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FINAL DOCUMENT

ATTACHMENT A

Environmental Baseline Survey Report for the Title Transfer of the K-1580 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee

This document is approved for public release per review by:

Martin W. Davis for 9/23/2004

~~BJC~~ ETTP Classification & 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-1580 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee

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Prepared by
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Office of Environmental Management

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 contracts DE-AC05-98OR22700 and DE-AC05-03OR22980
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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.

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ACRONYMS

bgs	below ground surface
BJC	Bechtel Jacobs Company LLC
C&CCC	Carbide and Carbon Chemical Corporation
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
CROET	Community Reuse Organization of East Tennessee
cpm	counts per minute
DCE	dichloroethene
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
ED	exposure duration
EPA	U. S. Environmental Protection Agency
ESU	exterior survey unit
ETTP	East Tennessee Technology Park
FFA	Federal Facility Agreement
FSU	furnishings survey unit
GSU	grounds survey unit
H_o	null hypothesis
H_a	alternative hypothesis
HI	hazard index
HP	health physicist
ISU	interior survey unit
kg	kilogram
LAW	large area wipe
LOC	Oak Ridge Reservation Local Oversight Committee
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
ORO	Oak Ridge Operations Office
ORR	Oak Ridge Reservation
PHS	Preliminary Hazard Screening
PRG	preliminary remediation goal
QA/QC	quality assurance/quality control
RADCON	Radiological Control Organization
RCRA	Resource Conservation and Recovery Act of 1976
RCW	Recirculating Cooling Water
ROD	Record of Decision
RQ	reportable quantity
SSAB	Site Specific Advisory Board
TCE	trichloroethylene or trichloroethene
TDEC	Tennessee Department of Environment and Conservation

TRU	transuranic
TVA	Tennessee Valley Authority
U	uranium
UST	underground storage tank
VOC	volatile organic compound
μrem/h	microrem per hour

EXECUTIVE SUMMARY

This environmental baseline survey (EBS) documents the baseline environmental conditions of the U. S. Department of Energy's (DOE's) K-1580 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 Sect. 120(h) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

The K-1580 Building is located in the southern portion of ETTP. It is a 38,211-ft^2 (12,737 ft^2 on each of the three floors), three-story structure that was built in 1980 as an office building for ETTP Engineering personnel. Building K-1580 has been used by several site organizations since its construction and continues to be used for offices. There is an asphalt parking area on the north side of the building and a grassy yard that extends around the east and south sides of the building.

The area proposed for title transfer includes the K-1580 building; exterior electrical and air-conditioning equipment and grounds that surround the exterior equipment; and 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 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's radiological condition. Following is a summary of the findings of the evaluation that was performed:

- No evidence was found that any hazardous substances were stored in Bldg. K-1580 for one year or more in quantities equal to or greater than 1000 kilograms (kg) or their respective CERCLA reportable quantities (RQs).

- No evidence was found that acutely hazardous wastes were stored in Bldg. K-1580 for one year or more in quantities greater than or equal to 1.0 kg.

- There was no evidence found of a release or disposal of hazardous substances or petroleum products in excess of the substance's RQ occurring in Bldg. K-1580.

- The only confirmed asbestos-containing material in the building is 16 linear ft of clay rope-type insulation, which is in good condition. The vinyl floor tiles are assumed to contain asbestos; the floor tiles are in good condition.

- Based on the 1980 date of construction of Bldg. K-1580, polychlorinated biphenyls in the light fixture ballasts and the existence of lead-based paint in the building are considered improbable.

- The building interior, furnishings, exterior, and exterior equipment and surrounding grounds were radiologically surveyed in accordance with the survey plan (Appendix D and Addendum D.1). The data were analyzed using the Sign test, a non-parametric statistical test, to determine if any residual

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

radiological contamination was present and if the contamination may exceed the derived concentration guideline level (DCGL) established for each of the survey units. Survey results showed that the K-1580 study area had no areas of elevated residual radioactivity present above DOE contamination limits or the DCGL [total alpha, 5000 disintegrations per minute per 100 square centimeters (dpm/100 cm^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 in support of this transfer.

- Based on a winter 2004 sampling event, sub-slab soil vapor sampling results show that the vapor intrusion pathway is not complete beneath K-1580, and, thus, there is no adverse impact to human health. To confirm this determination, a summer 2004 sampling event has been completed and the results will be posted on the World Wide Web.

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-1580*, DOE recommends the following:

1. Due to the uncertainty associated with the nature of the on-site groundwater and the need to evaluate and possibly address groundwater in the future, DOE recommends that the transfer of Bldg. K-1580 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. Assumed 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.

In addition, no evidence was found that any hazardous substances were stored in K-1580 for one year or more in quantities greater than or equal to 1000 kilograms (kg) or their respective CERCLA reportable quantities (RQs). No evidence was found that acutely hazardous wastes were stored in K-1580 for one year or more in quantities greater than or equal to 1.0 kg. No evidence was found that any hazardous substances were released or disposed of at K-1580 in quantities exceeding their respective RQs.

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-1580 are summarized below. Full details are found in the Covenant Deferral Request (CDR) 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.

3. Disturbance of soils on the transferred property is prohibited unless the transferee complies with the site process for obtaining an excavation penetration permit.

4. 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.

5. DOE reserves the right of access to all portions of the property for environmental investigation, remediation, or other corrective action.

6. 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 East Tennessee Technology Park

Sitewide Record of Decision (ROD), currently scheduled to be signed by 2007, and will take interim measures to ensure protectiveness until the ROD is signed.

The interim measures include: (a) collecting samples inside the building during the summer of 2004; and (b) if needed, based on the summer sampling results, making physical modifications to the building, as necessary, to ensure protectiveness. In addition, until the ROD is implemented, comprehensive changes to the building (e.g., installation of a new heating, ventilating, and air-conditioning system) may require a re-evaluation to ensure protectiveness. (See Sect. 4.4 for more details.)

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. Changes in response to those comments have been incorporated throughout this report. Responses to additional general comments from EPA, received in January 2004, are included in this final version of the report. No comments specific to Bldg. K-1580 were received.

In addition, the Site Specific Advisory Board (SSAB) and Oak Ridge Reservation Local Oversight Committee (LOC) submitted comments in March 2004 on the soil vapor sampling results for winter sampling for Bldgs. K-1007, K-1225, K-1330, K-1400, and K-1580. Text changes and clarifications, where warranted, have been made in the respective EBS reports for these buildings. None were needed in the K-1580 EBS or Risk Screen reports. The full set of SSAB and LOC comments and the individual responses can be found in Sect. 7 of the CDR package.

1. PROPERTY IDENTIFICATION

The K-1580 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-1580 is located within the ETTP perimeter fence. Figure 1.1 is a map showing the relationship of Bldg. K-1580 to ETTP, and Fig. 1.2 is an ortho image showing the footprint of the K-1580 study area. Figure 1.3 is an aerial photograph showing the location of Bldg. K-1580 in relation to ETTP.

The area proposed for title transfer includes the K-1580 building, exterior electrical and air-conditioning equipment and surrounding grounds, and 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[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]BJC 2003a. Personal communications with J. R. Russell and L. D. Charles (either previously or currently employed at the East Tennessee Technology Park) in February.

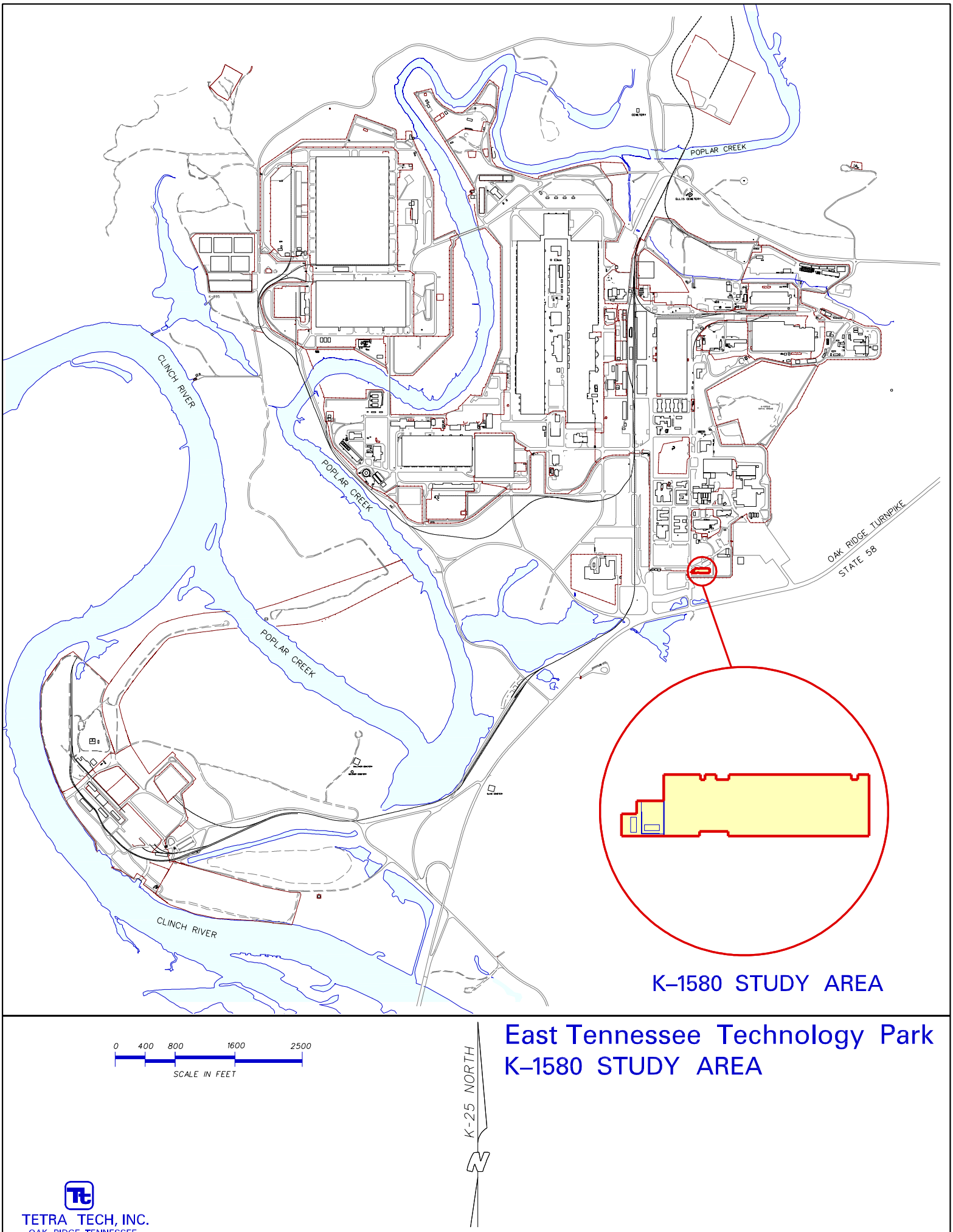


Fig. 1.1. Location map of the K-1580 study area.

0 25 50
SCALE IN FEET

K-25 NORTH

East Tennessee Technology Park
K–1580 STUDY AREA

LEGEND

STUDY AREA

TETRA TECH, INC.
OAK RIDGE, TENNESSEE
5/21/04 1580SP R1.DGN

Fig. 1.2. Ortho image of the K-1580 study area.

Fig. 1.3. 2001 aerial photograph of Bldg. K-1580 from the south.

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-1580 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-1580 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 shown on page B-5 in Appendix B.

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

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

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 Bldg. K-1580 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. Records reviewed did not identify spills, permits, or permit violations at Bldg. K-1580. In addition, the former underground storage tank (UST) manager stated that there are no regulated USTs associated with Bldg. K-1580. There are water treatment tanks associated with the chiller, but these tanks are not regulated.[5]

[4]BJC 2003a. Personal communication with J. R. Russell (either previously or currently employed at the East Tennessee Technology Park) in February.

[5]CDM 2003a. Email communication from S. T. Goodpasture (either previously or currently employed at the East Tennessee Technology Park) on October 28.

4. PAST AND PRESENT ACTIVITIES

4.1 PAST AND PRESENT ACTIVITIES IN THE TITLE TRANSFER FOOTPRINT

Prior to the acquisition of the land by the government, the entire area 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 Oak Ridge Gaseous Diffusion Plant (ORGDP), the K-1580 area was an undeveloped field outside the perimeter fence and remained as such until the K-1580 building was constructed in 1980. The perimeter fence was moved and K-1580 is inside the fence.

K-1580 was constructed in 1980 as an office building for Engineering personnel. In the 1990s, engineering personnel moved from the building, and other organizations have occupied the building for offices.

Historic maps of the ETTP area were reviewed to determine whether former facilities had been located in the K-1580 footprint. These maps included the following:

- J. A. Jones Drawing No. 20711, *General Layout, K-25 Area, Sanitary Water Distribution*, dated 1944;
- Kellex Corporation Drawing No. FD-01-AA-02, *K-25 and K-27 Plot Plan*, dated February 27, 1944, and Rev. 9 dated March 31, 1946;
- Carbide and Carbon Chemical Corporation (C&CCC) Drawing No. ERS-1, *Reference Plot Plan*, dated January 24, 1946;
- C&CCC Drawing No. AW-10M, *K-25 and K-27 Plot Plan*, Rev. 8, dated August 17, 1951;
- C&CCC Drawing S-KT-K100, *Area Plot Plan*, Rev. 3, dated June 28, 1956; and
- Union Carbide Nuclear Corporation Drawing No. C1E47365, *Reroof Process Buildings*, dated February 23, 1979.

Nothing was found during the search of these maps showing that any facilities had been located in the footprint.

As discussed in Chap. 1, interviews with current and former employees of Bldg. K-1580 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.

No evidence was found that any hazardous substances were stored in K-1580 for one year or more in quantities greater than or equal to 1000 kilograms (kg) or their respective Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) reportable quantities (RQs). No evidence was found that acutely hazardous wastes were stored in K-1580 for one year or more in quantities greater than or equal to 1.0 kg. No evidence was found that any hazardous substances were released or disposed of at K-1580 in quantities exceeding their respective RQs.

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 have been sampled. There is also a drain in the elevator pit that has been plugged because it goes to the storm sewer. Floor drains were plugged in the early 1990s as part of the sitewide drain-plugging

program. (The program was initiated to ensure that floor drains connected to the storm drain system were permanently plugged or rerouted to prevent discharge of materials into the storm drain system and to limit the potential for National Pollutant Discharge Elimination System permit[6] noncompliance.)

The sources of historical information listed below were searched for additional information about any spills at Bldg. K-1580. Additional research was conducted to see if other records could be found; however, any spills at or in excess of RQs would have been identified in the databases or reports, and none has been found.

- Approved *Preliminary Hazard Screening (PHS) Analysis for K-1580 and K-1550 Trailer Complex*, PHS/K-1580/PK/198.0/9-4-91 (Energy Systems 1991);
- Occurrence Reporting and Processing System (database; ORPS 2003);
- *Environmental, Health, and Safety Concerns for the New ORGDP Contractor* (Mitchell 1983);
- *Hazardous Waste Sites Historical Investigation* (Legeay et al. unpublished);
- *U. S. Department of Energy, DOE Oak Ridge Operations, ETTP Unit Map* (DOE 2000a); and
- *Independent Investigation of the East Tennessee Technology Park,* ETTP-363, Vol. 1 (DOE 2000b).

4.2 PAST AND PRESENT ACTIVITIES FOR THE ADJACENT PROPERTY

The study area is located in the southern portion of ETTP to the east of the former K-1001 Administration Building. The nearest non-DOE property is the Oak Ridge Turnpike/State Highway 58, located approximately 400 ft south of the building. There is no indication that activities from this non-DOE area would have contributed any contamination to the area to be transferred.

The closest facility to Bldg. K-1580 is the K-1320 Office Building. Building K-1320 was constructed in 1982 to provide additional office space for Engineering. In 1984, an addition was added to K-1320 and designated K-1320-A.

