Acetone	4.60E-01
2-Butanone	7.31E-01

[a] PRG = Preliminary remediation goal.
[b] Industrial 25-year PRGs are the lower of the concentrations corresponding to an excess lifetime cancer risk of 10^{-5} or a hazard quotient of 0.1.

For soil vapor samples, the sampling and analytical protocols must ensure that VOCs are quantified at levels at or below the levels that trigger indoor air sampling to further evaluate the potential risks associated with the vapor intrusion pathway. For ambient air (indoor and outdoor) samples, the sampling and analytical protocols must ensure that VOCs are quantified at or below the 25-year industrial PRGs. The 25-year industrial PRGs are the lower of the airborne concentrations corresponding to an ELCR of 10^{-5} or a hazard quotient of 0.1. Table 5.1 also provides the 25-year industrial PRGs for the preliminary set of analytes of interest.

Soil vapor action or trigger levels will inherently be larger than risk screening criteria due to the attenuation within the foundation materials and dilution effects as the vapors migrate into the indoor air volume of the buildings lowest floor. Therefore, detection and reporting limits for indoor air samples are suitable to meet the established objectives for soil vapor samples. Detection and reporting limits for the VOCs to be reported in groundwater, soil vapor, and ambient air samples are further identified in Chap. 7 of this SAP.

5.2 SAMPLING DESIGN

To evaluate the potential for VOC intrusion into the ETTP buildings designated for transfer, the general sampling approach has been divided into two phases. The first phase involves collection of soil vapor samples from directly beneath the slab of the buildings lowest floor. A groundwater sample will also be collected in the first phase of sampling. This groundwater sample will be collected from the upgradient monitoring well that has historically exhibited the most elevated concentrations of VOCs. Data obtained from the groundwater sample will be used to define current conditions and monitor for any future change in conditions. The second phase of sampling involves collection of indoor ambient air samples at the normal breathing zone height within the lowest floor of the subject building. An outdoor ambient air sample would also be collected in this second phase to identify any potential external sources that may contribute VOCs detected in the indoor air samples. The second phase of sampling would be implemented only if the soil vapor trigger levels are exceeded in the first phase samples.

5.2.1 Phase 1 – Sub-Slab Soil Vapor and Groundwater Sampling

During the first phase, five soil vapor samples will be collected directly beneath the first floor or foundation slab of Bldg. K-1225. The VOC concentrations measured in these sub-slab soil vapor samples reflect equilibrium conditions resulting from attenuation in the soil column beneath the building. Samples taken in this fashion eliminate the uncertainty associated with partitioning calculations in modeling.

The five sample stations for the sub-slab soil vapor samples will be located on the basis of best professional judgment. Sampling stations for Phase 2 indoor air samples will generally coincide with the locations selected for sub-slab soil vapor sampling. Therefore, the selection of sampling stations will attempt to avoid locations immediately adjacent to activities that may be fugitive VOC sources (such as lavatories or janitorial closets that may contribute VOCs from cleaners, floor stripping, indoor painting activities or industrial activities that use organic solvents). Additionally, the sampling stations will be located toward the building interior to avoid leakage of atmospheric air and the resulting dilution of soil vapor samples that may occur if sample stations are located near the building edge.

The soil vapor samples shall be collected by drilling a small (~ 9/16 in diameter) penetration through the first floor or foundation slab. If a vapor barrier is present beneath the floor slab, penetration of this barrier will be required. Otherwise care shall be taken to avoid disturbance or penetration of the underlying soil or aggregate. Soil vapor samples shall be grab samples (sample collection duration of less than 60 seconds) collected using 5L pre-evacuated SUMMA canisters. The preliminary analytes for the soil vapor samples are identified in Table 5.1. Any VOCs that are currently analyzed by the groundwater program that are detected will also be reported.

A groundwater sample shall be collected concurrent with the soil vapor samples to determine current groundwater conditions. The groundwater sample shall be collected from the monitoring well in closest proximity to the subject building that exhibited the most elevated VOC concentrations in the most recent groundwater monitoring event. For Bldg. K-1225 the groundwater sample shall be collected from well BRW-050. This well will be purged and sampled using micropurging techniques to produce samples of lower turbidity. To be consistent with the groundwater program, samples will be analyzed for those VOCs typically reported under the ETTP groundwater monitoring program.

5.2.2 Phase 2 – Ambient Air Sampling

Phase 2 ambient air sampling will be performed for buildings scheduled for transfer only if VOC concentrations in the Phase 1 soil vapor samples from beneath the building exceed the site-specific soil vapor trigger levels. Proposed site-specific soil vapor trigger levels are presented in Table 5.2.

Table 5.2. Proposed site-specific soil vapor trigger levels indicating the need for indoor air sampling

Volatile organic compound	Proposed trigger level[a] (mg/m^3)	Concentration in building (ug/m^3)	Alpha[b]
1,1,1-Trichloroethane	3.01E+02	3.21E+02	1.07E-03
1,1,2,2-Tetrachloroethane	6.67E-01	7.05E-01	1.06E-03
1,1,2-Trichloroethane	1.91E+00	2.04E+00	1.07E-03
1.1.2-Trichloro-1,2,2-trifluoroethane	4.04E+03	4.38E+03	1.08E-03
1,1-Dichloroethane	6.88E+01	7.31E+01	1.06E-03
1,1-Dichloroethene	7.55E-01	8.18E-01	1.08E-03
1,2-Dichloroethane	1.43E+00	1.57E+00	1.10E-03
1,2-Dichloroethene	3.95E+00	4.60E+00	1.16E-03
1,2-Dichloropropane	5.45E-01	5.83E-01	1.07E-03
2-Butanone	6.84E+02	7.31E+02	1.07E-03
2-Hexanone	na[c]	na[c]	1.04E-03
4-Methyl-2-pentanone	4.06E+02	4.38E+02	1.08E-03
Acetone	4.13E+02	4.60E+02	1.11E-03
Benzene	4.05E+00	4.38E+00	1.08E-03
Bromodichloromethane	2.62E+00	2.38E+00	9.11E-04
Bromoform	1.39E+01	1.02E+01	7.38E-04
Bromomethane	6.89E-01	7.31E-01	1.06E-03
Carbon disulfide	9.31E+01	1.02E+02	1.10E-03
Carbon tetrachloride	3.35E-01	3.58E-01	1.07E-03
Chlorobenzene	2.75E+00	2.92E+00	1.06E-03
Chloroethane	1.38E+03	1.46E+03	1.06E-03
Chloroform	1.62E+00	1.78E+00	1.10E-03
Chloromethane	1.24E+01	1.31E+01	1.06E-03
cis-1,2-Dichloroethene	4.81E+00	5.11E+00	1.06E-03
cis-1,3-Dichloropropene	2.80E+00	2.92E+00	1.04E-03
Dibromochloromethane	1.26E+01	1.02E+01	8.11E-04
Ethylbenzene	3.49E+01	3.72E+01	1.06E-03
Methylene chloride	7.92E+01	8.67E+01	1.09E-03
Styrene	1.38E+02	1.46E+02	1.06E-03
Tetrachloroethene	6.66E+01	7.05E+01	1.06E-03
Toluene	5.39E+01	5.83E+01	1.08E-03
trans-1,2-Dichloroethene	9.67E+01	1.02E+02	1.06E-03
trans-1,3-Dichloropropene	4.91E+00	5.11E+00	1.04E-03
Trichloroethene	5.45E+00	5.83E+00	1.07E-03
Vinyl chloride	4.23E+00	4.65E+00	1.10E-03
Xylenes (total)	1.38E+01	1.46E+01	1.06E-03

[a]Proposed trigger level is the result of selecting a soil gas concentration that results in an indoor air concentration equal to the PRG. Note that these are still under negotiation with Region 4 of EPA.

[b]alpha is the infinite source indoor attenuation coefficient and directly correlates the soil gas concentration with the indoor air concentration.

[c]na – not available due to lack of toxicity data.

Five indoor air samples will be taken at 2 to 5 ft above the floor within the building. In order to ensure the samples are indicative of VOC concentrations within the building during normal operating or working conditions, all sampling activities will be conducted with the building heating, ventilation, and air-conditioning systems turned on. The sample stations for the five indoor air samples will coincide with the locations selected for the sub-slab soil vapor samples. As indicated, the location of indoor air sampling stations will be selected to attempt to avoid locations immediately adjacent to activities that may introduce fugitive VOC emissions.

The indoor air samples will be collected using pre-evacuated (sub-atmospheric) pre-cleaned and certified 5L SUMMA canisters. Indoor air samples will be 8-h., time-weighted average samples. A minimum of one 8-h, time-weighted average ambient air sample will be collected outside of the building to exclude any potential contributions from external industrial sources. This outdoor sample station will be set up near the building at an upwind location. The location of the sampling station will be made by contacting the Park Shift Superintendent's (PSS) Office to acquire wind direction from the site meteorological station. The sampling station shall be located no more than 20 ft from the building at a location that will be minimally impacted by facility operations (i.e., high-traffic areas shall be avoided to the extent possible). The final location of this sampling station shall be determined in the field during sampling activities. Sample stations for the five indoor samples are discussed in Chap. 6.