There are no past or present facilities in the vicinity of Bldg. K-1580 that are considered to be potential areas of contamination. The closest environmental restoration area is the Recirculating Cooling Water (RCW) Lines Leak Sites 500 ft to the north. The RCW Lines, in conjunction with a cooling tower, served a process support building from the mid-1950s to 1984. The makeup water for the system used a chromate/zinc/phosphate treatment until 1977, when it was replaced by a phosphate treatment system. The cooling tower was demolished in the 1990s. Potential leaks from the RCW lines are listed as a Solid Waste Management Unit under the Resource Conservation and Recovery Act of 1976 (RCRA) and Appendix C of the Federal Facility Agreement (FFA).[7] [The FFA is an agreement between DOE, the U. S. Environmental Protection Agency (EPA), and the state of Tennessee to integrate the requirements of RCRA corrective actions and CERCLA remedial investigations at specific sites within the ORR. The specific facilities to which the FFA applies are listed in Appendix C of the FFA.] In 1946, K-1028-2 (a gatehouse) and K-1017-S2 (a guard tower) are shown near the future site of the K-1580 building. The exact location of these structures in relation to the present K-1580 is difficult to determine because the road was relocated. By 1955 these structures had been removed.

[6]CDM 2003b. Email communication from J. Murphy of CDM Federal (currently employed at ETTP) on August 14.

[7]DOE 1992. *Federal Facility Agreement for the Oak Ridge Reservation*, DOE/OR-1014, U. S. Environmental Protection Agency Region 4, U. S. Department of Energy, and Tennessee Department of Environment and Conservation, Washington, D.C.

4.3 HYDROGEOLOGIC ENVIRONMENT

This information is being presented to lay the basis for evaluation of potential vapor intrusion into Bldg. K-1580.

Building K-1580 is located in the southern portion of ETTP, which is underlain by bedrock of the Chickamauga Supergroup. The Chickamauga Supergroup formations in this area include the Carters Limestone and the Hermitage Formation (Lemiszki 1994). 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-1580 with the axis of this structure located just north of the building and trending northeast–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-1580 is located on the south side of the anticline axis; thus, bedding is expected to dip primarily to the southeast. The approximate location of the axis of the anticline 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 Bldg. K-1580 generally consist of thick to massive beds of limestone with some thin to medium beds and occasional interbedded argillaceous limestone and calcareous shales. 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 ETTP, the middle part of the Carters Limestone also contains two distinctive metabentonite beds, which range from 1 to 3 ft in thickness. Irregular, cobbly, and fossiliferous beds characterize the Hermitage Formation. Generally, both of these formations are subject to karst development due to their high carbonate content. Evidence of karst development in the Chickamauga includes cavities encountered in drilling at ETTP. Thirty-one percent of the monitoring wells that have been completed in the Chickamauga 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-1580, sinkholes were identified to the southwest within the geologic formations, which underlie Bldg. K-1580. Groundwater flow through bedrock at ETTP is primarily controlled by fractures, bedding planes, and hydraulic gradient.

Hydrogeologic characterization data for Bldg. K-1580 are limited because, currently, no groundwater monitoring wells exist in the immediate vicinity of the building. Six bedrock monitoring wells have been installed approximately 300 to 400 ft north of Bldg. K-1580. The hydrogeologic characterization data presented below for Bldg. K-1580 are partly based on the data from these wells and partly based on interpolation from available ETTP sitewide information.

Because no monitoring points exist, depth to bedrock and depth to groundwater can only be interpolated from available data. Based on pre-construction topographic maps, it appears that as much as 10 ft of fill material may have been placed in the area of Bldg. K-1580 during construction of ETTP. This fill was placed under a portion of Bldg. K-1580, primarily along a slope at the eastern end of the building. Depth to bedrock, interpolated from data in the general vicinity of Bldg. K-1580, is expected to be from 2 to 20 ft below ground surface (bgs), likely being shallower on the south side of the building where fill material was not placed. The depth to groundwater, interpolated from the ETTP sitewide potentiometric map, is expected to range from 8 to 20 ft bgs. Shallow groundwater flow is anticipated to be to the south–southwest toward the shallow ponds south of ETTP. Hydrologic parameters, such as hydraulic conductivity and hydraulic gradient, are also estimated 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 Bldg. K-1580.

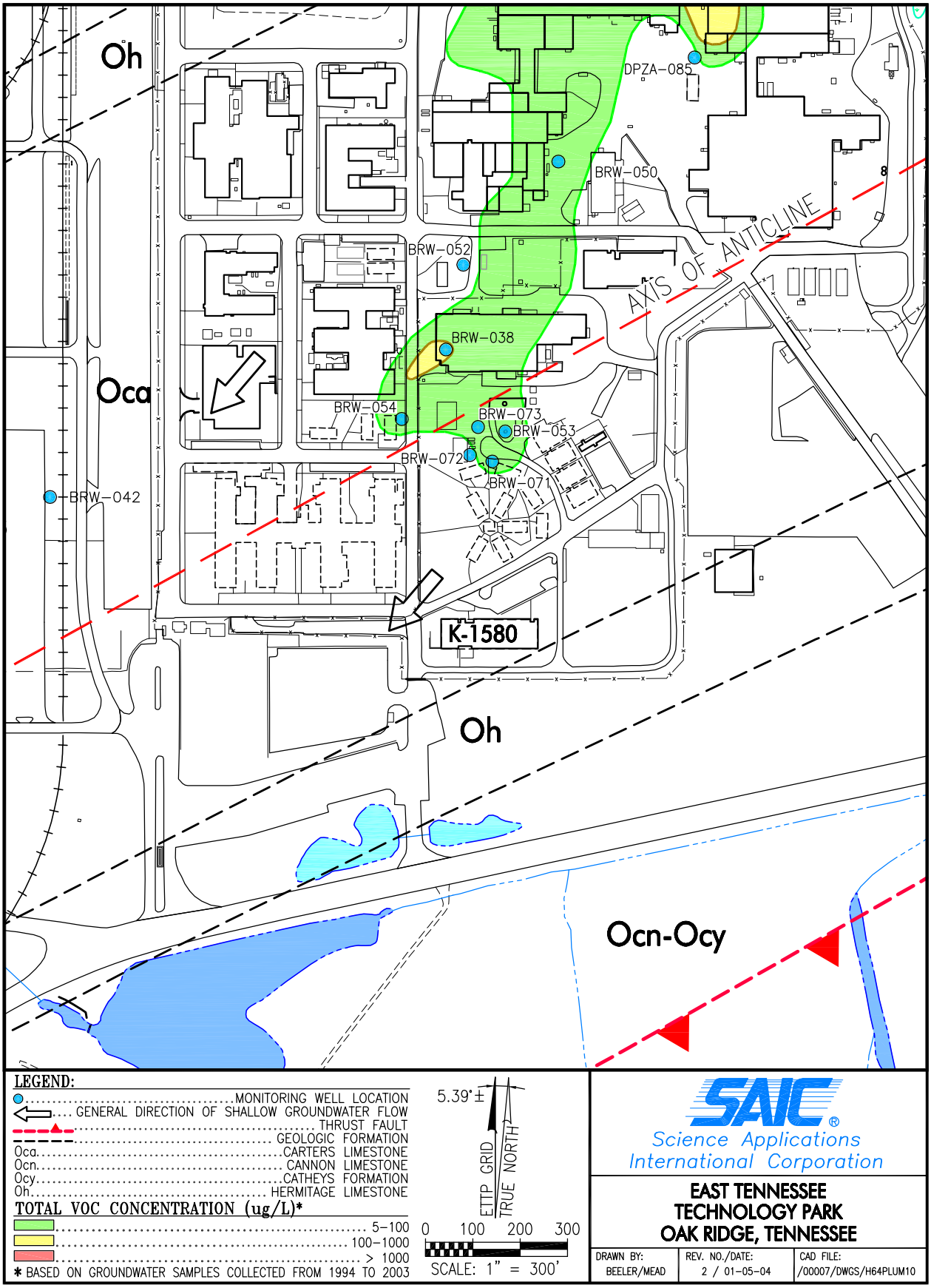


Fig. 4.1. Groundwater VOC concentrations in the vicinity of K-1580.

Table 4.1. Summary of hydrogeologic conditions at Bldg. K-1580

Parameter	Site conditions
Is a groundwater plume present beneath the facility?	None identified
Distance from facility to nearest upgradient plume (ft)	320[a]
Is karst present?	Yes
Depth to bedrock (ft)	2–20[b]
Depth to groundwater (ft)	8–20[b]
Are fill materials present at the facility?	Yes
Composition of overburden materials present.	Silty clay[b]
Shallow groundwater flow direction	SW
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 facility (ft/ft)	0.03[b]
Is a perched water table present at the site?	Unknown

[a]Based on anticipated flow direction, movement of the nearest identified plume is not likely to be toward Bldg. K-1580.

[b]Represents interpolated value based on available data.

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

[d]Represents average hydraulic conductivity of unconsolidated zone at ETTP based on slug tests of wells completed in Chickamauga bedrock.

A groundwater plume has not been identified beneath Bldg. K-1580. However, there are data gaps with respect to groundwater movement in bedrock at ETTP. Groundwater flowpaths in bedrock are a significant unknown due to the complex geology and geologic structure underlying ETTP. An identified groundwater plume does exist within 350 ft upgradient of Bldg. K-1580. This plume occurs in bedrock, and the possibility of transport through bedrock flowpaths toward Bldg. K-1580, although unlikely, cannot be completely discounted based on available data. Table 4.2 summarizes the analytical results for the volatile organic compounds (VOCs) detected in groundwater samples collected from the six bedrock wells located north of Bldg. K-1580 (BRW-038, BRW-053, BRW-054, BRW-071, BRW-072, and BRW-073). It should be noted that these concentrations do not represent groundwater beneath Bldg. K-1580 but have been included to provide characterization data for the known plume nearest to the building. In addition, monitoring well BRW-053 is the only well in the vicinity of Bldg. K-1580 that has been sampled since 1998; however, this well was not sampled between 1994 and 2000. Well BRW-038 has not been sampled since 1995, and the remaining wells have not been sampled since 1998. The VOCs that have been detected above a federal drinking water maximum contaminant level (MCL) at these monitoring wells include 1,2-dichloroethene (DCE); tetrachloroethene; trichloroethene (TCE); and vinyl chloride. Concentrations of TCE have remained relatively steady over the sampling events of record at these wells. TCE has been detected in only one of five sampling events at BRW-072, which is located only 50 ft west of BRW-071 (see Fig. 4.1 for well locations), since 1994.

Although contemporaneous sampling of the monitoring wells in the vicinity of Bldg. K-1580 has not been conducted, it can be seen in Table 4.2 that TCE concentrations are significantly lower at wells BRW-054, BRW-071, BRW-072, and BRW-073 as compared to BRW-053, which is located upgradient of these wells. TCE concentrations drop from an average of 76 μg/L over the five most recent sampling events at BRW-053 to an average of 6 μg/L (using one-half the detection limit for non-detect values) over the five most recent sampling events at BRW-071 and less than 5 μg/L at BRW-072. This represents a ten-fold decline in TCE concentration over a distance of approximately 75 ft in both a southern and western direction from BRW-053. TCE has been detected only once, at an estimated concentration of

Table 4.2. Summary of VOCs detected in groundwater samples from bedrock monitoring wells north of Bldg. K-1580

Analyte (µg/L)	MCL	BRW-038			BRW-053						BRW-054				
		Oct-94	Mar-95	Oct-95	Sep-00	Apr-01	Sep-01	Mar-02	Sep-02	Mar-03	Oct-94	Mar-95	Sep-95	May-98	Jul-98
1,1,1-Trichloroethane	200	100 U	14	25 U	200 U	20 U	2 U	2 U	2	20 U	5 U	5 U	2 U	2 U	5 U
1,2-Dichloroethene	70[a]	49 J	6 J	33	200 U	67	37	30	**130**	43	2 J	4 J	3 J	6	7
Benzene	5	100 U	10 U	25 U	200 U	20 U	2 U	2 U	2 U	20 U	5 U	5 U	1 J	5 U	5 U
Tetrachloroethene	5	**36 J**	3 J	**17 J**	200 U	20 U	2 U	2 U	2 U	20 U	5 U	**8**	**8**	**9**	**13 J**
Trichloroethene	5	**170**	**35**	**120**	200 U	**99**	**44**	**50**	**87**	**100**	**13**	**17**	**13**	**15**	**20 J**
Vinyl chloride	2	200 U	20 U	50 U	100 U	10 U	**3**	1	**7**	10 U	10 U	10 U	10 U	10 U	10 U

Analyte (µg/L)	MCL	BRW-071					BRW-072					BRW-073				
		Oct-94	Mar-95	Oct-95	June-98	Aug-98	Oct-94	Mar-95	Oct-95	June-98	Aug-98	Oct-94	Mar-95	Oct-95	Jun-98	Aug-98
1,1,1-Trichloroethane	200	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloroethene	70[a]	3 J	3 J	2 J	4 J	3 J	5 U	5 U	5 U	5 U	2 U	3 J	3 J	2 J	8 J	3 J
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U	5 U	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	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5	3 J	**6**	5 U	**10 J**	**8 J**	5 U	5 U	4 J	5 U	2 U	**7**	5 U	4 J	**17 J**	5 J
Vinyl chloride	2	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

[a]Represents MCL for the *cis*-1,2-dichloroethene isomer.
BRW = bedrock zone monitoring well.
MCL = maximum contaminant level.
VOC = volatile organic compound.

J = estimated concentration.
U = analyte not detected at indicated concentration.
UJ = analyte not detected at indicated concentration, which is an estimated concentration.
Bold indicates the concentration exceeds the MCL.

4 μg/L, over the five most recent sampling events at BRW-072, which is located approximately 100 ft downgradient of BRW-053. Concentrations of 1,2-DCE show a similar relationship with an order of magnitude decline from BRW-053 (average of 61 μg/L) to the downgradient wells BRW-071 (average of 3 μg/L) and BRW-073 (average of 4 μg/L) and no detects at BRW-072. Natural attenuation may account for the decline in VOC concentrations observed in wells downgradient of BRW-053.

Although, as stated previously, groundwater flow in the bedrock at ETTP cannot be reliably predicted, based on observed concentration distributions and trends, age of the source releases, and hydrogeologic controls, it appears unlikely that VOCs would be transported via groundwater flow to the area of Bldg. K-1580. However, given the natural attenuation processes that would affect the concentrations of VOCs in groundwater, if the transport of contaminated groundwater from the nearest plume to Bldg. K-1580 did occur, it is likely that concentrations would not exceed those observed at BRW-071. Concentrations of TCE and 1,2-DCE have ranged from 6 to 10 μg/L and 2 to 4 μg/L, respectively, between 1994 and 1998 at this well.

4.4 PATH FORWARD FOR EVALUATING THE POTENTIAL FOR VAPOR INTRUSION AT EAST TENNESSEE TECHNOLOGY PARK FACILITIES TARGETED FOR TRANSFER

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. Generally, the *Draft Vapor Intrusion Guidance* is intended for residential settings and does not apply to occupational settings. However, 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 the Community Reuse Organization of East Tennessee (CROET) or other qualified parties.

In accordance with the *Draft Vapor Intrusion Guidance*, and through consultation with representatives from EPA Region 4, DOE-ORO has developed a process to evaluate the potential for vapor intrusion at existing ETTP properties to be transferred to the private sector under a CERCLA Sect. 120(h) Covenant Deferral Request (CDR). The following outlines that process.

ORO, EPA Region 4, and the Tennessee Department of Environment and Conservation (TDEC) agree that vapor intrusion will be addressed in the ETTP Sitewide (groundwater) Record of Decision (ROD). The Sitewide ROD is currently scheduled to be signed by 2007. Until those actions of the ROD related to vapor intrusion are implemented, ORO will implement the following interim measures to ensure that transfer of these properties is protective of human health.

All properties (buildings 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 suited for occupancy (e.g., the telecommunications buildings known as K-1039/K-1039-1).

1. When evaluation of the vapor intrusion pathway is required, ORO will collect soil-vapor samples on the property proposed for transfer, and will proceed as follows:

   a. EPA will review the soil-vapor planned sampling locations prior to implementation.

   b. Two sampling events will be conducted for each property, one during the winter and one during the summer, to account for seasonal variability.