6. FIELD SAMPLING PLAN

Soil vapor and ambient air sampling activities at K-1225 will be implemented in two separate mobilization events. Prior to each mobilization event the sampling subcontractor (SSC) will obtain evacuated 5L SUMMA canisters that have been cleaned, conditioned and certified in accordance with the requirements of Method TO-15. Other sampling system components shall be cleaned in accordance with Method TO-15 prior to assembly of the sampling system. Non-metallic parts shall be rinsed in deionized water and dried in a vacuum at 50° C. Stainless steel parts and fittings shall be cleaned in an ultrasonic bath using methanol followed by ultrasonic cleaning in hexane. These parts shall be subsequently rinsed in deionized water and baked in a vacuum oven at 100° C for 12 to 24 h.

During the first phase of sampling, soil vapor samples will be collected from directly beneath the first floor slab of the building. A groundwater sample will also be collected from monitoring well BRW-050 during the first phase of sampling. The data from the upgradient groundwater sample will be used to assess current conditions and provide a basis for monitoring changes in subsurface conditions in the future.

The sampling systems for soil vapor shall be 5L subatmospheric SUMMA canisters. For collection of the soil vapor samples, flow restriction will be provided by a critical orifice set to charge the canisters to the desired end pressure over a 60 second sample collection period. The sampling systems shall be assembled in accordance with Fig. 1 of Method TO-15 prior to mobilization to the field.

Five sub-slab soil vapor samples shall be collected during the sampling event at locations shown in Fig. 6.1. A penetration permit may be required for installation of the sub-slab sample ports. Floor penetrations shown in Fig. 6.1 are approximate only and must be field located prior to installation based upon the requirements of the penetration permit. Prior to penetration of the floor slab, the sampling system shall be located at the stations indicated in Fig. 6.1. Once the sampling system has been set up at the designated locations, the SSC shall record temperature, humidity, and other parameters indicated by Method TO-15. The inlet tubing to the sampling system shall be as short as possible. Samples will be taken by drilling small (~9/16-in.-diam) holes through the slab taking care not to disturb the materials underlying the slab. If a vapor barrier is part of the design, penetration of this barrier will be required.

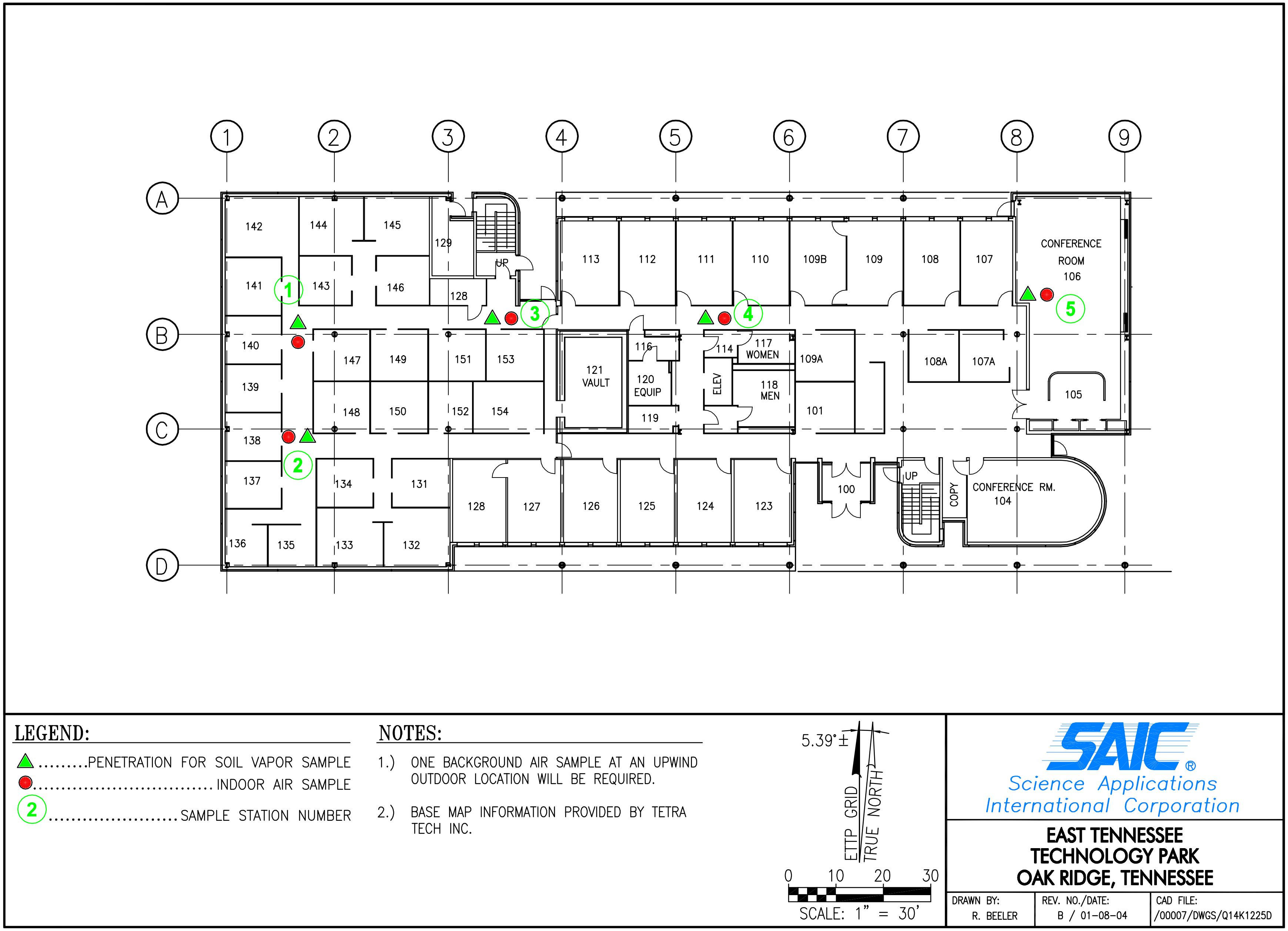


Fig. 6.1. Building K-1225 soil vapor and indoor air sampling locations.

Consistent with EPA guidance, a capped brass or stainless steel tube will be inserted into the penetration. Immediately upon completion of the penetration, it will be sealed using non-VOC-bearing caulk. After completion of the penetration, the cap shall be removed from the stainless tube in order to attach the inlet line of the sampling system. The inlet line of the sample system shall be attached to the floor penetration tube and the flow valves opened.

Upon collection of the air samples, the SUMMA canisters shall be valved closed. The sampling line shall be disconnected from the canister and the canister removed from the sampling system. Upon collection of the samples, the final pressure shall be checked and recorded. The final system pressure should be ~ 88 Kpa (~90-100 torr vacuum).

Upon collection of the SUMMA canister, it shall be labeled as required by the SSC's standard operating procedures (SOPs). The canisters shall be shipped to the laboratory in a canister shipping case as required by the manufacturer's specifications or the SSC's SOPs.

Decontamination of sampling equipment used for collection of air samples is not required. All equipment, including the sampling inlet line, used at each sampling station shall be dedicated.

Groundwater samples shall be collected from well BRW-050 using micropurging techniques. The SSC shall locate the sampling equipment at the indicated well and place sufficient plastic sheeting around the well to prevent cross contamination. The sampling pump should be of stainless steel construction fitted with Teflon bladders and Teflon-lined polyethylene tubing. The SSC should ensure that the Micropurge Water Analyzer and Flow Cell are calibrated in accordance with the manufacturer's instructions. In order to collect the groundwater sample, the well should be opened and the headspace monitored for organic vapors using a photoionization detector. Water levels in the well should be measured using an electronic level indicator. After determination of the water level, the pump should be inserted to the midpoint of the water column or midpoint of the screen as required by the SSC SOPs. The water level indicator should subsequently be reinserted and purging should be initiated. The purge rate should be adjusted to maintain the static water level in the well. Purging should continue until the parameters of temperature, pH and specific conductance have stabilized and the turbidity has reached the desired end point (usually 5-10 nephelometric turbidity units). Sampling should be conducted immediately after the well has been purged by re-directing the flow through cell to the specified sample containers.

If the average concentrations of any of the VOCs detected in the soil vapor samples from beneath the floor slab exceed their site-specific trigger levels, indoor air samples will be collected in a second phase of sampling. Indoor air samples shall be collected at the same sample stations indicated for the soil vapor samples in Fig. 6.1. The sampling systems for the indoor air samples shall be cleaned, conditioned, and certified in accordance with Method TO-15 prior to mobilization. Sampling systems for indoor air samples should be assembled prior to field mobilization as previously described. In order to collect the indoor air samples, the sampling systems shall be located at the stations depicted in Fig. 6.1 with the inlet suspended 3 to 5 ft above the floor surface. Once the sampling system has been set up at the designated locations, the SSC shall record temperature, humidity, and other parameters indicated by Method TO-15.

Flow restriction for the indoor air samples shall be provided by an electronic mass flow controller as described by Method TO-15. A practice canister, as described in Method TO-15, shall be used to verify the system fill rate and absence of leakage prior to collecting the ambient air samples. The reading from the certified mass flow meter should be within ±10% of the reading from the system's mass flow controller. If the values are in disagreement, the system should be checked for leakage, the mass flow controller recalibrated, or the sampling system replaced. After adjustment of the canister flow rate to the proper value, the sampler should be turned off and the practice canister disconnected from the system. A clean certified canister shall be attached to the system for sampling and the system valves opened. The system timer shall be set to start and stop the sampling period at the appropriate times.

An outdoor ambient air sample will be collected in Phase 2 to identify any contribution of VOCs from fugitive sources. Outdoor air samples shall be collected at a location determined in the field by the SSC. This location shall be recorded on a map in the SSC field logbook. Outdoor air samples will also be collected with subatmospheric 5L SUMMA canisters that have been cleaned, conditioned and certified in accordance with Method TO-15. To collect the outdoor air sample, the SSC shall set up the sampling system at the field determined location. The inlet for the outdoor air sample shall be suspended ~ 5 ft above ground surface. Flow restriction for the outdoor ambient air sample will be provided by an electronic mass flow controller and magnelatch valve as described by Method TO-15. As described above for indoor air samples, a practice canister shall be used to verify the system fill rate and absence of leakage prior to actual sample collection. Once the system has been determined to be leak tight and properly calibrated, a clean certified canister shall be attached to the system for sampling, the system valves opened, and the timer set for initiating the sampling period.

The only field quality control samples required for the soil vapor and air samples are field equipment blanks. These quality control samples will be required for only the second sampling event. A field blank shall be required for groundwater sampling. All samples shall have the appropriate radiological analyses performed to comply with shipping protocols.

Sample container, preservation, and holiday time requirements are summarized in Table 6.1. All samples shall have the appropriate radiological analyses performed to comply with shipping protocols.

7. ANALYTICAL REQUIREMENTS

Air samples shall be quantitated for VOCs using gas chromatography/mass spectrometry (GC/MS) analyses as required by Method TO-15. Any of the VOCs indicated in Table 7.1 that are detected shall be reported. Additionally the laboratory shall report up to twenty tentatively identified components (TICs). Quantitation of VOCs in air samples shall meet the detection limits specified in Table 7.1. Groundwater samples shall be quantified by GC/MS per Method OLM 03.1 VOA. Analyses of groundwater samples shall meet the reporting limits specified in Table 7.2. Additionally, the laboratory shall report up to twenty TICs in the groundwater sample.

8. DATA MANAGEMENT AND REPORTING

Data obtained from this sampling event shall be managed in accordance with the requirements of the *Data Management Implementation Plan for the Reindustrialization Program, Oak Ridge, Tennessee* (BJC/OR-865). Results will be provided to EPA Region 4 and to the Tennessee Department of Environment and Conservation DOE-Oak Ridge Oversight Office.

Table 6.1. Sample container, preservation and holding time requirements for K-1225

Event	Sample station[a]	Sample type	Parameters of concern	Analytical protocols	Container type/volume	Preservation	Holding time
01	AU-01-41-1225-V	Soil vapor-grab	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
01	AU-02-41-1225-V	Soil vapor-grab	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
01	AU-03-41-1225-V	Soil vapor-grab	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
01	AU-04-41-1225-V	Soil vapor-grab	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
01	AU-05-41-1225-V	Soil vapor-grab	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
01	AU-00-41-1225-W	Groundwater[c]	Volatile organics[b]	OLM03.1VOA	3×40 ml VIA vials	HCl to pH < 2, Cool 4°C	14 d
01	AU-93-41-1225-B	Field blank	Volatile organics[b]	OLM03.1VOA	3×40 ml VIA vials	Prepreserved	14 d
02	AU-01-42-1225-I	Indoor air: 8 h TWA[c]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
02	AU-02-42-1225-I	Indoor air: 8 h TWA[c]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
02	AU-03-42-1225-I	Indoor air: 8 h TWA[c]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
02	AU-04-42-1225-I	Indoor air: 8 h TWA[c]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
02	AU-05-42-1225-I	Indoor air: 8 h TWA[c]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
02	AU-05-42-1225-D	Indoor air duplicate: 8 h TWA[c]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
02	AU-06-42-1225-A	Outdoor air: 8 h TWA[c]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
02	AU-91-42-1225-B	Air Field Blank	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
02	AU-92-42-1225-B	Air Field Blank	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d

[a]Sample station nomenclature is AU-AA-BC-DDDD-EE where the AA field is the station number 01-89. Sample station numbers 91 and 92 are dedicated for air field blanks. Station 93 is reserved for the groundwater field blank. The BC field designates the fiscal year and sampling event in that year. The DDDD field designates the building number. The EE field designates the sample type where V = soil vapor; I – indoor air; A = outdoor air; B = blank; D = duplicate; and W = groundwater.

[b]Volatile organics of concern for air sampling at K-1225 include tetrachloroethene; trichloroethene; 1,2-dichloroethene; vinyl chloride; 1,1,1-trichloroethane; 1,1-dichloroethene; 1,1-dichloroethane; carbon tetrachloride; chloroform; methylene chloride; chloromethane; acetone; and 2-butanone.

[c]TWA = time-weighted average.

Table 7.1. VOCs and their respective quantitation and detection limits for soil vapor and air sampling

Analyte	Analytical method	Air quantitation level (mg/m^3)[a]	Air detection level (mg/m^3)
1,1,1-Trichloroethane	TO-15	3.21E-01	3.21E-02
1,1,2,2-Tetrachloroethane	TO-15	7.05E-04	7.05E-05
1,1,2-Trichloroethane	TO-15	2.04E-03	2.04E-04
1,1,2-Trichloro-1,2,2-trifluoroethane	TO-15	4.38E-00	4.38E-01
1,1-Dichloroethane	TO-15	7.31E-02	7.31E-03
1,1-Dichloroethene	TO-15	8.18E-04	8.18E-05
1,2-Dichloroethane	TO-15	1.57E-03	1.57E-04
1,2-Dichloroethene	TO-15	4.60E-03	4.6E-04
1,2-Dichloropropane	TO-15	5.83E-04	5.83E-05
2-Butanone	TO-15	7.31E-01	7.31E-02
3-Hexanone	TO-15	na[b]	na[b]
4-Methyl-2-pentanone	TO-15	4.38E-01	4.38E-02
Acetone	TO-15	4.60E-01	4.6E-02
Benzene	TO-15	4.38E-03	4.38E-04
Bromodichloromethane	TO-15	2.38E-03	2.38E-04
Bromoform	TO-15	1.02E-02	1.02E-03
Bromomethane	TO-15	7.31E-04	7.31E-05
Carbon disulfide	TO-15	1.02E-01	1.02E-02
Carbon tetrachloride	TO-15	3.58E-04	3.58E-05
Chlorobenzene	TO-15	2.92E-03	2.92E-04
Chloroethane	TO-15	1.46E+00	1.46E-01
Chloroform	TO-15	1.78E-03	1.78E-04
Chloromethane	TO-15	1.31E-02	1.31E-02
cis-1,2-Dichloroethene	TO-15	5.11E-03	5.11E-04
cis-1,3-Dichloropropene	TO-15	2.92E-03	2.92E-04
Dibromochloromethane	TO-15	1.02E-02	1.02E-03
Ethylbenzene	TO-15	3.72E-02	3.72E-03
Methylene chloride	TO-15	8.67E-02	8.67E-03
Styrene	TO-15	1.46E-01	1.46E-02
Tetrachloroethene	TO-15	7.05E-02	7.05E-03
Toluene	TO-15	5.83E-02	5.83E-03
trans-1,2-Dichloroethene	TO-15	1.02E-01	1.02E-02
trans-1,2-Dichloropropene	TO-15	5.11E-03	5.11E-04
Trichloroethene	TO-15	5.83E-03	5.83E-04
Vinyl chloride	TO-15	4.65E-03	4.65E-04
Xylenes (total)	TO-15	1.46E-02	1.46E-03

[a] mg/m^3 = milligram per cubic meter.
[b] na = no toxicity data available.