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

   d. If the soil-vapor analytical results are below the trigger levels, interim monitoring may be conducted if building conditions change, and/or at the frequency required (see below for further details).

   e. When the property proposed for transfer is a building, if the soil vapor analytical results are above the trigger levels, discussions will be held with EPA and TDEC to determine if indoor air 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}, etc.).

   f. If the results exceed the preliminary remediation goals (PRGs), the risks will be unacceptable, and the vapor intrusion pathway will be considered complete. If this occurs, 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 results for indoor air samples do not exceed the PRGs, risks will be considered acceptable, and the building will be transferred. 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. When the property proposed for transfer is a land parcel, if the soil vapor analytical results are above the trigger levels, the vapor intrusion pathway will be assumed complete, and the transferee will be required, through the quitclaim deed, to incorporate engineered controls (e.g., engineered barriers) in new building construction plans to ensure protectiveness.

   i. After the initial evaluation (consisting of the winter and summer sampling events), and in accordance with EPA's *Draft Vapor Intrusion Guidance* and/or other appropriate EPA guidance, re-evaluation of the vapor intrusion pathway may be conducted as determined using the risk and hazard equations from the CERCLA risk assessment guidance. This will be done by aggregating the winter and summer sampling results and identifying the maximum detected concentration for each analyte. Next, the risk and hazard equations will be rearranged to solve for the quotient exposure duration. This approach will determine the number of years a worker would need to be exposed to the maximum detected concentrations of VOCs in order to have a cumulative risk of 1.0×10^{-6} or an HI of 1.0 and, hence, the frequency of sampling needed in order to be protective of workers. The detailed approach for determining the interim monitoring frequency is contained in an agreement between EPA Region 4 and ORO titled *Approach to Interim Monitoring of the Vapor Intrusion Pathway for Transferred Facilities at the East Tennessee Technology Park (ETTP)* [DOE 2004]. Additionally, comprehensive changes to the building structure or infrastructure

(e.g., replacement of the heating, ventilating, 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 ORO and, if necessary, ORO 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.

5. RESULTS OF VISUAL AND PHYSICAL INSPECTIONS

5.1 VISUAL AND PHYSICAL INSPECTIONS OF THE PROPERTY FOR TRANSFER

In February 2003, a walkdown of the K-1580 building was conducted by representatives from Science Applications International Corporation and BJC to observe the environmental conditions of the building (SAIC 2003). This chapter documents the observations of this inspection.

The 1st, 2nd, and 3rd floor plans for Bldg. K-1580 are shown in Fig. 5.1. The building is a rectangular-shaped, three-story structure with 12,737 ft^2 on each floor for a total of 38,211 ft^2. It is constructed of reinforced concrete with pre-cast concrete siding.

The floors in the offices, conference rooms, and most of the corridors are carpeted. The stairwells, remaining portions of corridors, and several storage rooms are covered with vinyl floor tiles. The restrooms and janitors' closets have ceramic floor tile. The ceilings are suspended, man-made mineral fiber panels with fluorescent light fixture insets. There is a stairwell on each end of the building, and an elevator is located in the northwest corner.

Due to the date of construction of the building (built in 1980), the fluorescent light fixtures are not suspected to contain polychlorinated biphenyls in the ballast. All insulation in the building is man-made mineral fiber or rubber foam except for 16 linear ft of clay rope-type insulation. A 1994 asbestos survey[8] of the K-1580 building reported the only asbestos-containing materials in the building to be the 16 linear ft of clay rope-type insulation. It is located in the second- and third-floor vaults on the east end of the building. Also, the 2165 ft^2 of 12-in. by 12-in. vinyl floor tile in the building are assumed to contain asbestos. These tiles are in good condition. Due to the date when the building was built, it is improbable that lead-based paint exists in the building.

No evidence was found that any hazardous substances were stored in K-1580 for one year or more in quantities greater than or equal to 1000 kg or their respective CERCLA RQs. No evidence was found that acutely hazardous wastes were stored in K-1580 for one year or more in quantities greater than or equal to 1.0 kg. No evidence was found that any hazardous substances were released or disposed of at K-1580 in quantities exceeding their respective RQs.

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.

Building K-1580 is equipped with a recirculating air-exchange ventilation system. The building is cooled with a chilled water system and heated by a hot-water-circulating heating system located in the Mechanical Room (Room 167) on the 1st floor. A water-cooling tower chills the water for the cooling system, and steam generated by the K-1501 Steam Plant supplies the heat for the hot water system. The water is circulated by pumps to registers throughout the building.

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 used in the building are janitorial supplies, the hydraulic fluid for the elevator, and glycol in the water of the heating and cooling system.

[8]Radian Corporation 1994. *Oak Ridge K-25 Site Building K-1580 Asbestos Survey*, Oak Ridge, TN, September.

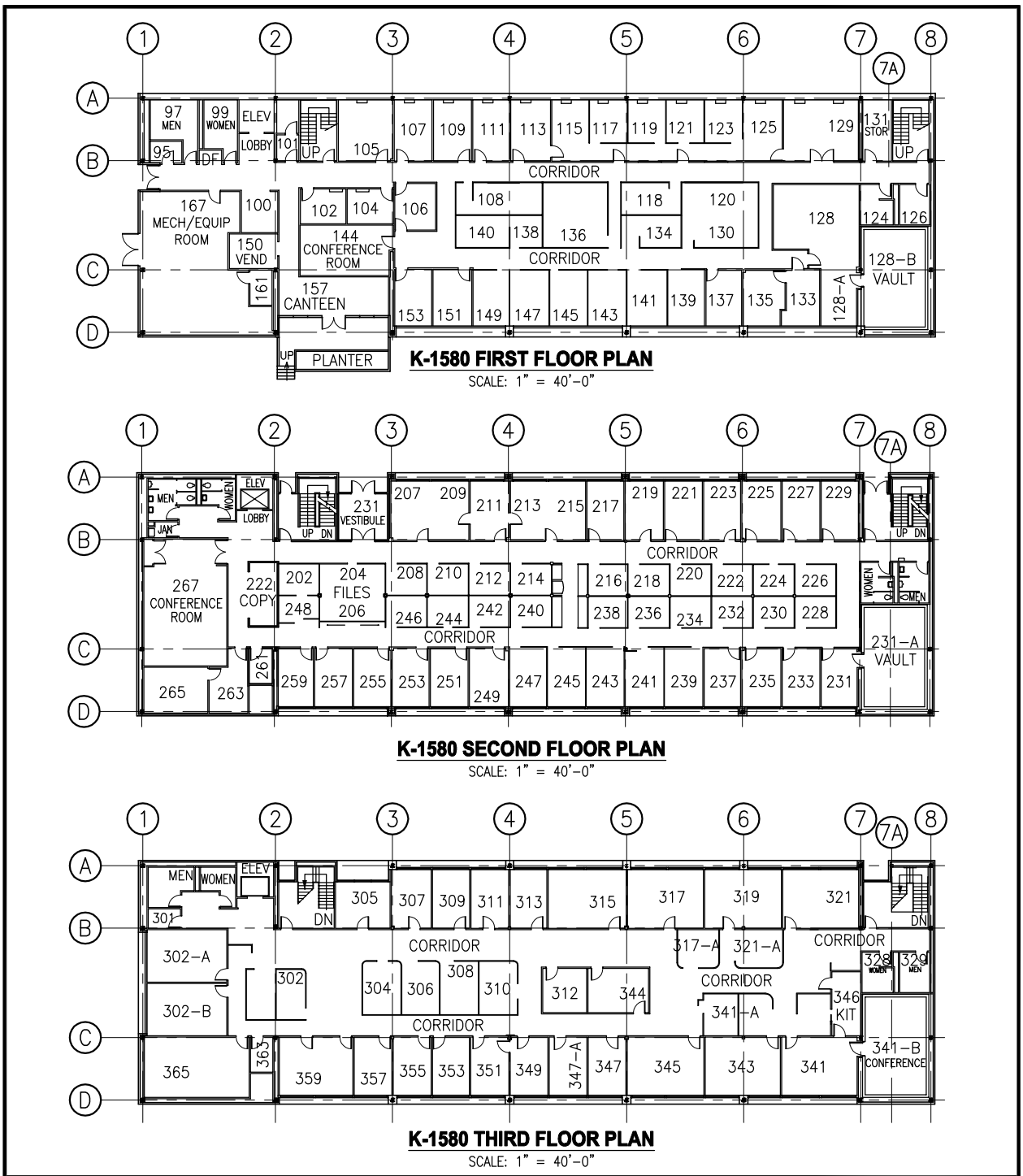


Fig. 5.1. K-1580 first, second, and third floor plans.

Also included in the title transfer are two electrical transformers and a water-cooling tower associated with the chilled-water cooling system of the building. They are located on the west end of Bldg. K-1580. Electricity for K-1580 is provided through two 13.8-kV transformers. The transformers are a dry type and contain no oil. In addition, the surrounding grounds of the transformers and the water-cooling tower are also included for transfer.

5.2 VISUAL AND PHYSICAL INSPECTION OF ADJACENT PROPERTY

The areas adjacent to Bldg. K-1580 are owned by DOE, and an assessment (review of records, reports, and data) determined that actual or potential releases of hazardous substances or petroleum products have not occurred. The nearest area that may contain contamination is the RCW Line Leaks 500 ft to the northwest. Information about this area is documented in Sect. 4.2.

The K-1320 Office Building is the nearest structure to Bldg. K-1580. It is located to the northeast of Bldg. K-1580 and is a two-story structure with a lightweight steel frame and pre-finished aggregate, asbestos/concrete siding. It was built in 1982. In 1984, Bldg. K-1320 was expanded with the addition of K-1320-A. It is constructed like K-1320 except without asbestos in the siding. The two buildings have a total floor space of 13,270 ft^2.

6. SAMPLING RESULTS

6.1 DESCRIPTION OF BUILDING K-1580

The facility proposed for title transfer includes the K-1580 building, the electrical transformers and water-cooling tower to the west, and the underlying property, also known as the underlying fee. In addition to the land under the building, a small area immediately adjacent to the western side of the building and extending around the water-cooling tower and on to the electrical transformers is included for transfer. The K-1580 building has been used for office space since its construction in 1980 and has three floors (12,737 ft^2 on each of the three floors for a total of 38,211 ft^2).

6.2 CHEMICAL AND RADIOLOGICAL SAMPLING

Based on discussions with EPA, it has been agreed that the need to collect soil and groundwater 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.

Based on document reviews of the K-1580 property and adjacent areas, there is no indication that the area has been contaminated from past activities; therefore, no soil samples were collected. Any potential risk that a future tenant may be exposed to is evaluated in the *Risk Screen to Support the Title Transfer of the K-1580 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee*, BJC/OR-1411/R2 (BJC 2004a).

6.2.1 Soil Vapor Sampling

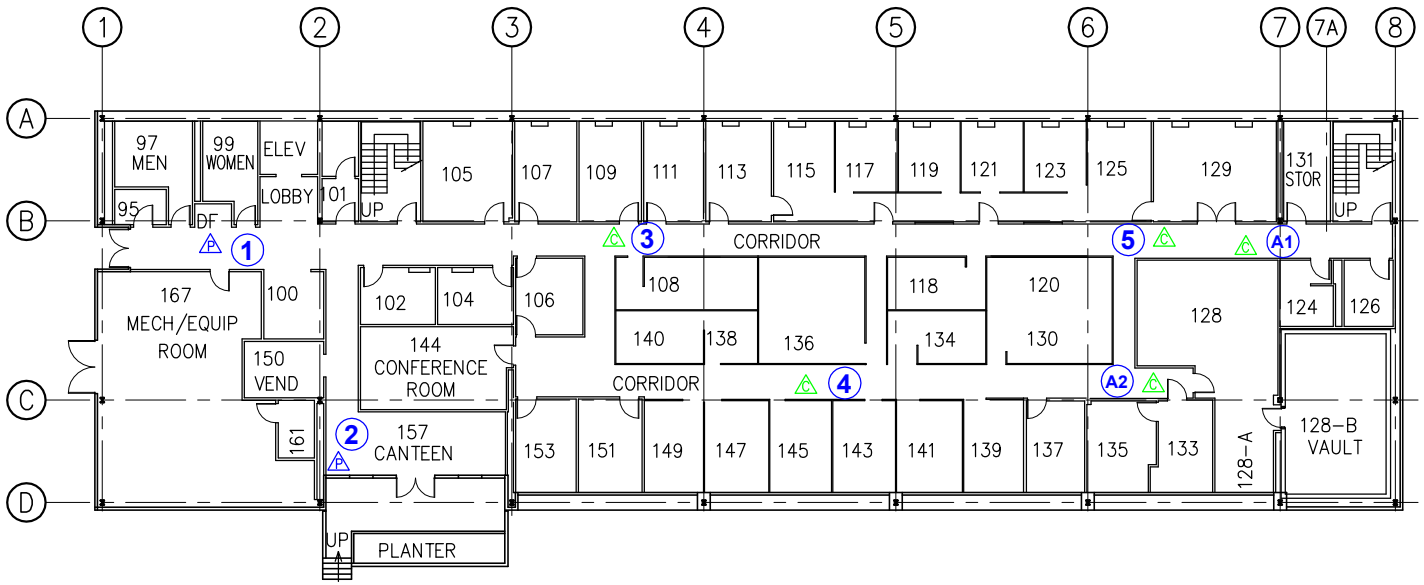
The results of the sampling conducted in the winter months in Bldg. K-1580 are presented below (see Appendix C for the vapor sampling plan). Sub-slab soil vapor was collected on January 16 and January 26, 2004, to determine if a potential source for VOCs exists under the building (see Fig. 6.1). Two sampling efforts were required because during the first sampling event, the drilling met refusal[9] at locations 3 and 5. During the second event, the sample at location 3 was collected successfully. Because the sample at location 5 was planned to provide coverage, during negotiations, DOE and EPA agreed not to collect the sample at location 5 for the winter sampling. To obtain data for that area, two alternate locations were selected for the sampling event planned for the summer of 2004 (see Fig. 6.1). The results for the winter sampling event were validated using standard validation rules. A 100% validation was performed. No data were rejected (i.e., "R" qualified for this project).

If a compound was never detected in any sample, it was considered a non-detect and was not analyzed further. If a compound was detected at least once, all values [including the non-detects at half of their respective detection levels per EPA's *Risk Assessment Guidance for Superfund, Vol. 1: Human Health Evaluation Manual (Part A)*][10] were used to calculate an arithmetic mean concentration. The resulting values were then compared to their respective soil vapor trigger levels (a level deemed to be health protective).

Based on the results of the winter 2004 sampling, no VOC exceeded its respective trigger level (see Table 6.1). In addition, to ensure that the VOCs did not cumulatively exceed trigger levels, the average concentration for each VOC was divided by its respective trigger level to determine what fraction the

[9] "Refusal" occurs when the sampling crew cannot take a sample due to encountering a material that cannot be penetrated by the sampling equipment.

[10] EPA 1989. Interim Final, EPA/540/1-89/002, Office of Emergency and Remedial Response, Washington, D.C., December.



LEGEND:

- PENETRATION FOR SOIL VAPOR SAMPLE SELECTED FOR COVERAGE
- PENETRATION FOR SOIL VAPOR SAMPLE SELECTED BASED ON SUSPECTED PREFERENTIAL PATHWAY
- 2 ..... SAMPLE STATION NUMBER
- A1 ALTERNATE SAMPLE STATION NUMBER IF ANY OF STATIONS 1 THROUGH 5 CAN'T BE COLLECTED

NOTES:

1.) SOIL VAPOR STATIONS 1 AND 2 SELECTED DUE TO PROXIMITY TO POTENTIAL PREFERENTIAL PATHWAY

2.) SOIL VAPOR SAMPLES 3, 4, AND 5 SELECTED FOR AREA COVERAGE

3.) BASE MAP INFORMATION PROVIDED BY TETRA TECH INC.

5.39°±
ETTP GRID
TRUE NORTH
0 10 20 30
SCALE: 1" = 30'

SAIC®
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EAST TENNESSEE TECHNOLOGY PARK
OAK RIDGE, TENNESSEE

DRAWN BY:	REV. NO./DATE:	CAD FILE:
R. BEELER/MEAD	4 / 06-08-04	/00007/DWGS/Q14K1580

Fig. 6.1. Building K-1580 soil vapor sampling locations.