Table 7.2. VOCs to be reported and their respective quantitation limits for groundwater

Analyte	Analytical method	Groundwater quantitation level (µg/L)[a]
1,1,1-Trichloroethane	OLM03.1VOA[b]	5
1,1,2,2-Tetrachloroethane	OLM03.1VOA	5
1,1,2-Trichloroethane	OLM03.1VOA	5
1,1-Dichloroethane	OLM03.1VOA	5
1,1-Dichloroethene	OLM03.1VOA	5
1,2-Dichloroethane	OLM03.1VOA	5
1,2-Dichloroethene	OLM03.1VOA	5
1,2-Dichloropropane	OLM03.1VOA	5
2-Butanone	OLM03.1VOA	10
3-Hexanone	OLM03.1VOA	10
4-Methyl-2-pentanone	OLM03.1VOA	10
Acetone	OLM03.1VOA	10
Benzene	OLM03.1VOA	5
Bromodichloromethane	OLM03.1VOA	5
Bromoform	OLM03.1VOA	5
Bromomethane	OLM03.1VOA	10
Carbon disulfide	OLM03.1VOA	5
Carbon tetrachloride	OLM03.1VOA	5
Chlorobenzene	OLM03.1VOA	5
Chloroethane	OLM03.1VOA	10
Chloroform	OLM03.1VOA	5
Chloromethane	OLM03.1VOA	10
cis-1,2-Dichloroethene	OLM03.1VOA	5
cis-1,3-Dichloropropene	OLM03.1VOA	5
Cibromochloromethane	OLM03.1VOA	5
Ethylbenzene	OLM03.1VOA	5
Methylene chloride	OLM03.1VOA	5
Styrene	OLM03.1VOA	5
Tetrachloroethene	OLM03.1VOA	5
Toluene	OLM03.1VOA	5
trans-1,2-Dichloroethene	OLM03.1VOA	5
trans-1,2-Dichloropropene	OLM03.1VOA	5
Trichloroethene	OLM03.1VOA	5
Vinyl chloride	OLM03.1VOA	2
Xylenes (total)	OLM03.1VOA	5

[a]µg/L = microgram per liter.
[b]OLM = organic laboratory method, EPA Contract Laboratory Program.
VOA = Volatile organic analysis.

9. REFERENCES

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APPENDIX D

RADIOLOGICAL SURVEY PLAN FOR THE K-1225 BUILDING

1. AREA TO BE SURVEYED

The area to be surveyed is the K-1225 building (both interior and exterior surfaces), the building contents, and the exterior sidewalk immediately adjacent to the building, all of which are to be transferred to the Community Reuse Organization of East Tennessee (CROET). No exterior laydown, parking, or soil areas are associated with this footprint. The K-1225 building has been primarily used for office space for different groups and has two floors (with a total floor area of 23,500 ft^2). The building exterior is pre-cast concrete, the interior is drywall, and the facility floors are primarily carpeted. See Figs. 1 and 2 in this appendix for the survey area.

2. HISTORY OF THE AREA

K-1225 was built in 1980 as the office building for gas centrifuge personnel. It is a two-story structure constructed primarily of reinforced, pre-cast concrete on a concrete slab. Since the shutdown of the gas centrifuge project in the late 1980s, other organizations have used the building for offices. These have included the X-10 Applied Technology Division and Bechtel Jacobs Company LLC (BJC) staff. The building has always been inside the control fence of the plant.

Radiological contamination, if present, is expected to be a small percentage of the applicable U. S. Department of Energy (DOE) surface contamination limits due to the results of the prior surveys performed in the area (and discussed in the following sections), but mainly due to the historical usage of the facility. In general, no contamination was found within the area that exceeded the DOE limits.

3. EXISTING SURVEY DATA SUMMARY

A search of the BJC Radiation Control (RADCON) electronic survey data collected since 1996 revealed that a total of 43 surveys were performed in the building, including one of five pregnancy surveys that had elevated beta-gamma readings. The elevated readings, however, were taken in the restroom on ceramic floor tiles, which have naturally occurring radioactive materials (NORMs) in their matrices. All other survey readings (of the 43 surveys) were below background levels. A review of these surveys provided some information for the survey classification of the individual survey units.

Sixteen equipment surveys were conducted in the building consisting of surveys of office equipment, computers, and other miscellaneous materials. No elevated activity above background levels was detected, except for computer monitors, which have a NORM in the phosphorus contained in the monitor screen.

4. DATA QUALITY OBJECTIVES/PURPOSE

The purpose of this survey plan is to obtain radiological survey data to determine the presence of residual contamination in the area. The data gathered will be used to make a decision regarding the release of the K-1225 building, the building contents, and the surrounding sidewalk (immediately adjacent to the building) to CROET.

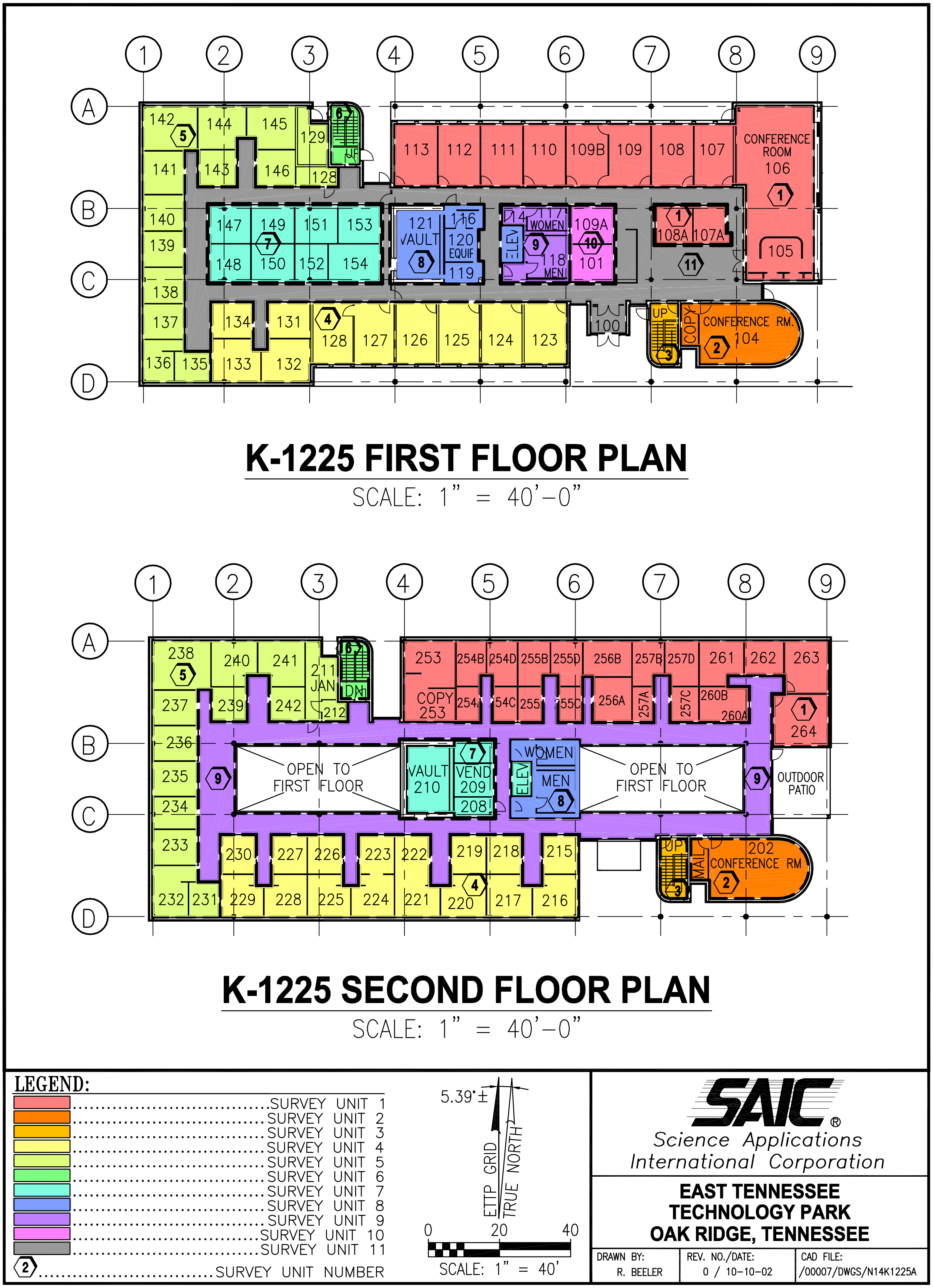

Fig. 1. K-1225 interior survey units.

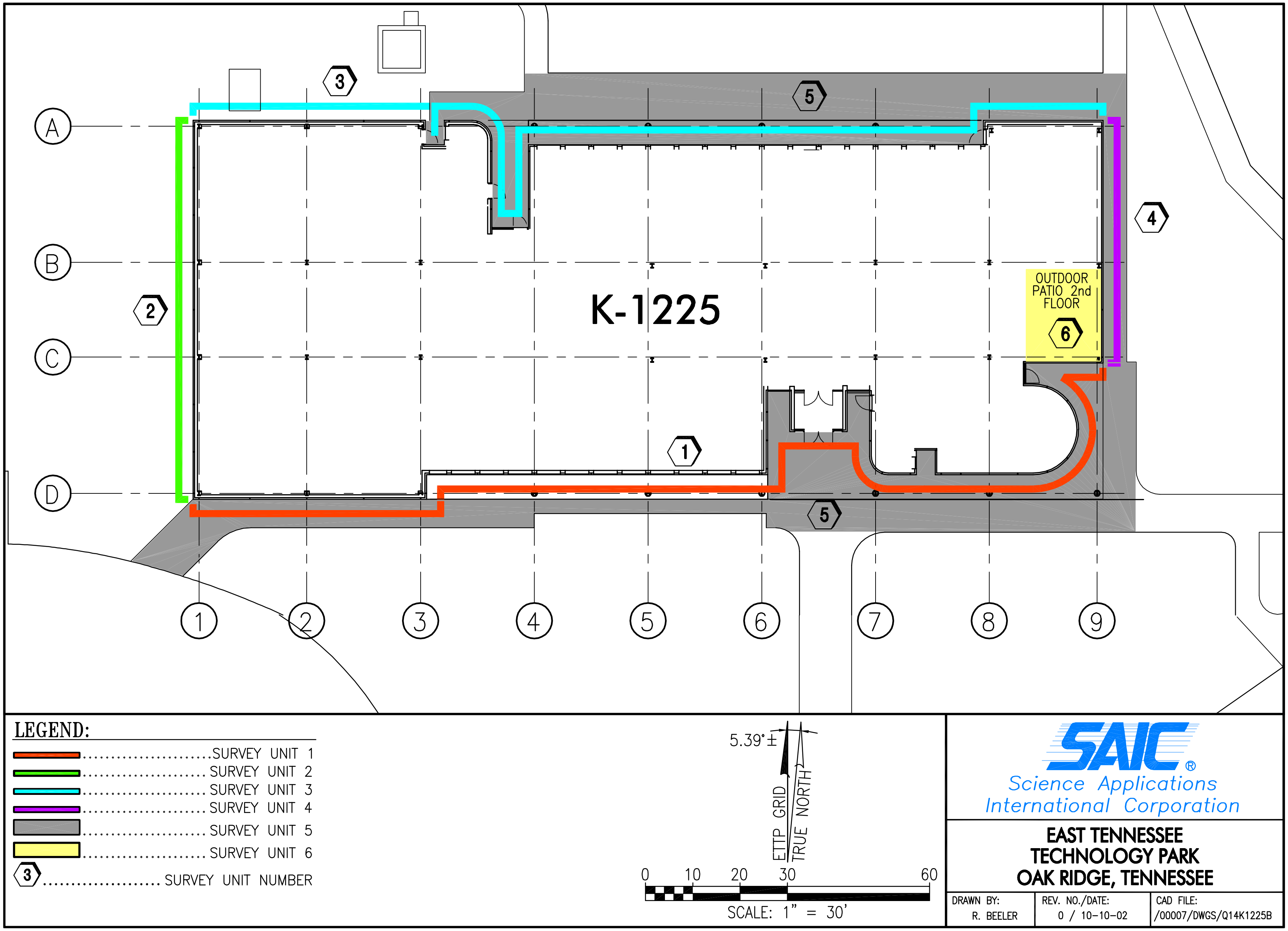

Fig. 6.2. K-1225 exterior survey units.

5. MEASUREMENT TECHNIQUES/SURVEY APPROACH

5.1 RADIONUCLIDES OF CONCERN

Process history of the East Tennessee Technology Park (ETTP) site indicates that uranium (whether natural, depleted, or enriched) would be the most prominent radiological contaminant potentially present in the K-1225 building due to tracking of contamination from other on-site buildings. Uranium-235 enrichment levels expected from operations since the early 1960s would be anticipated to be between 0.2 and 5.0%. Most facilities would be potentially contaminated via tracking from enrichments of less than 3%.[18] As, however, this has been an administrative building throughout its history, it is assumed that the uranium would be from natural sources and the enrichment is approximately that of natural uranium, 0.72%.

Other radionuclides (^{60}Co, ^{137}Cs, $^{89/90}$Sr, ^{237}Np, ^{99}Tc, and $^{238/239/240}$Pu) also have been detected on-site at ETTP. These other radionuclides originated from the introduction of contaminated materials from the Oak Ridge National Laboratory or from the Hanford and Savannah River reactor returns uranium reprocessing program; however, these radionuclides are expected to be found in much lower quantities than uranium and to be undetectable in this area, based upon its operational history as an administrative facility. If they were present, it is assumed that they would be present at ratios of 1140:1 for uranium to transuranic (U:TRU) and 350:1 for uranium to technetium-99 (U:^{99}Tc)[19] (both ratios are process buildings weighted averages).[20]

5.2 DETERMINATION OF THE RESIDUAL RADIOACTIVITY LIMITS

The overall goal of this survey is to show that residual contamination exceeding the release criteria is not present in each of the survey units. As shown by modeling, the dose and risk obtained from exposure to radioactivity at the DOE surface contamination limits, as set forth in Title 10 *Code of Federal Regulations* (*CFR*) 835[21] and also in DOE Order 5400.5,[22] is less than that from the dose and risk criteria, as explained in the Design of Radiological Surveys document[23] (hereafter referred to as the "design document"). As a result of this modeling, the derived concentration guideline levels (DCGLs) for this survey will be set at the DOE contamination limits for uranium (see Table 1 in this appendix), which is the dominant contaminant present on-site. A separate limit for the maximum allowable contamination that is concentrated in a smaller area, the derived concentration guideline $\text{level}_{\text{elevated measurement comparison}}$ ($DCGL_{EMC}$), normally is calculated based upon modeling the dose obtained from an area determined by

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[18]Contracted Health Physics Technician Training handouts, K-25, 1993.

[19]The average transuranic (TRU) composite for ETTP is 47% ^{237}Np, 10% ^{238}Pu, 20% $^{239/240}$Pu, and 23% ^{241}Am. The uranium to TRU (U:TRU) ratio ranged from 43.2:1 to 62,500:1 for ETTP, with the vast majority > 50:1. A ratio of 50:1 indicates that uranium radiological protective measures for surface contamination would be sufficient for the TRU content. The uranium to technetium (U:Tc) ratios for ETTP range from 0.00258:1 to 1640:1, with the ratios less than 1:1 coming from the posted Tc areas within the process and main support buildings (K-25 East, K-27, K-29, K-31, K-1231, and K-1420). With a ratio greater than or equal to 1:1, the implication is that the uranium radiological protective measures would be sufficient for the Tc content.

[20]*Isotopic Distribution of Contamination Found at the U. S. Department of Energy Gaseous Diffusion Plants*, Science Applications International Corporation (SAIC) report delivered to Bechtel-Jacobs, SAIC document number 143.19991103.002, October 1999.

[21](*CFR* 1999). 10 *Code of Federal Regulations*, entitled *Occupational Radiation Protection*; the values are taken from Appendix D, "Surface Radioactivity Values."

[22]DOE Order 5400.5 is entitled *Radiation Protection of the Public and the Environment*; the values are taken from Fig. IV-1, "Surface Contamination Guidelines."

[23]*Design of Radiological Surveys of Potential Lease Space at East Tennessee Technology Park*, Oak Ridge, Tennessee (BJC/OR-554).

Table 1. Contamination limits (DCGLs) for all survey units

	DCGL (dpm/100 cm^2)	$DCGL_{EMC}$ (dpm/area)
Total alpha	5000	15,000
Removable alpha	1000	N/A
Total beta-gamma	5000	15,000
Removable beta-gamma	1000	N/A

DCGL = derived concentration guideline level.
$DCGL_{EMC}$ = derived concentration guideline level$_{\text{elevated measurement comparison}}$.
dpm = disintegrations per minute.
N/A = not applicable.

the number of samples taken in the survey unit and the spacing between them. The $DCGL_{EMC}$, however, will be set to three times the appropriate contamination limit, which equates to the contamination averaging criteria as set forth by DOE Order 5400.5 for an elevated reading within a 1-m^2 maximum size area.

If activity is detected at levels exceeding 80% of the DCGL, i.e., 4000 disintegrations per minute (dpm)/100 cm^2, but less than 100%, the data will be reviewed and approved by the RADCON site project Health Physicist prior to release of the materials or areas.

5.3 IDENTIFICATION OF SURVEY UNITS AND CLASSIFICATIONS

Areas are classified as either Class 3, 2, or 1 based upon historical data and process knowledge.