Table 6.1. Sub-slab soil vapor results for Bldg. K-1580

Analyte	Frequency of detection	Minimum detected concentration	Maximum detected concentration	Arithmetic mean concentration	Trigger level[a]	Trigger level exceeded?	Arithmetic mean fraction of trigger level
			Volatile organic compounds (μg/m³)				
1,1,1-Trichloroethane	2/4	7.00E-01	4.00E+00	1.33E+00	3.01E+05	No	4.40E-06
1,1,2,2-Tetrachloroethane	4/4	2.00E-02	7.00E-01	3.05E-01	6.67E+02	No	4.58E-04
1,1,2-Trichloro-1,2,2-trifluoroethane	4/4	2.00E-01	1.00E+00	8.00E-01	4.04E+06	No	1.98E-07
1,1,2-Trichloroethane	3/4	3.00E-01	1.00E+00	5.00E-01	1.91E+03	No	2.61E-04
1,1-Dichloroethane	0/4	ND[b]	ND	ND	6.88E+04	NA[c]	NA
1,1-Dichloroethene	0/4	ND	ND	ND	7.55E+02	NA	NA
1,2-Dichloroethane	4/4	1.00E-01	3.00E-01	2.50E-01	1.43E+03	No	1.75E-04
1,2-Dichloroethene	0/4	ND	ND	ND	3.95E+03	NA	NA
1,2-Dichloropropane	4/4	1.00E-01	6.10E+01	1.54E+01	5.45E+02	No	2.82E-02
2-Butanone	2/4	2.00E+00	5.00E+00	3.25E+00			4.75E-06
2-Hexanone	2/4	8.00E-01	2.00E+00	2.70E+00	2.51E+04	No	1.08E-04
4-Methyl-2-pentanone	0/5	ND	ND	ND	4.06E+05	NA	NA
Acetone	5/5	5.00E-01	5.20E+02	1.25E+02	4.13E+05	No	3.03E-04
Benzene	4/4	2.00E+00	3.30E+02	8.65E+01	4.05E+03	No	2.14E-02
Bromodichloromethane	2/4	1.00E+00	4.00E+00	1.43E+00	2.62E+03	No	5.44E-04
Bromoform	0/4	ND	ND	ND	1.39E+04	NA	NA
Bromomethane	0/4	ND	ND	ND	6.89E+02	NA	NA
Carbon disulfide	2/4	2.00E-01	7.40E+02	1.85E+02	9.31E+04	No	1.99E-03
Carbon tetrachloride	4/4	2.00E-01	1.00E+00	8.00E-01	3.35E+02	No	2.39E-03
Chlorobenzene	2/4	1.00E-01	2.00E+00	6.50E-01	2.75E+03	No	2.36E-04
Chloroethane	0/4	ND	ND	ND	1.38E+06	NA	NA
Chloroform	2/4	2.40E+01	3.20E+01	1.41E+01	1.62E+03	No	8.72E-03
Chloromethane	2/4	3.00E-01	2.00E+00	6.25E-01	1.24E+04	No	5.04E-05
Dibromochloromethane	0/4	ND	ND	ND	1.26E+04	NA	NA
Ethylbenzene	4/4	1.00E+00	1.60E+01	5.25E+00	3.49E+04	No	1.50E-04
Methylene chloride	4/4	2.00E+00	1.70E+02	4.58E+01	7.92E+04	No	5.78E-04
Styrene	4/4	5.00E-01	1.90E+02	5.21E+01	1.38E+05	No	3.77E-04
Tetrachloroethene	4/4	4.00E-01	4.00+00	2.35E+00	6.66E+04	No	3.53E-05
Toluene	4/4	4.00E+00	2.90E+02	8.20E+01	5.39E+04	No	1.52E-03
Total Xylene	4/4	1.00E+00	2.10E+02	6.28E+01	1.38E+04	No	4.53E-03
Trichloroethene	3/4	6.00E-01	7.00E+00	2.21E+00	5.45E+03	No	4.06E-04
Vinyl chloride	1/4	2.00E+01	2.00E+01	5.11E+00	4.23E+03	No	1.21E-03

Table 6.1. Sub-slab soil vapor results for Bldg. K-1580 (continued)

Analyte	Frequency of detection	Minimum detected concentration	Maximum detected concentration	Arithmetic mean concentration	Trigger level[a]	Trigger level exceeded?	Arithmetic mean fraction of trigger level
cis-1,2-Dichloroethene	1/4	2.00E-01	2.00E-01	2.00E-01	4.81E+03	No	4.15E-05
cis-1,3-Dichloropropene	0/4	ND	ND	ND	2.80E+03	NA	NA
trans-1,2-Dichloroethene	0/4	ND	ND	ND	9.67E+04	NA	NA
trans-1,3-Dichloropropene	2/4	2.00E-01	3.00E+01	7.68E+00	4.91E+03	No	1.56E-03
						Sum of fractions	7.52E-02

[a]Trigger level was developed with the Johnson-Ettinger (JE) model, assuming an indoor air preliminary remediation goal based on risk level of 1E-5 and hazard index of 0.1 for industrial exposure (250 d/year, 25 years).

[b]ND = non-detection.

[c]NA = not applicable; no detected concentrations.

concentration represented. The resulting fractions were then added for all VOCs that had at least one detection. If, collectively, the VOC concentrations had exceeded the trigger levels, the resulting value would be above 1.0 (i.e., the fractions would add up to over 1.0). As shown in Table 6.1, the value is not above 1.0 for Bldg. K-1580.

Based on the winter 2004 sampling event, the results and comparisons presented show that the vapor intrusion pathway is not complete beneath Bldg. K-1580, and, thus, there is no adverse impact to human health (BJC 2004b). This determination will be confirmed with a summer 2004 soil vapor sampling event, which has been completed, and the results will be posted on the World Wide Web.

6.3 RADIOLOGICAL SURVEYS

Radiological surveys were conducted on the interior and exterior surfaces of Bldg. K-1580, the building contents, the exterior sidewalk, the electrical transformers, the water-cooling tower, and grounds that surround the exterior equipment. See Figs. 6.2 and 6.3 for the interior and exterior survey areas, respectively. This section presents and discusses the current radiological survey data that have been collected and reported in ETTP/PEM-0223, *Radiological Survey Report for the Transfer of the K-1580 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee, to the Community Reuse Organization of East Tennessee* (BJC 2003b). 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 results.

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-1580 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 could be potentially contaminated via tracking from enrichments of less than 3%.[11] As this, however, 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 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 the vicinity of Bldg. K-1580, based upon its history as an administrative facility. If they were present, it is assumed that these other radionuclides 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 Radiological Control (RADCON) electronic survey data collected since 1996 indicated that five radiological surveys have been performed inside the building. A review of these surveys provided a basis for the classification of the individual survey units, and the results are provided for informational purposes only.

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

[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.

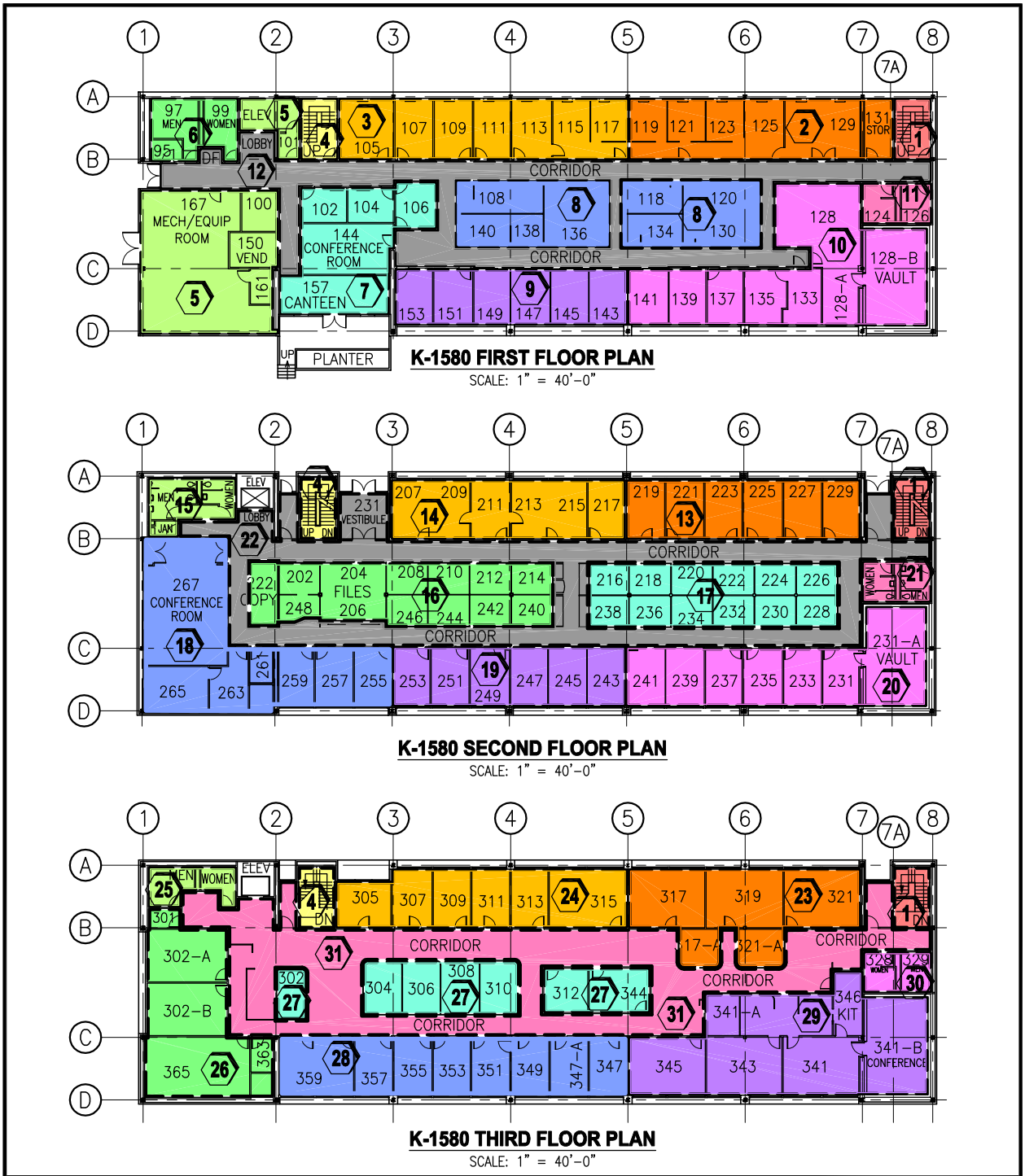

Fig. 6.2. K-1580 interior survey units.

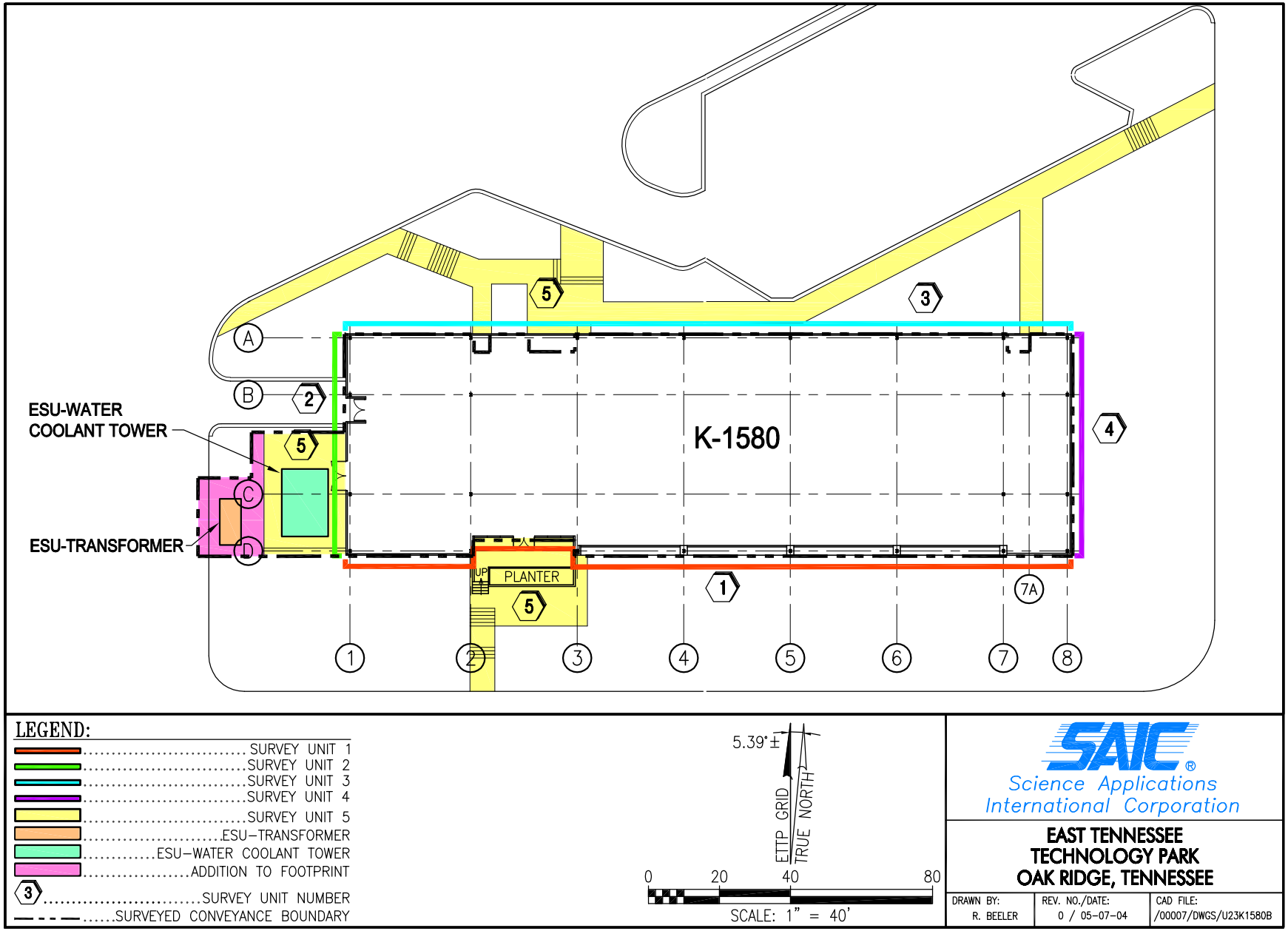

Fig. 6.3. K-1580 exterior survey units.

Two surveys were conducted in the building on the third floor, one in 1996 and the other in 1998 because of the presence of pregnant workers. No activity was detected above background levels, and the dose equivalent rates ranged from 3 to 5 μrem/h (microrem per hour). A survey on the third floor was conducted in July 1998 after a safe that had been moved to another building from K-1580 was found to have removable contamination on its base. No radioactivity was detected above background levels, and the dose equivalent rates ranged from 4 to 7 μrem/h. The identification of the radioisotopes making up the contamination was not evaluated. In 1999, during a scoping survey of several buildings for another project, large area wipes (LAWs) over an approximate area of 1 m^2 were taken at all entrances of the building, and dose rates were taken throughout the hallways. No activity above background levels was detected on the LAWs. The dose equivalent rates ranged from 3 to 5 μrem/h.

Also in 1999, a survey of the floors of the building was performed using a computerized, position-sensitive detector system by Shonka and Associates.[13] The maximum surface activity level measured by the Shonka survey was 1671 alpha disintegrations per minute per 100 square centimeters (dpm/100 cm^2); for comparison, the acceptable DOE uranium surface activity level for non-radiological facilities is 5000 alpha dpm/100 cm^2. The highest activity level was associated with tape on newly installed carpet. Gross gamma scans of doorways, halls, and other main traffic areas were also performed at this time; these scans did not identify locations of potential contamination and indicated equivalent gamma exposure rates in the approximate range of 4 to 10 μrem/h, which is consistent with previous survey findings and comparable to typical ambient background levels inside masonry structures.

A total of 35 equipment/furnishings surveys were performed in the K-1580 building. This included surveys of desks, chairs, computer equipment, carpet, and various hand tools. No activity was detected above background levels for all surveys. In 1999, as a part of the scoping survey of several buildings by another project, two statistical surveys of the furnishings were performed, with the readings given in gross (uncorrected for background) counts per minute. All readings associated with these surveys were at background levels.

6.3.2 Current Surveys

A total of 105 surveys (including all associated QA/QC surveys) were conducted in the study area (Table 6.2). See Fig. 6.1 for the locations of the first, second, and third floor interior survey units (ISUs)[14] and Fig. 6.2 for the exterior survey units (ESUs). These surveys were performed from November 27 to December 20, 2002, in accordance with ETTP RADCON procedures,[15] the survey design document (hereafter referred to as the "design document"), and the survey plan (see Appendix D). These surveys also include a supplemental survey of ancillary equipment (transformers and a cooling tower that support the operation of the building), located at the exterior of Bldg. K-1580, which was performed on December 19, 2002. Also listed in Table 6.2 is a survey performed of grounds in May 2004.

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.