Survey units must be of the same or similar material type, for example, a survey unit cannot contain both asphalt and soil. It would be divided into a survey unit of asphalt and another survey unit of soil. Refer to the design document for complete descriptions of the different classifications of survey units. In general, a Class 3 survey unit is not expected to have residual radioactivity levels above 25% of the DCGL prior to any historical remediation (1250 dpm/100 cm^2 total activity or 250 dpm/100 cm^2 removable activity). A Class 2 survey unit is expected to have residual radioactivity levels less than the DCGL prior to any historical remediation. A Class 1 survey unit is expected to have residual radioactivity levels above the DCGL prior to any historical remediation. Based upon the historical usage and process knowledge for the facility, all areas are initially classified as Class 3 areas. The K-1225 building will be composed of a total of 23 Class 3 survey units, as shown in Table 2 in this appendix. See Fig. 1 in this appendix for the locations of the first and second floor interior survey units (ISUs) and Fig. 2 in this appendix for the exterior survey units (ESUs).

5.4 INSTRUMENTATION SELECTION AND SURVEY TECHNIQUES

See the design document appendix for details on instrumentation selection. In general, alpha scintillation and beta-gamma Geiger-Müeller (GM) detectors used for static measurements will be attached to scalar rate meters and will have minimum detectable activities less than 25% of the DCGL. Gas-proportional floor monitors or floor monitors with the probe detached from the monitor cart for usage as a hand-held probe, calibrated and operated to detect both alpha and beta-gamma radiations, will be used for as many of the scan surveys as possible, including the primary work surfaces, walls, and ceilings.

Table 2. Survey units classification

Area	Class	
	Interior areas	Exterior areas
K-1225, first floor, northeast corner (ISU 1)	Class 3	N/A
K-1225, first floor, southeast corner (ISU 2)	Class 3	N/A
K-1225, first floor, east open office space (ISU 3)	Class 3	N/A
K-1225, first floor, restrooms (ISU 4)	Class 3	N/A
K-1225, stairwell from first to second floor (ISU 5)	Class 3	N/A
K-1225, first floor, corridor from south entrance to northern office area (ISU 6)	Class 3	N/A
K-1225, first floor, maintenance/mechanical/elevator rooms (ISU 7)	Class 3	N/A
K-1225, first floor, southwest corner (ISU 8)	Class 3	N/A
K-1225, first floor, northwest corner (ISU 9)	Class 3	N/A
K-1225, second floor, northeast corner (ISU 10)	Class 3	N/A
K-1225, second floor, southeast corner (ISU 11)	Class 3	N/A
K-1225, second floor, east open office space and conference room (ISU 12)	Class 3	N/A
K-1225, second floor, maintenance/storage/copier/elevator rooms (ISU 13)	Class 3	N/A
K-1225, second floor, restrooms (ISU 14)	Class 3	N/A
K-1225, second floor, corridor form south to main entrance (ISU 15)	Class 3	N/A
K-1225, second floor, southwest corner (ISU 16)	Class 3	N/A
K-1225, second floor, northwest corner (ISU 17)	Class 3	N/A
K-1225 building exterior walls (entire wall) (ESUs 1 through 4)	N/A	Class 3
K-1225 building sidewalk (entire walk) (ESU 5)	N/A	Class 3
K-1225 building outdoor patio (second floor) (ESU 6)	N/A	Class 3
K-1225 building roof (ESU 7 – not pictured)	N/A	Class 3

ESU = exterior survey area.
ISU = interior survey area.
N/A = not applicable.

Sodium iodide (NaI) meters and Bicron MicroRem® meters[24] also will be used, as specified in this survey plan. Removable contamination surveys (i.e., smear surveys) will be conducted at all locations where a fixed/total measurement is taken. All removable contamination survey smears will be counted on a gas-proportional counter, or equivalent, that is calibrated to detect both alpha and beta-gamma radiations.

For Class 3 areas, a minimum of 10% judgmental surface scan surveys will be performed over the primary traffic and work surfaces of the entire survey unit, as accessible. In the Class 2 areas, 100% of the accessible floor area will be scanned. Other surfaces that are classified as Class 2 areas, such as walls, ceilings, and overhead areas, will have a scan coverage that varies in accordance with how close the expected activity levels are to the DCGLs. Class 1 survey units will have a 100% scan of all surfaces. Emphasis will be placed upon entrances/high-traffic areas, suspect areas, and professional judgment for all scan surveys. (*Note*: A 10% scan survey is not interpretable as surveying 100% of 10% of the offices in a particular survey unit and not performing any surveys in the other 90%; 10% of all floors, of all walls, and of all ceilings will be scanned, as accessible.)

All surveys will be performed in accordance with established the DOE contractor RADCON procedures (i.e., scan rate, probe distance, source checks). The current ETTP DOE contractor is BJC.

[24]Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof.

5.5 AREA PREPARATION

All areas will be surveyed in an "as-found" condition. Materials may be rearranged or moved to allow for survey access to areas covered by material or equipment.

5.6 REFERENCE COORDINATE SYSTEM FOR SURVEY

Class 3 areas do not require a sample grid. A reference coordinate system will be used in each survey unit to reference measurements so they can be relocated or verified as needed, unless the measurement is at an easily identifiable location, such as "Room 201, 4 ft up on west wall, approximately 2 ft from south wall." The starting point of the reference grid, if needed, will be the southwest corner of each survey unit, with the distance north being Y and the distance east being X in an X-Y coordinate system, i.e., (X,Y), with the units measured in feet.

Class 2 and Class 1 survey units require a sample grid with systematic measurements taken based upon a random starting point. These survey grids are based upon the survey unit's area and number of systematic sample measurements required in each.

If a survey unit has to be reclassified to a higher classification and survey requirements, a revision to this survey plan will be issued containing the sample grids of the reclassified survey units.

6. SURVEY DESIGN

6.1 QUANTIFY DATA QUALITY OBJECTIVES

The null hypothesis (H_o) for each survey unit is that the residual contamination exceeds the DCGL. The alternative hypothesis (H_a) is that the survey unit meets the DCGL. Decision error levels, as set forth in the design document, are 0.05 for Type I (α) errors and 0.10 for Type II (β) errors in all survey units as the building is expected to be releasable without remediation. The Lower Bound of the Gray Region (LBGR) is initially set to 50% of the DCGL. These parameters apply to all survey units, regardless of their classification. The design document discusses the data quality objective (DQO) process and specific DQOs in greater detail.

6.2 DETERMINATION OF THE NUMBER OF DATA POINTS

Because of the lack of actual area survey data for the building that is not recorded as "NEAD" (No Elevated Activity Detected) or "<", the default values suggested in the design document were used to determine the number of survey data points per survey unit. Since the facility has always been used as office space and has no real area survey data of the facility, it was determined that using the default values found in the design document, in lieu of actual data, was appropriate. Using the prescribed statistical testing methodology found in the design document (Sign test), a Δ/σ value (also known as the "relative shift") of three (3), and an LBGR set at 50% of the DCGL (2500 dpm/100 cm^2), were chosen. The Sign test was utilized, as the residual contamination present within the survey units should be at a very small fraction of the DCGL. For all survey units, 11 survey data points (total and removable readings) are needed, at a minimum, not including any tool, furniture, or equipment surveys.

6.3 SURVEY PROCEDURES

All surveys are to be performed in accordance with this survey plan, the design document, and the DOE contractor RADCON procedures. *Note*: Survey technique is covered in the design document and will not be repeated in this plan. Variations or clarifications of the design document, however, will be included.

In any area where the scan survey indicates activity exceeding 5000 dpm/100 cm^2, notify the Project Health Physicist for approval to apply the DOE Order 5400.5 averaging release criteria. If approval is given, direct alpha and beta-gamma measurements will be made following the establishment of a 1-m^2 grid. If the area or equipment still exceeds the $DCGL_{EMC}$, the DOE contractor RADCON procedures will be followed for posting of the immediate area. In addition, any contamination survey location found in excess of two times the DCGL also will have a dose rate measurement taken at a distance of 3 ft.

Any activity in excess of 25% of the DCGL will require that a Class 3 survey unit be reclassified as Class 2 and surveyed appropriately. *Note*: If the area exceeding 25% of the DCGL is on a glazed clay tile floor and is less than 3500 dpm/100 cm^2 total beta-gamma (or 2800 dpm/100 cm^2 total beta-gamma for a red clay brick[25]) with no alpha contamination above 25% of the DCGL, then no upgrading of the unit is required. This level of radioactivity is within that of the NORM contained in the glazed clay tile/brick matrix. Any activity in excess of the DCGL will require that a Class 3 or 2 survey unit be reclassified as Class 1 and surveyed appropriately. Notify the RADCON supervisor so the project radiological engineer can make any appropriate changes to this survey plan.