[13]"Rollback Program: Survey of the Twenty-Eight Discreet Areas," Shonka Research Associates, Inc., and Millenium Services, Inc., Marietta, GA, November 1999.

[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.

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

Table 6.2. ETTP current radiological survey numbers

20021127KA36145001	20021205KA36155002	20021209PA01388005	20021213KA36145001
20021202002082600 4	20021205KA36155003	20021209PA01388008	20021213PA01388001
20021202002082600 5	20021205KA36155004	20021210PA01388001	20021213PA01388002
20021202002082600 6	20021205KA36155005	20021210PA01388002	20021213PA01388003
20021202PA01388001	20021205KA36155007	20021210XA50370001	20021213T3TDESK001
20021202PA01388002	20021205KA36155008	20021211KA36145001	20021213XA50370001
20021202PA01388004	20021205PA01388001	20021211KA36145002	20021213XA50370002
20021202PA01388005	20021205PA01388002	20021211KA36145003	20021216KA36145001
20021202PA01388006	20021205XA50370001	20021211KA36145004	20021216KA36145002
20021202XA50370001	20021206KA36145002	20021211KA36155001	20021216KA36145003
20021202XA50370002	20021206KA36155001	20021211KA36155002	20021216KA36145004
20021202XA50370003	20021206KA36155002	20021211PA01388001	20021216KA36145005
20021202XA50370004	20021206KA36155003	20021211PA01388002	20021217KA36145001
20021203KA36145001	20021206KA36155004	20021211PA01388003	20021217KA36145002
20021203KA36145002	20021206PA01388001	20021211XA50370001	20021217KA36145003
20021203KA36145003	20021206PA01388002	20021211XA50370002	20021217KA36145005
20021203KA36155003	20021206PA01388003	20021212PA01388001	20021217KA36145008
20021203PA01388001	20021209202933500 4	20021212PA01388002	20021217PA01388001
20021203PA01388002	200212093CEDESK001	20021212PA01388003	20021217PA01388002
20021203PA01388003	20021209KA36155001	20021212PA01388004	20021217PA01388003
20021203XA50370001	20021209KA36155002	20021212PA01388005	20021217PA01388004
20021204KA36155001	20021209KA36155003	20021212PA01388006	20021217XA50370001
20021204PA01388001	20021209KA36155004	20021212XA50370001	200212183CEDESK001
20021204XA50370001	20021209PA01388002	20021212XA50370002	20021219PA01388002
20021205002082600 4	20021209PA01388003	20021212XA50370003	200212203CEDESK001
20021205KA36145002	20021209PA01388004	20021212XA50370004	200212203CEDESK002
20021205KA36155001			200405170023053001

Hand-held meter survey results were taken and compared to the following values (Table 6.3), which are the appropriate 10 *Code of Federal Regulations* 835[16] and DOE Order 5400.5[17] 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 6.3. 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	5,000	1,250	15,000
Removable alpha	1,000	250	N/A
Total beta-gamma	5,000	1,250	15,000
Removable beta-gamma	1,000	250	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.

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

[17]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.

Each survey unit dataset 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 [i.e., the null hypothesis, (H_o), that the residual contamination in each of the individual survey units exceeds the survey unit DCGL, was rejected]. 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 m^2 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-1580 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 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 usage 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 on the survey; 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 survey of each survey unit, using a Bicron MicroRem® meter,[18] 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.

Six of the ISUs had results above 25% of the DCGL. All six had maximum total beta-gamma activities above 1250 dpm/100 cm^2. The highest value obtained was 1926 dpm/100 cm^2. All of these results were obtained in restrooms or other rooms that contained a glazed, clay-tile floor. Some of the elevated readings were also obtained on porcelain sinks. The screening limit established in the survey plan is 3500 dpm/100 cm^2 for such materials. Therefore, all results were less than the screening level for Class 3 areas. 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, including QA/QC surveys, all total activities were less than 550 dpm/100 cm^2 total alpha and 1930 dpm/100 cm^2 total beta-gamma, with all removable contamination results less than 8.1 dpm/100 cm^2 removable alpha and 74.8 dpm/100 cm^2 removable beta-gamma. The maximum tissue-equivalent dose rate was 7 μrem/h. See Table 6.4 for the summary of the survey results for all ISUs.

[18]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 6.4. Summary of contamination and dose rates for the K-1580 study area

Location	Alpha total (dpm/100 cm^2)		Alpha removable (dpm/100 cm^2)		Beta-gamma total (dpm/100 cm^2)		Beta-gamma removable (dpm/100 cm^2)		Dose equivalent rate (mrem/h)
	Min	Max	Min	Max	Min	Max	Min	Max	
Interior Survey Units									
ISU 1	< 0	46.62	< -2.69	2.69	< -372.36	310.3	< -11.1	21.52	.003 – .004
ISU 2	< 0	43.95	< 0	5	< -293.85	359.15	< -2.77	64.0	.003 – .005
ISU 3	14.65	542	< 0	5.0	< -848.9	< -97.95	< -2.77	55.0	.003 – .005
ISU 4	< 0	59	< 0	2.69	< -32.65	718	5.54	44.0	.003 – .004
ISU 5	< 0	88	< -2.69	< 2.69	< -97.95	555	< -13.9	< 24.93	.002 – .004
ISU 6	< -30.2	136.0	< 0	5	< -63.18	1800	< -69.25	< 22.16	.004 – .005
ISU 7	< 0	58.6	< 0	< 2.69	< -489.75	< 261.2	< -47.1	< 13.85	.003 – .004
ISU 8	< 14.65	163	< -5.38	< 2.69	< -587.7	< 195.9	< -47.1	< -8.31	.002 – .004
ISU 9	< -14.65	< 29.39	< -5	5	< -261.2	490	< -47.1	< 19.39	.003 – .005
ISU 10	< 14.65	87.9	< 0	< 2.69	< -32.65	783.6	< -27.7	< 27.7	.003 – .006
ISU 11	29.3	117.2	< -5.38	< 0	97.95	1534.6	< -52.6	< -16.6	.005
ISU 12	< 14.65	74	< -5.38	< 0	< -326.5	< 489.25	< -33.2	< 0	.003 – .004
ISU 13	< -14.65	44	< -8.07	2.69	< -457.1	< 424.45	< -38.8	< -2.77	.003 – .005
ISU 14	< 0	43.95	< 0	< 2.69	< -261.2	< 359.15	< -58.2	< -8.31	.002 – .005
ISU 15	< 0	58.6	< -2.69	< 2.69	< 424.45	1828.4	< -52.63	< 74.79	.003 – .005
ISU 16	< 0	58.6	< -2.69	< 2.69	< -359.15	< 228.55	< -74.8	< 16.62	.003 – .005
ISU 17	< 14.65	59	< -8.07	< 0	< -261.2	< 195.9	< -47.1	< 0	.003 – .005
ISU 18	< 0	59	< -5.38	< 0	< -97.95	< 359.15	< -33.2	< 8.31	.004 – .005
ISU 19	< 0	59	< 0	8	< -457.1	< 195.9	< -5.54	< 41.55	.003 – .004
ISU 20	< 0	59	< 0	5.0	< -65.3	522	< -33.24	66	.002 – .005
ISU 21	< 14.65	73.25	< 0	< 5.38	< 391.8	946.85	< 2.77	< 38.78	.004
ISU 22	< 0	44	< -2.69	5.0	< -457.1	< 97.95	< -16.0	< 30.47	.002 – .004
ISU 23	< 0	59	< -2.69	5.0	< -97.95	620	< -5.54	61.0	.003 – .005
ISU 24	< 14.65	58.6	< -2.69	< 2.69	< -130.6	< 326.5	< -5.54	< 44.32	.003 – .004
ISU 25	< 29.3	147	< -2.69	< 0	718	1535	< 13.85	55.4	.005
ISU 26	< 0	59	< -5.38	< 2.69	< -326.5	1600	< -36.01	< 16.62	.003 – .005
ISU 27	< -14.65	< 0	< -5.38	8.07	< -228.55	< 195.9	< -38.8	< 24.93	.003 – .005
ISU 28	< 14.65	44	< -5.38	8.0	< -293.85	555	< -38.8	< 16.62	.003 – .005
ISU 29	< -14.65	< 43.95	< -5.38	< 2.69	< -457.1	< 359.15	< -24.9	< 19.39	.003 – .004
ISU 30	< 14.65	< 29.3	< -5.38	< 2.69	1273.4	1926.4	< -33.24	< 16.62	.004 – .005
ISU 31	< -14.65	< 29.3	< -5.38	< 2.69	< -555.05	< 326.5	< -44.3	< 27.7	.003 – .004

Table 6.4. Summary of contamination and dose rates for the K-1580 study area (continued)

Location	Alpha total (dpm/100 cm^2)		Alpha removable (dpm/100 cm^2)		Beta-gamma total (dpm/100 cm^2)		Beta-gamma removable (dpm/100 cm^2)		Dose equivalent rate (mrem/h)
	Min	Max	Min	Max	Min	Max	Min	Max	
Exterior Survey Units									
ESU 1	< 0	58.6	< -8.07	< 0	< -97.95	588	< 0	64	.004 – .006
ESU 2	< 0	14.65	< -8.07	< 0	< -293.85	359.15	2.77	36.01	.003 – .005
ESU 3	< 0	< 29.3	< -5.38	2.69	< -32.65	< 293.85	< 5.54	< 36.01	.003 – .005.
ESU 4	< 0	< 0	< -5.38	< 0	< -130.6	< 424.45	< -19.4	<44.32	.004 – .007
ESU 5	< 14.65	102.55	< -8.07	< 2.69	< -97.95	< 522.4	< -5.54	< 30.47	.003 – .005
ESU Roof	< 0	105	< 0	< 2.43	< 13.59	2432	< -33.0	< 35.88	.002 – .005
ESU Roof – Class 2	< 0	106	< 0	8.0	479	1301	< -32.3	< 8.31	.002 – .005
ESU Transformer	< 0	44	< -2.69	5.0	< -555	588	< -38.8	< 24.93	NR[a]
Water Coolant Tower	< 0	147	< -2.69	< 2.69	< -555.05	718	< -30.5	< 36.01	.003 – .004
Furnishings Survey Units – Class 3									
FSU 2	< -14.7	44	< 0	< 2.43	< -549.1	< 86.7	< 0	84	NR[b]
FSU 3	< -29.4	< 14.7	< 0	< 2.43	< -375.7	< 404.6	< -8.97	65.78	NR[b]
FSU 5	< 0	58.8	< 0	< 2.43	< -606.9	< 0	< 20.93	50.83	NR[b]
FSU 7	< -15.1	< 15.1	< 0	5.0	< -284.31	< 473.85	< -24.93	< 13.85	NR[b]
FSU 8	< -15.1	60	< 0	5.0	< -315.9	< 252.72	< -30.47	< 27.7	NR[b]
FSU 9	< -15.1	30	< 0	9.72	< -315.9	600	< -38.87	< 26.93	NR[b]
FSU 10	< -15.1	106	< 0	8.0	< -379.08	< 126.36	< -30.47	< 16.62	NR[b]
FSU 12	< 0	< 46.62	< -5.38	< 2.69	< -217.21	< 186.18	< -24.93	< 33.24	NR[b]
FSU 13	< -31.08	< 62.16	< -5.38	< 0	< -310.3	< 186.18	< -24.93	52.63	NR[b]
FSU 14	< 0	62.16	< -5.38	< 2.69	< -186.18	< 248.24	< -16.62	< 27.7	NR[b]
FSU 16	< 14.65	73.25	< -2.69	< 0	< -391.8	< 359.15	< -33.24	< 11.08	NR[b]
FSU 17-1	< -15.54	62.16	< -5.38	< 2.69	< -217.21	403.39	< -22.16	47.09	NR[b]
FSU 17-2 Offices	< 0	< 29.3	< -2.69	< 2.69	< -228.55	< 457.1	< -27.7	< 33.24	NR[b]
FSU 18	< 0	< 46.62	< -2.69	5.38	< -248.24	558.54	< -22.16	< 30.47	NR[b]
FSU19	< 0	< 46.62	< -2.69	5.38	< -837.81	< 217.21	< -24.93	< 44.32	NR[b]
FSU 20	< -15.54	< 31.08	< -2.69	< 2.69	< -341.33	< 310.3	< -36.01	< 24.93	NR[b]
FSU 22	< -14.65	43.95	< -2.69	2.69	< -97.95	457.1	< -38.78	38.78	NR[b]
FSU 23	< 14.65	< 29.3	< -2.69	< 0	< -424.45	< 130.6	< -47.89	< 36.01	NR[b]
FSU 24	< 0	< 29.3	< -2.69	5.0	< -261.2	< 163.25	< -49.86	< 24.93	NR[b]
FSU 26	< 0	73	< -2.69	< 2.69	< -163.25	620	< -44.32	< 30.47	NR[b]
FSU 27	< -29.3	103	< -2.69	< 0	< -359.15	< 228.58	< -44.32	< -8.31	NR[b]
FSU 28	< 14.65	103	< -2.69	< 0	< -195.9	< 228.55	< -38.78	< 0	NR[b]
FSU 29	< 0	58.6	< -5.38	< 2.69	< -685.65	< 32.65	< -60.94	< 19.39	NR[b]
FSU 31	< -14.65	59	< -2.69	5.0	< -457.1	< 163.25	< -49.86	< 36.01	NR[b]
Transformer	< -13.26	< 13.26	< 0	< 2.69	< 171.2	< 308.16	< 8.31	< 24.93	NR[b]

Table 6.4. Summary of contamination and dose rates for the K-1580 study area (continued)

Location	Alpha total (dpm/100 cm^2)		Alpha removable (dpm/100 cm^2)		Beta-gamma total (dpm/100 cm^2)		Beta-gamma removable (dpm/100 cm^2)		Dose equivalent rate (mrem/h)
	Min	Max	Min	Max	Min	Max	Min	Max	
Furnishings Survey Units – Class 2									
FSU 2	< -46.68	< 15.56	< -2.69	< 2.69	< 56.52	508.68	< -19.39	< 41.55	NR[b]
FSU 3	< -46.68	< 31.12	< -2.69	< 2.69	< -367.38	480.42	< -24.93	< 38.78	NR[b]
FSU 5	< -31.12	< 31.12	< -2.69	< 2.69	< -339.12	< 254.34	< -19.39	< 27.7	NR[b]
FSU 7	< -15.1	30	< 0	5.0	< -189.54	< 284.31	< -24.93	< 16.62	NR[b]
FSU 8	< -15.1	60	< 0	< 2.69	< -284.3	< 252.71	< -33.24	< 30.47	NR[b]
FSU 9	< -15.1	30	< 0	5.0	< -379.08	< 189.54	< -26.91	< 8.97	NR[b]
FSU 10	< 0	45	< 0	5.0	< -379.08	< 157.95	< -19.39	< 19.39	NR[b]
FSU second Floor	< 0	44	< -2.69	< 2.69	< 0	424	< -22.16	< 24.93	NR[b]
FSU third Floor	< 0	59	< -2.69	< 2.69	< -522.4	< -97.95	< -27.7	< 38.78	NR[b]
Grounds Survey Unit – Class 3									
GSU 1	NA	NA	NA	NA	NA	NA	NA	NA	.005 – .008
DOE limits	5000		1000		5000		1000		20

Notes: All readings are in units of disintegrations per minute per 100 square centimeters (dpm/100 cm^2).
A "<" preceding a value indicates that the result cannot be distinguished from background at the 95% confidence level.
This table does not include results from quality assurance/quality control surveys.
DOE = U. S. Department of Energy.
ESU = exterior survey unit.
FSU = furnishings survey unit.
GSU = grounds survey unit.
ISU = interior survey unit.
NR = no reading (was taken).
[a]The transformer is immediately adjacent to the cooling tower; therefore, the cooling tower data applies to the transformer as well.
[b]Dose rate measurements for furnishings are part of the dose rates for the individual survey units that contain the furnishings.

6.3.2.2 Exterior survey units

All exterior areas were initially classified as Class 3 ESUs 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 for which that the survey technician's professional judgment would indicate a higher probability of finding elevated readings. The building exterior walls and roof were covered under the survey plan. In addition, there are two pieces of ancillary equipment located on the exterior of Bldg. K-1580 that support the operation of the building and will be included in the title transfer. This equipment, an electrical transformer and a water coolant tower, was included in a supplemental survey conducted in December 2002 and will be designated as ESU-Transformer and ESU-Water Coolant Tower. Another transformer was included as a furnishings survey unit (FSU). 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. Tissue-equivalent dose rates were required every 20 ft per the survey plan. 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.

Most beta-gamma readings taken on the exterior of the building were less than 1250 dpm/100 cm^2 total activity. However, there were several locations on the roof that had a total beta-gamma activity that exceeded 1250 dpm/100 cm^2. The highest result obtained was 2432 dpm/100 cm^2. Therefore, the roof was reclassified as Class 2, and additional surveys were performed with a scan coverage percentage of 50% and 11 static measurements made according to a systematic survey grid starting at a random point (see Fig. 6.4). The highest result obtained from the Class 2 survey was 1301 dpm/100 cm^2. Because all results were less than the screening level for Class 3 and Class 2 units, no further statistical analysis was performed. From an inspection of the individual surveys, including QA/QC surveys, all total activities were less than 150 dpm/100 cm^2 total alpha and 2440 dpm/100 cm^2 total beta-gamma, with all removable contamination results less than 10 dpm/100 cm^2 removable alpha (from a QA/QC measurement) and 70 dpm/100 cm^2 removable beta-gamma. The maximum tissue-equivalent dose rate was 7 μrem/h. See Table 6.4 for the summary of the survey results for all ESUs.

6.3.2.3 Furnishings survey units

All 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 one 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 113 dpm/100 cm^2 total alpha and 630 dpm/100 cm^2 total beta-gamma, with all removable contamination results less than 15 dpm/100 cm^2 removable alpha and 90 dpm/100 cm^2 removable beta-gamma. See Table 6.4 for the summary of the survey results for all FSUs.

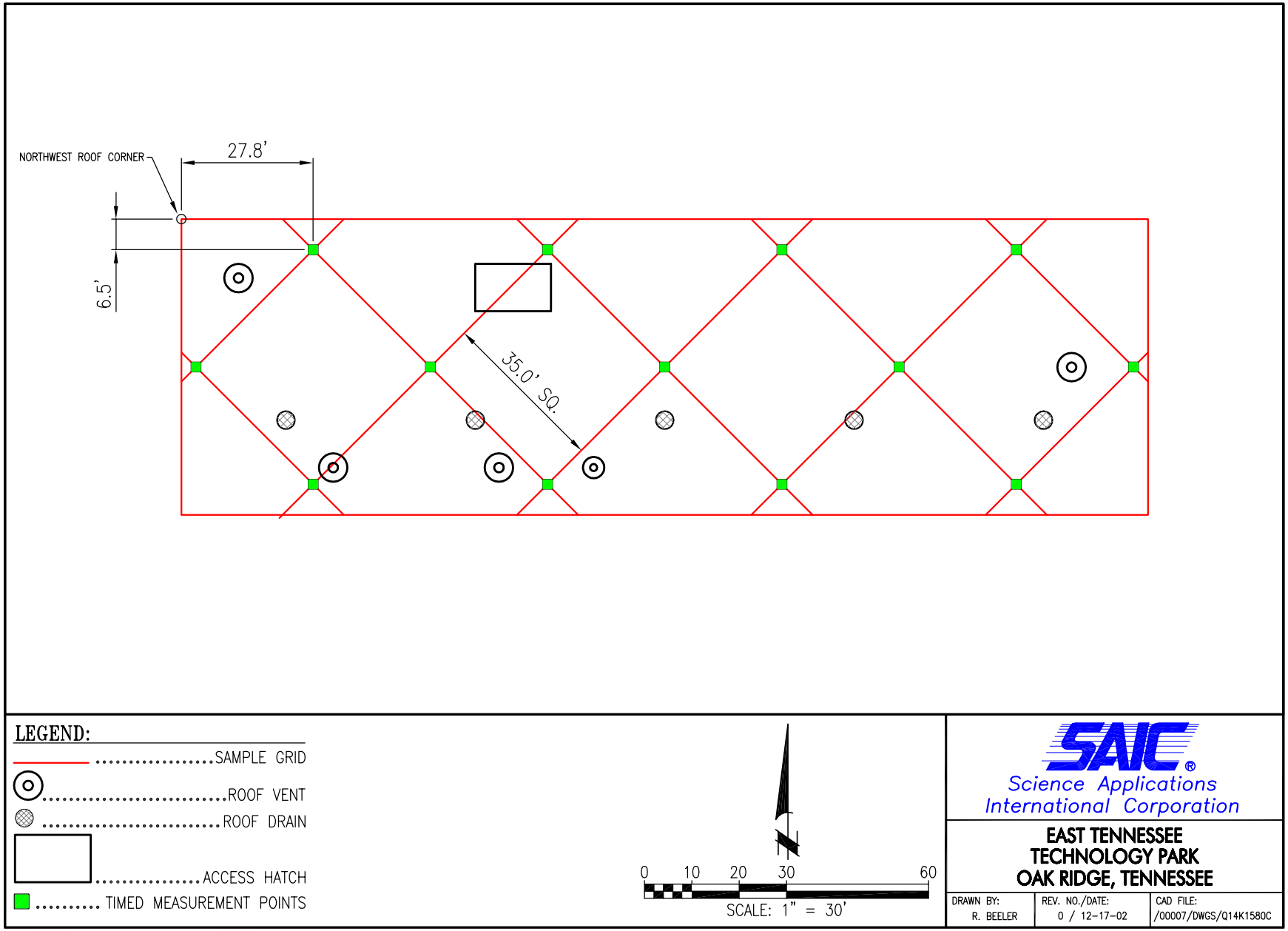

Fig. 6.4. K-1580 roof survey grid.

6.3.2.4 Grounds survey unit

After the initial survey and the supplemental survey of exterior equipment had been completed, it was determined that grounds that are located on the exterior of Bldg. K-1580 and that surround the exterior equipment will be included in the title transfer. Therefore, the relevant grounds were surveyed as grounds survey unit (GSU) 1 (see Fig. 6.5). No random soil sampling of GSUs was performed. A sodium iodide walkover survey was performed to identify locations for biased soil sampling. No readings were over three times the established background; thus, no biased soil samples were collected (per the addendum survey plan; see D.1). Tissue-equivalent dose rates ranged from 5 to 8 μrem/h.

6.3.2.5 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 within the uncertainty of the measurements.

6.3.3 Survey Data Review and Analysis

All of these survey data were reviewed by a health physicist (HP) prior to use in this report. All surveys were conducted in accordance with the survey plan per the BJC team HP (correct number of survey units, data points per survey unit, instrumentation data, QA/QC survey performed, etc.).

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, present furnishings, exterior equipment, and grounds surrounding the equipment are below the DOE surface contamination limits and within the acceptable dose equivalent rate range for building surfaces. The null hypothesis was rejected for each survey unit based upon the non-parametrical statistical Sign test. Therefore, the alternative hypothesis (H_a) is 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.

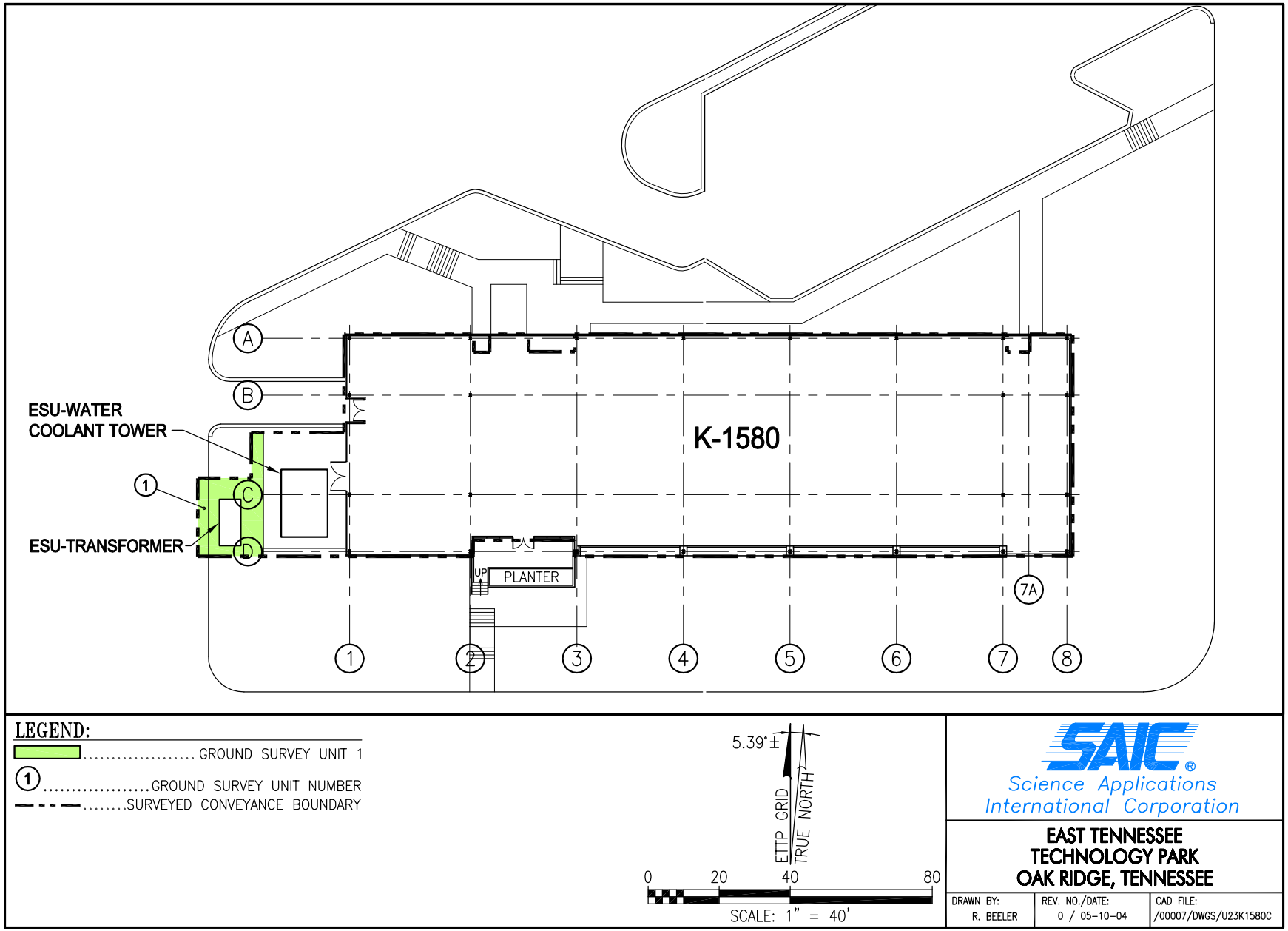

Fig. 6.5. Grounds survey units for Bldg. K-1580.

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Attachment 1

Comments and Responses for the K-1580 Environmental Baseline Survey and Risk Screen Reports to Support Transfer of K-1580

COMMENTS AND RESPONSES FOR THE K-1580 ENVIRONMENTAL BASELINE SURVEY AND RISK SCREEN REPORTS TO SUPPORT TRANSFER OF K-1580

Note: The comments received from the U. S. Environmental Protection Agency (EPA), Region 4, in May 2003 were made after reviews of the K-1007 and K-1330 Environmental Baseline Surveys (EBSs) and Risk Screens and the Supplement to the Parcel ED-5 East Baseline Environmental Analysis Report. These documents were considered to be representative documents for title transfers at the East Tennessee Technology Park. The comments are considered to be general guidance; therefore, the general comments below have been applied to the K-1580 EBS and Risk Screen.

EBS Comments Received May 2003

Numerous comments were made regarding the level of detail and information to be included in EBS reports for properties proposed for title transfer. Additional information in response to these comments appears throughout the EBS, including the Executive Summary and Chaps. 2, 3, 4, and 5. The comments included the following:

- Include a conclusion section noting any land use restrictions, recommending future actions, and showing any regulator comments and their responses.

- Include a regulatory summary in Chap. 3 indicating if the records showed any tanks, etc., permit violations, etc.

- Include information from the section about past and present activities (Sect. 4.1) in the Title Search section as well. Describe how the search was conducted. Describe the past use (land use) of the site.

- Include information on the past use of the property and the regulatory environment in Sect. 3.1. For example, note that the past use of the property was agricultural prior to acquisition by the U. S. Government. For the regulatory environment, note that from its initial use in 1943 until the 1980s, activities on the property occurred under DOE authority and were not subject to external regulation.

- Note, in Chap. 1, if interviews were conducted. If none were conducted then explain why.

- In Chap. 5, discuss not only the presence but also the absence (based on record reviews, etc.) of items such as asbestos, lead paint, and asbestos-containing material (ACM). Note the condition of these items. Especially note the presence of friable asbestos and known polychlorinated biphenyl (PCB) items.

- Include maps that show the locations of groundwater monitoring wells, with the wells labeled.

- Revise Chap. 6 to note that risks were within the acceptable range.

The EPA questioned whether the U. S. Department of Energy's (DOE's) Reindustrialization activities were considered in the Land Use Control Implementation Plan (LUCIP). The LUCIP is a plan regarding how workers will be protected (e.g., deed restrictions) from residual contamination under the Land Use Control Assurance Plan. The LUCIP was developed by Environmental Management (EM) and the responsibility for implementation rests with EM. DOE's Office of Legacy Management has the mission to manage the Department's post-closure responsibilities and ensure the future protection of human health and the environment (see http://www.lm.doe.gov/).

Updating information about vapor intrusion issues was requested. Section 4.4 has been added to describe: (1) how vapor intrusion issues are being addressed, and (2) the activities planned to provide protectiveness related to vapor intrusion prior to implementation of the sitewide groundwater Record of Decision. Also, a section has been added to Chap. 6 to provide results for a winter (sub-slab) soil vapor sampling event.

Additional EPA Comment Received May 2003

A comment was received suggesting that the text describe how the data gaps associated with vapor intrusion will be addressed and a timetable be provided for future revision of the document (as indicated in the Supplement). These data gaps have been addressed by sampling, and the results are provided in the June 2004 EBS report.

Risk Comments Received May 2003

There was a question about the explanation in Chap. 6 of the Risk Screen, about the meaning of the risk estimates (e.g., 1×10^{-x}), and requests that the calculated cancer risk be explained so that it is clear that it represents the probability of excess individual cancer risk. Rather than indicate that 1 person in a population of 10^{x} will get cancer, it should be stated that risk values estimate the probability of an excess cancer for an individual with the exposure parameter selected (i.e., each roving worker would have an individual excess cancer risk of 1×10^{-x}). In addition, a comment was received about comparing a facility's contamination and resulting dose against the *total* radiation dose from all sources, as the 360 mrem/year dose includes all sources, both an individual's medical, home, and work exposure as well as other radionuclides not part of East Tennessee Technology Park. In both cases the text was revised.

A comment was made that Chap. 6 should include a table that summarizes the contaminants of potential concern (COPCs) for the site. Text was added in the appropriate section (Chap. 5 of this iteration of the report) to refer the reader to Table A.3 in Appendix A.

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

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

Attachment-Plat Exhibit

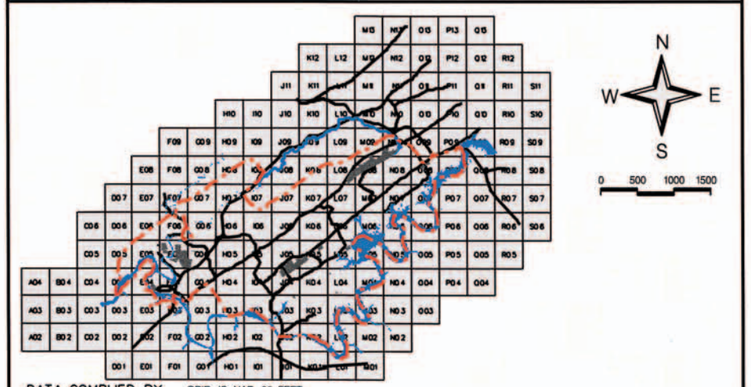
APPENDIX B

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

B-3

APPENDIX C

SOIL VAPOR SAMPLING AND ANALYSIS PLAN FOR THE K-1580 BUILDING

BJC/OR-1713/R1

Sampling and Analysis Plan for Collection of Groundwater, Air, and Soil Vapor Samples for the K-1580 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee

This document is approved for public release per review by:

26 MAY 04

BJC ETTP Classification and Information Control Office

Date

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

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

BJC/OR-1713/R1

Sampling and Analysis Plan for Collection of Groundwater, Air, and Soil Vapor Samples for the K-1580 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee

Date Issued—April 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 contracts DE-AC05-98OR22700 and DE-AC05-03OR22980
for the
U. S. DEPARTMENT OF ENERGY

03-056(doc)/092004

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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
ORGDP	Oak Ridge Gaseous Diffusion Plant
PRG	preliminary remediation goal
PSS	Park Shift Superintendent
QC	quality control
RCRA	Resource Conservation and Recovery Act of 1976
RCW	recirculating cooling water
SAP	Sampling and Analysis Plan
SOP	standard operating procedure
SSC	sampling subcontractor
TCA	1,1,1-trichloroethane
TCE	trichloroethene
TIC	tentatively identified compound
TWA	time-weighted average
VOC	volatile organic compound

1. INTRODUCTION

This Sampling and Analysis Plan (SAP) describes sampling efforts to be undertaken in order to determine whether subsurface contamination from volatile organic compounds (VOCs) has resulted in organic vapors entering the K-1580 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.