Comparison to background levels is required because only a gross signal will be measured. Topographical considerations should be weighed for background comparison. Furthermore, material specific backgrounds might be necessary for material such as tile, brick, concrete and cinderblock because these materials contain elevated levels of naturally occurring radionuclides. For this reason, survey units might have to be subdivided by material type.

A summary of the requirements for each type of survey unit is found in Table 3 in this appendix, and a survey technician summary is found in Table 4 in this appendix.

6.3.1 Interior Survey Units

Any asbestos-controlled areas will be identified with any pertinent information on whether radiological contamination is suspected (e.g., ventilation hoods, exhaust vents, posted radiological areas) but not entered as part of this survey. No surveys will be performed above suspended ceiling tiles, in the elevator shaft, or under elevated flooring. Any ventilation exhausts and air intakes in the survey footprint also will be surveyed for contamination. At least one tissue-equivalent dose rate will be taken in each office or open area.

6.3.1.1 Class 3 interior survey units

See Fig. 1 in this appendix for the first and second floor survey units. Ten percent of each of the survey units, including the primary traffic areas, work surfaces, walls, and ceilings, will be scanned with floor monitors, NaI meters, and hand-held meters (including a floor monitor probe set up as a hand-held probe and calibrated to detect alpha and beta-gamma contamination for large area scans of non-floor surfaces), as appropriate. Emphasis will be placed on the primary traffic areas and the work areas, i.e.,

[25]Values computed based upon the beta-gamma background levels for brick and ceramic tile found in Table 5.1 of NUREG-1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, December 1997 (NRC 1997c), and an average beta-gamma Geiger-Müeller (GM) correction factor of 34 (dpm per 100 cm^2)/cpm for a planar radiation source.

Table 3. Summary of survey unit requirements

Survey unit type	Class 3	Class 2	Class 1
Interior	• 10% scan of all accessible surfaces • 11 total and removable readings, at a minimum per survey unit • Reading locations based on professional judgment and scan survey • Dose rate walkover survey in each survey unit • Minimum of 1 dose rate reading per office or open space • 1 dose rate reading per every 20 ft of hallway • Upgrade to Class 2 if activity > 25% DCGL • Upgrade to Class 1 if activity > DCGL	• 100% scan of primary traffic and work spaces • Scan of walls, overhead areas with scan % = % of DCGL • 11 total and removable readings, at a minimum per survey unit • Reading locations based upon a grid to be determined as needed • Dose rate walkover survey in each survey unit • Minimum of 1 dose rate reading per office or open space • 1 dose rate reading per every 20 ft of hallway • Upgrade to Class 1 if activity > DCGL	• 100% scan of primary traffic and work spaces • 11 total and removable readings, at a minimum per survey unit • Reading locations based upon a grid to be determined as needed • Dose rate walkover survey in each survey unit • Minimum of 1 dose rate reading per office or open space • 1 dose rate reading per every 20 ft of hallway
Exterior	• 10% scan of accessible surfaces • Scan walls up to at least 8 ft • 11 total and removable readings, at a minimum per survey unit • Reading locations based on professional judgment and scan survey • Dose rate walkover survey in/on each survey unit • 1 dose rate reading per every 20 ft • Upgrade to Class 2 if activity > 25% DCGL • Upgrade to Class 1 if activity > DCGL	• Scan of surfaces with scan % = % of DCGL • Scan walls up to at least 8 ft • 11 total and removable readings, at a minimum per survey unit • Reading locations based upon a grid to be determined as needed • Dose rate walkover survey in/on each survey unit • 1 dose rate reading per every 20 ft • Upgrade to Class 1 if activity > DCGL	• 100% scan of all surfaces • Scan walls up to at least 8 ft • 11 total and removable readings, at a minimum per survey unit • Reading locations based upon a grid to be determined as needed • Dose rate walkover survey in/on each survey unit • 1 dose rate reading per every 20 ft
Furnishings	• 10% scan of all accessible surfaces • Maximum total surface area < 5000 m^2 • Activity > 25% of DCGL, remove that item and all other similar items to be placed in a new Class 2 survey unit	• 10% scan of all accessible surfaces • Maximum total surface area < 1000 m^2 • Activity > DCGL, remove item and all other similar items to be placed in a new Class 1 survey unit	• 100% scan of all accessible surfaces • Maximum total surface area < 100 m^2

DCGL = derived concentration guideline level.

Table 4. Survey technician summary of survey requirements

Class 3	Class 2	Class 1
• 10% scan all accessible surfaces, 10% of exterior accessible surfaces, and 10% of furnishings accessible surfaces • Professional judgment for wall and ceiling scans • Scan exterior walls up to at least 8 ft • 11 (minimum) total and removable readings • Dose rate walkover survey in each survey unit (minimum of 1 reading/office or open space, 1/20 ft of hallway or exterior) • Furnishings activity > 25% of DCGL, remove that item and all other similar items to be placed in a new Class 2 survey unit • Notify Supervisor if activity > 25% DCGL	• 100% scan interior floor/primary work areas • Scan of walls, overhead areas with scan % = % of DCGL (TBD) • Furnishings scan 10% accessible surfaces • Scan exterior walls up to at least 8 ft • 11 (minimum) total and removable readings • Reading locations based upon a grid TBD • Dose rate walkover survey in each survey unit (minimum of 1 reading/ office or open space, 1/20 ft of hallway or exterior) • Notify Supervisor if activity > DCGL • Furnishings activity > DCGL, remove item and all other similar items to be placed in a new Class 1 survey unit	• 100% scan all surfaces • Scan exterior walls up to at least 8 ft • 11 (minimum) total and removable readings • Reading locations based upon a grid TBD • Dose rate walkover survey in each survey unit (minimum of 1 reading/office or open space, 1/20 ft of hallway or exterior)

DCGL = derived concentration guideline level.
TBD = to be determined.

floor areas. Tools, office furniture, and equipment will be a separate survey unit and surveyed per the guidance found in Sect. 6.3.6. No removal of suspended ceiling tiles or floor panels will be required for this survey, unless the NaI scan survey indicates areas of elevated activity that require additional investigation. Eleven measurements of total and removable contamination, at a minimum, will be recorded within each survey unit at locations, which are determined (during the scan survey) to have the highest activity.

A general dose rate walkover survey of each survey unit, using a Bicron MicroRem® meter, will be performed to determine if any variations exist in the penetrating radiation dose rate. If variations exist, then the location, the distance the dose rate was taken from the wall or floor, and the dose rate at that location are to be recorded. Dose rate measurements will be obtained at a minimum of every 20 ft in hallways and large rooms.

6.3.1.1 Class 2 interior survey units

Although there currently are no Class 2 areas, the potential exists for having a Class 3 area upgraded to a Class 2. Class 2 survey protocols are as follows: 100% of the accessible floor surface will be scan surveyed using a floor monitor or hand-held meters, as appropriate, and with an NaI meter; other surfaces (such as walls, overhead areas, and ceilings) will be scanned according to what percent of the DCGL was found; if the data show that a maximum of 35% of the DCGL was detected, then the scan percentage is 35%. The measurement locations will be chosen systematically per the design document. No removal of suspended ceiling tiles or floor panels will be required for this survey, unless the NaI scan survey indicates areas of elevated activity that require additional investigation.

6.3.1.2 Class 1 interior survey units

While there currently are no Class 1 areas, the potential exists for having a Class 3 or 2 area upgraded to a Class 1. Class 1 survey units follow the Class 2 survey protocols, with the exception that all surfaces (not just the accessible ones) are surveyed 100%.

6.3.2 Exterior Survey Units

All exterior wall areas will be surveyed with hand-held meters, or with a gas-proportional probe, and with an NaI meter up to a minimum height of 8 ft. The building sidewalks will be scanned using a floor monitor or hand-held meters. No exterior grass or parking areas are covered under this survey plan. Emphasis is to be placed upon air vents and intakes, windowsills, gutter downspouts, and wherever professional judgment would indicate a higher probability of finding elevated readings. A tissue-equivalent dose rate survey will be performed over the survey units, with readings being taken every 20 ft.

6.3.2.1 Class 3 exterior survey units

See Fig. 2 in this appendix for the exterior wall survey units. (There is no figure for the roof survey unit.) Class 3 exterior surveys will have 10% of the accessible surfaces scanned with hand-held meters or gas-proportional probes, as appropriate, and with an NaI meter. Eleven measurements of total and removable contamination, at a minimum, will be recorded within each survey unit at locations determined during the scan survey to have the highest activity. Any air intakes will need to be turned off, preferably overnight, to allow for the decay of radon and thoron daughters prior to the survey.

6.3.2.2 Class 2 exterior survey units

While there currently are no Class 2 areas, the potential exists for having a Class 3 area upgraded to a Class 2. Class 2 survey protocols are as follows: walls, up to 8 ft, will be scan surveyed using hand-held meters and/or gas-proportional meters (if possible), and with an NaI meter, with the scan percentage being equal to the maximum percentage of the DCGL found prior to the reclassification as a Class 2 survey unit.