During the construction of the Oak Ridge Gaseous Diffusion Plant (ORGDP), the K-1580 area was an undeveloped field outside the perimeter fence and remained as such until the K-1580 building was constructed in 1980. The perimeter fence was moved and K-1580 is inside the fence.

The K-1580 building is located in the southern portion of ETTP. It is a 38,211-ft^2, three-story structure (12,737 ft^2 on each of the three floors) that was built in 1980 as an office building for ETTP Engineering personnel. Building K-1580 has been used by several site organizations since its construction and continues to be used for offices. There is an asphalt parking area on the north side of the building and a grassy yard that extends around the east and south sides of the building.

This SAP presents the rationale and details of air sampling to be conducted in the ETTP K-1580 building. These sampling activities are being conducted to determine the potential for vapor intrusion into the building by VOCs that may be present in the subsurface. The VOCs selected for analyses are those present in the shallow bedrock groundwater plume located 300 to 350 ft north of Bldg. K-1580.

2. OPERATIONS CONDUCTED WITHIN PROXIMITY OF THE K-1580 BUILDING

The closest facility to K-1580 is the K-1320 Office Building. Building K-1320 was constructed in 1982 to provide additional office space. In 1984, an addition was added to K-1320 and designated K-1320-A.

There are no past or present facilities in the vicinity of K-1580 that are potential areas of contamination. The closest environmental restoration area is the Recirculating Cooling Water (RCW) Lines Leak Sites 500 ft to the north. The RCW lines, in conjunction with a cooling tower, served as a process support building from the mid-1950s to 1984. The makeup water for the system used a chromate/zinc/phosphate treatment until 1977, when it was replaced by a phosphate treatment system. The cooling tower was demolished in the 1990s. Potential leaks from the RCW lines are listed as a Solid Waste Management Unit under the Resource Conservation and Recovery Act of 1976 (RCRA) and Appendix C of the Federal Facility Agreement (FFA).[1] [The FFA is an agreement between DOE, the EPA, and the state of Tennessee to integrate the requirements of RCRA corrective actions and Comprehensive Environmental Response, Compensation, and Liability Act of 1980 remedial investigations

[1]DOE 1992. *Federal Facility Agreement for the Oak Ridge Reservation*, DOE/OR-1014, U. S. Environmental Protection Agency Region 4, U. S. Department of Energy, and Tennessee Department of Environment and Conservation, Washington, D.C.

at specific sites within the Oak Ridge Reservation. The specific facilities to which the FFA applies are listed in Appendix C of the FFA.]

3. EXISTING/HISTORICAL DATA

Hydrogeologic characterization data for K-1580 are limited because no groundwater monitoring wells exist in its immediate vicinity. Much of the hydrogeologic characterization data have been interpolated from available ETTP-wide information. Based on pre-construction topographic maps, it appears that up to 10 ft of fill material may have been placed in the area of K-1580 during construction of the ORGDP. A portion of this fill extends beneath the eastern edge of the K-1580 building. Depth to bedrock (interpolated) is expected to be from 2 to 20 ft below ground surface (bgs). Bedrock is likely to be encountered at more shallow depths on the south side of the building where fill was not placed. The interpolated depth to groundwater is from 12 to 20 ft bgs. Shallow groundwater flow is expected to be to the south-southwest toward the shallow ponds south of ETTP.

Although a groundwater plume has not been identified beneath K-1580, there are data gaps regarding possible groundwater contamination beneath this building. Groundwater flowpaths in bedrock at ETTP are a significant unknown due to the complex geology and geologic structure underlying ETTP. As shown in Fig. 3.1, an identified groundwater plume exists ~ 320 ft upgradient from K-1580. This plume occurs in bedrock, and the possibility of transport through bedrock flowpaths toward the building cannot be completely discounted based on available data.

Contaminants that have been detected in this plume include 1,1,1-trichloroethane (TCA), tetrachloroethene, trichloroethene (TCE), 1,2-dichloroethene (DCE), vinyl chloride, methylene chloride, and benzene. Although 1,1-DCE and 1,1-dichloroethane were not detected, these degradation products of 1,1,1-TCA should be considered to be potentially present. Methylene chloride is a potential degradation product of carbon tetrachloride via chloroform. It is unknown if the methylene chloride results from biological degradation of these parent compounds or from its historic use. Accordingly, carbon tetrachloride, chloroform, methylene chloride, and chloromethane are considered to have the potential to be present in the groundwater plume.

Monitoring well BRW-071, which is located 300 ft north of K-1580 (Fig. 3.1), contained TCE at a maximum concentration of 10 micrograms per liter (μg/L) during sampling events conducted between 1994 and 1998. This well has not been sampled since 1998. Monitoring well BRW-053, located ~ 375 ft upgradient from K-1580, represents the most contaminated well near the building. During the September 2002 sampling event at well BRW-053, TCE and 1,2-DCE were detected at concentrations of 87 μg/L and 130 μg/L, respectively. Concentrations of TCE found in the wells north of Bldg. K-1580 have declined since the initial monitoring event but have remained relatively constant over the past two years. Conversely, concentrations of 1,2-DCE increased an order of magnitude at well BRW-053 from 2001 to 2002. Concentrations of 1,2-DCE also increased an order of magnitude during the most recent sampling event at wells BRW-054, BRW-071, and BRW-073.

Although contemporaneous sampling of the wells indicated in Fig. 3.1 has not been performed, TCE and 1,2-DCE concentrations are significantly lower at wells BRW-054, BRW-071, BRW-072, and BRW-073 than at the upgradient well BRW-053. Average concentrations of TCE over the last five sampling events declined from 76 μg/L at well BRW-053 to 6 μg/L at well BRW-071. Over the past five sampling events, the average concentration of 1,2-DCE declined from 61 μg/L at well BRW-053 to 3 μg/L at well BRW-071. Given the observed concentrations in monitoring wells located nearest to K-1580, the age of original source

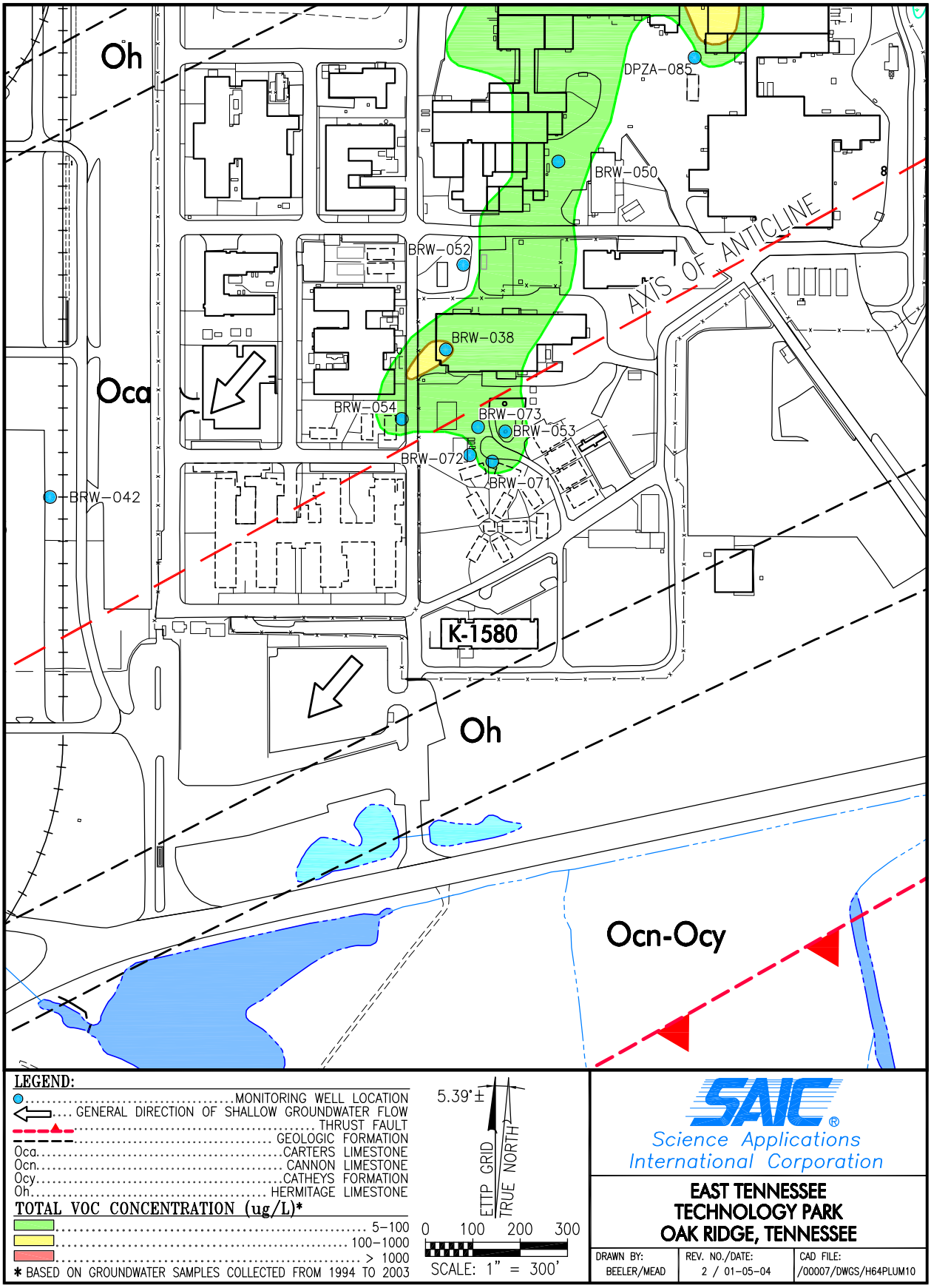

Fig. 3.1. Groundwater VOC concentrations in the vicinity of K-1580.

releases, and natural attenuation effects, it appears unlikely that concentrations of TCE in groundwater at K-1580, if transported to this building, would exceed those observed at monitoring well BRW-071.

4. SCOPE

The overall scope of this SAP is to determine VOC concentrations in the soil vapor directly beneath the K-1580 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 gas 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* (SPA 2002).[2] 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.

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[2]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 gas 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 screening criteria are not 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;

- as an option to groundwater sampling, DOE may obtain an upgradient soil gas sample 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 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-1580. In order to achieve this objective, sampling and analytical protocols followed under this SAP 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-1580 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-1580 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-1580

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
Benzene	4.38E-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 building's 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 building's 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. As an option to groundwater sampling, a soil gas sample may be collected from a location upgradient of the building. Data obtained from groundwater or upgradient soil gas samples 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 were 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-1580. 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 5-L 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-1580 the groundwater sample shall be collected from well BRW-071. 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.

As previously indicated, the groundwater monitoring wells in closest proximity to Bldg. K-1580 are ~ 400 ft north of the building. Therefore, as an option to groundwater sampling, an upgradient soil gas sample may be collected to determine current conditions and monitor for any changes in soil gas composition that may occur in the future. To collect these samples, a permanent soil gas monitoring well (piezometer) will be installed at a location upgradient to and in relatively close proximity to the building. Soil gas samples collected from this piezometer will be analyzed for the suite of 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.

Five indoor air samples will be taken at 2 to 5 ft above the floor within the building. 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 5-L SUMMA canisters. Indoor air samples will be 8-h, time-weighted average (TWA) samples. A minimum of one 8-h TWA 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.

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

Volatile organic compound	Trigger level (mg/m^3)	Concentration in building ($\mu g/m^3$)	Alpha[a]
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[b]	2.51E+01[b]	2.92E+01[b]	1.16E-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]Alpha is the infinite source indoor attenuation coefficient and directly correlates the soil gas concentration with the indoor air concentration.

[b]Toxicity data for 2-hexanone are unavailable; values represent those associated with N-hexane – a surrogate chemical approved for use for this purpose by U. S. Environmental Protection Agency Region 4.

6. FIELD SAMPLING PLAN

Soil vapor and ambient air sampling activities at K-1580 will be implemented in two separate mobilization events. Prior to each mobilization event, the sampling subcontractor (SSC) will obtain evacuated 5-L 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-071 during the first phase of sampling. As an option to groundwater sampling, a soil gas monitoring well may be installed in the vicinity of Bldg. K-1580 to obtain an upgradient soil gas sample. The data from the upgradient groundwater or soil gas samples 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 5-L sub-atmospheric 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 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.-diameter) 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. 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 to attach the inlet tubing 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 to 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 manufacturers specifications or the SSC's SOPs.

After the soil vapor sample has been collected, the floor penetration or sampling port shall be sealed by an appropriate method. The temporary seal shall ensure that the sampling port or penetration is vapor tight and does not present a tripping hazard. After completion of all soil vapor sampling events, the floor

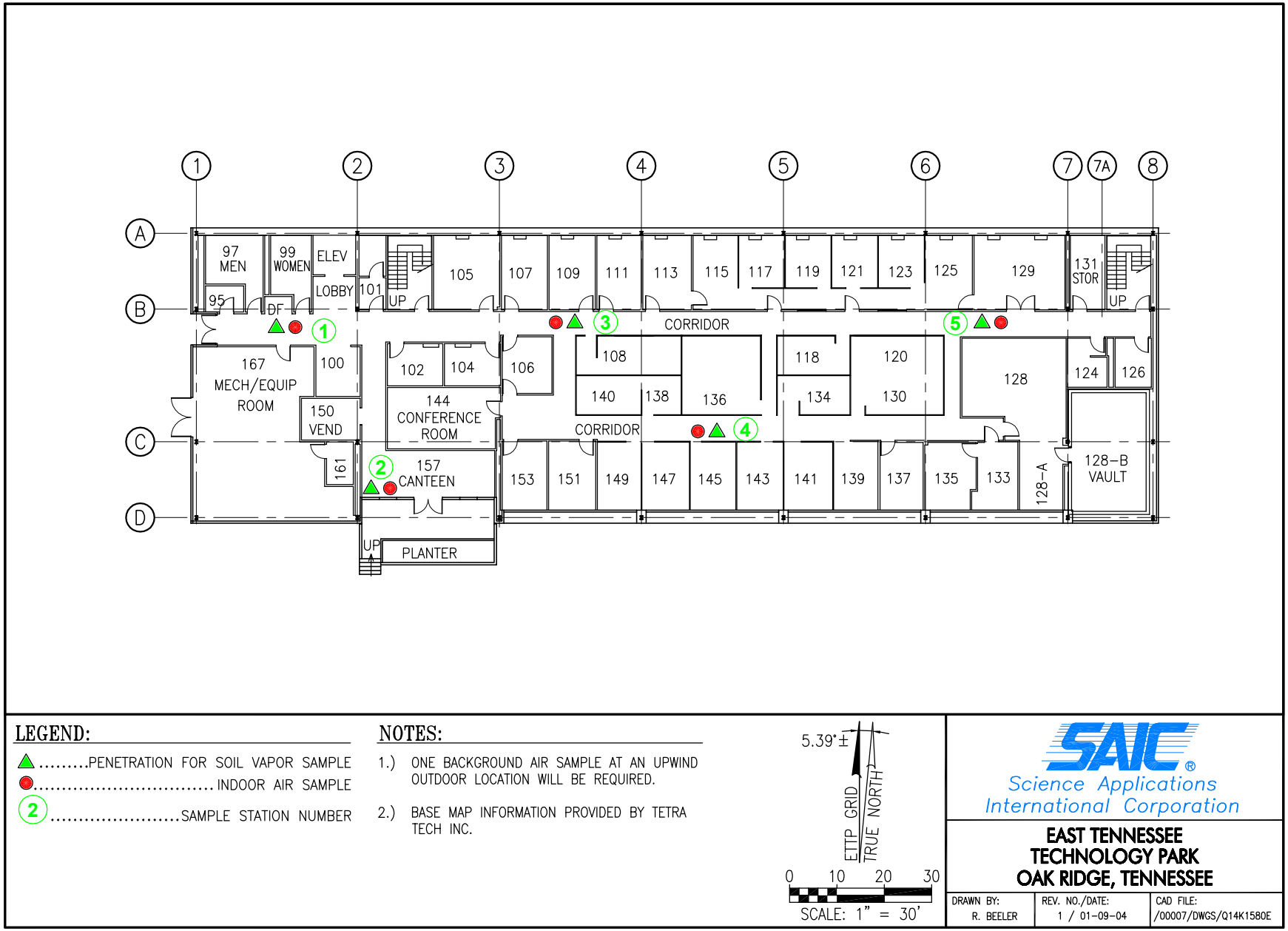

Fig. 6.1. Building K-1580 soil vapor and indoor air sampling locations.

penetration shall be sealed by cutting it level with the floor or removing it and backfilling with a non-shrinking grout. A layer of non-shrinking grout should be applied to the floor, covering the penetration and immediate surrounding area, and it should be finished smooth with the surrounding surface.