6.3.2.3 Class 1 exterior survey units

Although there currently are no Class 1 areas, the potential exists for having a Class 3 or 2 area upgraded to a Class 1. Class 1 survey units follow the Class 2 survey protocols, with the exception that 100% of the accessible surface will be surveyed.

6.3.3 Equipment and Furniture (Furnishings) Surveys

The survey of equipment and furnishings will be performed along the lines of the survey protocol developed by Safety and Ecology Corporation (SEC) for the release of materials from the K-1001-A, -B, -C, and -D buildings prior to their demolition.[26] The K-1001-A, -B, -C, and -D and the design document requirements that affect the number of survey data points are shown in Table 5 in this appendix.

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[26] *Survey Protocol Unrestricted Release of Building Furnishings*, prepared by Safety and Ecology Corporation for Bechtel Jacobs Company LLC Radiation Control (RADCON).

Table 5. Comparison of parameters for computing number of samples

Parameter	SEC K-1001-A, -B, -C, and -D furnishings survey plan	Survey design document
Type I error rate (α)	0.05	0.05
Type II error rate (β)	0.05	0.10
Non-parametrical statistical test	Wilcoxon-Rank Sum (WRS)	Sign[27]
LBGR	2500 dpm/100 cm^2	2500 dpm/100 cm^2
Number of data points per survey unit	20 (10 in each survey unit, 10 in each reference background survey unit)	11

dpm = disintegrations per minute.
LBGR = Lower Bound of the Gray Region.
SEC = Safety and Ecology Corporation.

6.3.3.1 Determination of the number of data points

The existing K-1225 survey dataset was unusable for determining the number of measurements independently required because of the minimal amount of actual data available. Based upon the historical survey data and facility usage, the default values from the design document will be used instead. Setting the LBGR at 50% of the DCGL and choosing the Δ/σ value (relative shift) to be three (3) results in 11 data points needed for alpha or beta-gamma measurements. This results in a 5% probability that the survey unit will be incorrectly determined to not need additional surveys (i.e., released) when it actually does (Type I error, α) and in a 10% probability that the survey unit will be incorrectly determined to need additional surveys when it does not (Type II error, β). Using the existing limited dataset (alpha and beta-gamma data averages of 38.4 dpm/100 cm^2 and 514.3 dpm/100 cm^2, respectively, with alpha and beta-gamma standard deviations of 63.3 dpm/100 cm^2 and 848.6 dpm/100 cm^2, respectively),[28] there is 95% confidence that the alpha readings will be within the interval -86 to 163 dpm/100 cm^2 and that the beta-gamma readings will be within the interval of -1149 to 2178 dpm/100 cm^2, of which the upper bounds of the 95% confidence intervals for both are below the DCGL.

6.3.3.2 Furnishings – survey unit classifications and survey procedures

As stated in Sect. 5.3, survey units are classified as either Class 1, 2, or 3 based upon historical data and process knowledge, which provides information on the contamination potential for the unit. Furnishings (which includes all furniture, equipment racks, and equipment for the purposes of this portion of the survey) are considered to have a low potential for residual contamination being present. All survey units will have NaI, alpha, and beta-gamma scan surveys performed on them, with the areas covered by the scans determined by professional judgment. In addition, direct and removable alpha and beta-gamma measurements will be taken, with the locations being the areas with the highest readings as determined during the scan surveys. A detailed listing of all the items within the survey unit is not required; a generalized item listing of survey unit classification and number, NaI scan results, and the individual survey data points is the minimum data reporting requirement.

Each building ISU (Table 2 in this appendix) is to be the basis for the furnishings survey unit (FSU); therefore, there is the potential for each building survey unit to have up to three different FSUs. The sole exception to this is if there are very few items to make up a survey unit of a particular class, in which case, the items can be combined from the entire building to make a survey unit. The individual FSUs will be

[27]The Wilcoxon-Rank Sum (WRS) statistical test is for usage when the primary contaminants are found in background. The Sign test is to be used when the contaminant is not found in background or when the contaminants are in background, but at a small fraction of the DCGL. The Sign test will be used for this survey.

[28]The alpha and beta-gamma average values quoted are actually the averages of the instrumentation's L_c values, as the readings were denoted as "No Elevated Activity Detected" (i.e., the radioactivity levels were essentially background).

designated in a manner similar to the following example to identify the ISU and the FSU: ISU 4 FSU C3, which designates that the data are from the interior survey unit 4 (ISU 4) furnishings survey unit Class 3 (FSU C3).

Class 3 Furnishings Survey Units

All newer furnishings will be grouped together in batches (survey units) and classified as Class 3, as they have a very low potential for having been used in other facilities or areas that are potentially contaminated. The total surface area of each Class 3 survey unit will not exceed 5000 m^2. The surface scan surveys will cover 10% of all accessible areas.

Class 2 Furnishings Survey Units

Older furnishings, which might have been used in other buildings or areas, will be grouped into survey units and classified as Class 2. The total surface area of a Class 2 FSU will not exceed 1000 m^2. The surface scan surveys will cover 10% of all accessible areas.

Class 1 Furnishings Survey Units

Only furnishings that have exceeded the Class 2 criteria, above, will be classified and surveyed as a Class 1 survey unit. The total surface area of a Class 1 FSU will not exceed 100 m^2. The surface scan surveys will cover 100% of all accessible areas.

All furnishings survey data results (in each survey unit) that meet the aforementioned criteria will be evaluated against the Sign test criteria to determine if the items can be released. The null hypothesis, H_o, to be tested is that the residual radioactivity in the survey unit exceeds the DCGL. If the null hypothesis is rejected based upon the non-parametrical statistical test, then the alternative hypothesis (H_a), which states that the residual radioactivity in the survey unit does not exceed the DCGL and, therefore, can be released, is accepted.

6.3.4 Survey Unit Reclassification

Any interior or exterior Class 3 areas that exceed 25% of the DCGL will be reclassified as Class 2 areas and resurveyed accordingly. Any Class 3 or 2 areas that exceed the DCGL will be reclassified as Class 1 areas and resurveyed accordingly. All reclassified areas will be discussed in the revision to this survey plan, the Radiological Survey Report, and the Environmental Baseline Summary (EBS) for the building.

If residual radioactivity, within the Class 3 FSUs, is found in excess of 25% of the DCGL, the item with the residual activity, and all items of a similar type and history in that survey unit, will be removed from that survey unit, reclassified as a separate Class 2 FSU, and resurveyed accordingly. If residual radioactivity is found in excess of the DCGL in an FSU, the item with the residual activity, and all items of a similar type and history in that survey unit, will be removed from that survey unit, reclassified as a separate Class 1 FSU, and resurveyed accordingly.

6.4 SPECIFICATION OF SAMPLING LOCATIONS

All recorded survey measurement locations are to be on a judgmental basis for Class 3 survey units, per the design document, and should include entrances, primary traffic areas, air vents, and primary workspaces; these are the areas that would be expected to have the highest probability of having elevated readings. Survey locations for any survey unit upgraded to Class 2 or 1 will be provided as needed.

6.5 DATA EVALUATION

All data will be evaluated using the Sign non-parametrical statistical test, as outlined in the design document, to assist in the decision to release the facility.

7. DOCUMENTATION

Survey data will be documented in accordance with the procedures and reviews required by the DOE contractor. A report will be prepared, describing the survey methods, results, and evaluation. The report will include the findings of the assessment, along with a description of the materials surveyed, their condition, and a justification for the potential contamination classification assigned. The data evaluation will be included, along with the assessment of the quality assurance/quality control (QA/QC) documentation.

This report, or a summary of the report, also will be included and referenced in the facility's baseline environmental conditions documentation.

8. QUALITY ASSURANCE

All appropriate QA/QC reviews to ensure the quality of the data gathered will be performed and documented.

Survey instruments and methods specified in applicable RADCON operating and technical procedures have been documented as to their ability to provide a 95% confidence level in the detection of surface contamination at levels that meet the requirements of this protocol. Supporting data are provided on each survey form.

For additional verification of survey results, Radiological Control Technicians not involved in the execution of this protocol will repeat approximately 5% of the direct and removable activity measurements on items destined for unrestricted release. To satisfy the release criteria, the results must confirm the initial findings.

A RADCON Certified Health Physicist (DOE contractor), or another designated health physicist, will review, evaluate, and validate the survey results, including assessment of the QA/QC information and data, prior to their use in generating the radiological survey report. The final radiological survey report will include the details of this assessment. The radiological survey report will be provided to the DOE contractor project QA Manager, project manager, and site project Health Physicist for approval prior to its inclusion into the facility's baseline conditions documentation.

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