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-071 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.[3] 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 photo ionized 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's 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 to 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.

As an option to sampling groundwater well BRW-071, a soil gas monitoring station may be installed upgradient from the building and sampled to assess current conditions. The location for this soil gas monitoring well (piezometer) is presented in Fig. 6.2. The borehole for installation of this piezometer will be developed using a Geoprobe®[4] track-mounted rig to remove the soil from a 4.0-in.-diameter borehole in a manner analogous to collecting sub-surface soil samples. The borehole shall be advanced to a depth of 8.0 ft bgs.

After completion of the borehole, the well screen and casing shall be inserted in the boring so that ~ 1.0 ft of granular filter pack material is beneath the well plug. The casing, screen, and fitting materials for construction of the piezometer shall be 1.0-in.-diameter, Schedule 40 carbon steel. Screen sections will be commercially fabricated with slotted openings equal to 0.025 cm (0.010 in.). The length of screen for the piezometer will be 2.0 ft. The casing will be of sufficient length for 2.5 ft of casing to extend above ground surface. The top of the casing will be provided with a threaded, airtight cap that is fitted with a sample port sized to join to the inlet line of a 5-L SUMMA canister. After insertion of the piezometer screen and casing in the borehole, granular filter pack material will be placed within the annular space around the screen to a depth of 1.0 ft above the top of the screen using a tremie pipe. Granular filter pack material shall be 0.0188-in. sand. Bentonite will be used to create an annular seal between the granular filter pack and an upper grout seal. Commercially available bentonite pellets will be added to the annular space above the filter pack using a tremie pipe. A sufficient quantity of bentonite pellets will be added to create a 2.0-ft-thick seal. After placement of the bentonite pellets, a small volume of VOC-free potable water will be added to hydrate the seal material. Hydration time for the bentonite pellets shall be a minimum of 1.0 h.

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[3]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 or its contractors or subcontractors.

[4]Same as footnote #3.

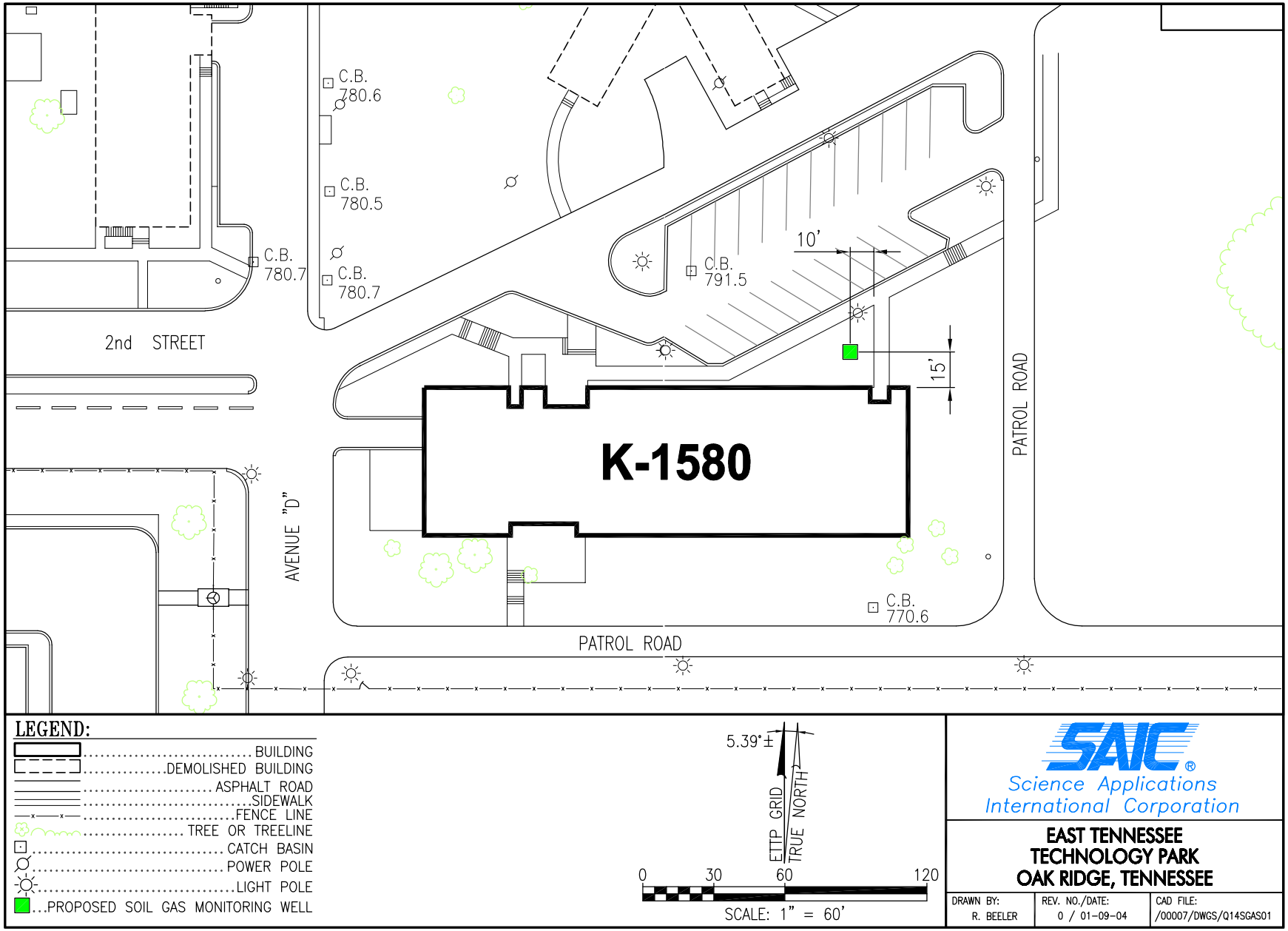

Fig. 6.2. Proposed location for K-1580 soil gas monitoring well.

After completion of the bentonite seal, the remaining annular space from the top of the bentonite seal will be grouted to ground surface. A 5.0-ft by 5.0-ft concrete collar will be poured around the piezometer. This concrete collar will have a minimum thickness of 4.0 in.

The piezometer shall be purged approximately 48 h after placement of the concrete collar to remove atmospheric air introduced during construction. Purging shall be accomplished by connection of a vacuum pump to the sampling port located on the piezometer's top cap using flexible stainless steel tubing. A flow totalizing indicator shall be attached to the discharge line of the vacuum pump. Purging shall be continued until three well volumes have been removed from the piezometer.

Sampling shall not be conducted for at least 72 h after initial purging of the soil gas monitoring well. The upgradient soil gas sample shall be collected using 5-L SUMMA canisters that have been cleaned, conditioned, and certified in accordance with Method TO-15. All components of the sampling system will be pre-cleaned and conditioned in accordance with Method TO-15. The sampling system should be assembled prior to field mobilization as previously described. Once the sampling system has been located at the soil gas sampling station, connection to the sample port in the piezometer shall be made with stainless steel tubing fitted with a stainless steel vacuum valve. The SSC technicians shall record temperature, pressure, and other relevant parameters specified by Method TO-15. After the sample system has been attached to the piezometer's sampling port, the connections shall be leak tested. The soil gas sample shall be collected by opening the system's valving for the specified sample collection period of 60 seconds. Flow restriction shall be provided by a critical orifice set to charge the canister to the desired end pressure over this sample collection period. Upon collection of the samples, the final pressure shall be checked and recorded. The final system pressure should be ~ 88 KPa (90 to 100 mmHg of vacuum).

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 SUMMA canister, it shall be labeled as required by the SSC's 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.

After the soil vapor sample has been collected, the floor penetration or sampling port shall be sealed by an appropriate method. The temporary seal shall ensure that the sampling port or penetration is vapor tight and does not present a tripping hazard. After completion of all soil vapor sampling events, the floor penetration shall be sealed by cutting it level with the floor or removing it and backfilling with a non-shrinking grout. A layer of non-shrinking grout should be applied to the floor, covering the penetration and immediate surrounding area, and it should be finished smooth with the surrounding surface.

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.

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 sub-atmospheric, 5-L 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 (QC) samples required for the soil vapor and air samples are field equipment blanks and one duplicate. These QC samples are required only for 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 holding time requirements are summarized in Table 6.1.

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 compounds (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 SW-8260B (EPA 1993). 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

Event	Sample station[a]	Sample type	Parameters of concern	Analytical protocols	Container type/volume	Preservation	Holding time
01	AU-01-41-1580-V	Soil vapor-grab	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 d
01	AU-02-41-1580-V	Soil vapor-grab	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 d
01	AU-03-41-1580-V	Soil vapor-grab	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 d
01	AU-04-41-1580-V	Soil vapor-grab	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 d
01	AU-05-41-1580-V	Soil vapor-grab	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 d
01	AU-00-41-1580-G	Soil gas upgradient-grab[c]	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 d
01	AU-00-41-1580-W	Groundwater[c]	Volatile organics[b]	SW-8260B	3 × 40-mL VIA vials	HCl to pH < 2, Cool 4°C	14 d
01	AU-93-41-1580-B	Field blank	Volatile organics[b]	SW-8260B	3 × 40-mL VIA vials	Prepreserved	14 d
02	AU-01-42-1580-I	Indoor air: 8 h TWA[d]	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 d
02	AU-02-42-1580-I	Indoor air: 8 h TWA[d]	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 d
02	AU-03-42-1580-I	Indoor air: 8 h TWA[d]	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 d
02	AU-04-42-1580-I	Indoor air: 8 h TWA[d]	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 d
02	AU-05-42-1580-I	Indoor air: 8 h TWA[d]	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 d
02	AU-05-42-1580-D	Indoor air duplicate: 8 h TWA[d]	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 d
02	AU-06-42-1580-A	Outdoor air: 8 h TWA[d]	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 d
02	AU-91-42-1580-B	Air Field Blank	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 d
02	AU-92-42-1580-B	Air Field Blank	Volatile organics[b]	TO-15	5-L 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; W = groundwater; and G = upgradient soil gas.

[b]Volatile organics of concern for air sampling at K-1580 include tetrachloroethene; trichloroethene; 1,2-dichloroethene; vinyl chloride; 1,1,1-trichloroethane; 1,1-dichloroethene; 1,1-dichloroethane; carbon tetrachloride; chloroform; methylene chloride; chloromethane; and benzene.

[c]As an option to groundwater sampling at well BRW-071, a soil gas well may be installed upgradient of K-1580 and sampled.

[d]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)[b]
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		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
2-Hexanone[b]	TO-15	2.92E-02[b]	2.92E-03[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-03
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]Toxicity data for 2-hexanone are unavailable; values represent those associated with N-hexane – a surrogate chemical approved for use for this purpose by U. S. Environmental Protection Agency Region 4.

VOC = volatile organic compound.

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	SW-8260B[b]	5
1,1,2,2-Tetrachloroethane	SW-8260B	5
1,1,2-Trichloroethane	SW-8260B	5
1,1-Dichloroethane	SW-8260B	5
1,1-Dichloroethene	SW-8260B	5
1,2-Dichloroethane	SW-8260B	5
1,2-Dichloroethene	SW-8260B	5
1,2-Dichloropropane	SW-8260B	5
2-Butanone	SW-8260B	10
2-Hexanone	SW-8260B	10
4-Methyl-2-pentanone	SW-8260B	10
Acetone	SW-8260B	10
Benzene	SW-8260B	5
Bromodichloromethane	SW-8260B	5
Bromoform	SW-8260B	5
Bromomethane	SW-8260B	10
Carbon disulfide	SW-8260B	5
Carbon tetrachloride	SW-8260B	5
Chlorobenzene	SW-8260B	5
Chloroethane	SW-8260B	10
Chloroform	SW-8260B	5
Chloromethane	SW-8260B	10
cis-1,2-Dichloroethene	SW-8260B	5
cis-1,3-Dichloropropene	SW-8260B	5
Cibromochloromethane	SW-8260B	5
Ethylbenzene	SW-8260B	5
Methylene chloride	SW-8260B	5
Styrene	SW-8260B	5
Tetrachloroethene	SW-8260B	5
Toluene	SW-8260B	5
trans-1,2-Dichloroethene	SW-8260B	5
trans-1,2-Dichloropropene	SW-8260B	5
Trichloroethene	SW-8260B	5
Vinyl chloride	SW-8260B	2
Xylenes (total)	SW-8260B	5

[a]μg/L = microgram per liter.

[b]EPA 1993. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846*, Third Edition (November 1986; Rev. 1, July 1992; Rev. 2, November 1992; and Update 1, August 1993), U. S. Environmental Protection Agency, Office of Solid Waste, Washington, D.C., August.

VOC = volatile organic compound.

9. REFERENCES

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APPENDIX D

RADIOLOGICAL SURVEY PLAN FOR THE K-1580 STUDY AREA

1. AREA TO BE SURVEYED

The area to be surveyed is the K-1580 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 other than the exterior patio and sidewalks. The K-1580 building has been primarily used as office space for different groups and has three floors (12,737 ft^2 on each of the floors for a total of 38,211 ft^2). The building exterior is pre-cast concrete siding over reinforced concrete, and the facility is primarily carpeted throughout. See Figs. 1 and 2 in this appendix for the survey area.

2. HISTORY OF THE AREA

K-1580 was built in 1980 to provide offices for K-25 engineering personnel. An elevator is located in the northwest corner and a stairway on each end of the building. During the 1990s, engineering personnel moved from the building and other organizations including Bechtel Jacobs Company LLC (BJC) Reindustrialization, Environmental Management, and Waste Management, as well as U. S. Department of Energy (DOE) site management, have occupied the building for offices. The building has always been inside the control fence area of the plant and no radioactive material or contamination incidents are known to have occurred within the building or immediate area.

Radiological contamination, if present, is expected to be a small percentage of the applicable DOE surface contamination limits due to the results of the prior surveys performed in the area (which are discussed in the following sections), but mainly due to the historical usage of the facility. In general, no radioactive contamination has been found within the survey area that has 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 five radiological surveys have been performed inside the building. A review of these surveys provided a basis for the classification of the individual survey units.

Two pregnancy surveys were conducted in the building on the third floor, one in 1996, the other in 1998. No activity was detected above background levels, and the dose equivalent rates ranged from 3 to 5 μrem/h. A survey on the third floor was conducted in July 1998 after a safe that had been moved to another building from K-1580 was found to have removable contamination on the bottom of it. No radioactivity was detected above background levels, and the dose equivalent rates ranged from 4 to 7 μrem/h. The identification of the radioisotopes making up the contamination was not evaluated. In 1999, during a scoping survey of several buildings for another project, large area wipes (LAWs) over an approximate area of 1 m^2 were taken at all entrances of the building, and dose rates were taken throughout the hallways. No activity above background levels was detected on the LAWs. The dose equivalent rates ranged from 3 to 5 μrem/h. Also in 1999, a survey of the floors of the building was performed using a computerized position sensitive detector system by Shonka and Associates for the "Release Project." The gross alpha reading ranged from 1 to 85 counts per minute (cpm), the gross beta readings ranged from 1032 to 1618 cpm, and the gross gamma readings ranged from 3599 to 10262 cpm. The highest readings were found on tape that was on some new carpet. The data, however, were normally distributed.

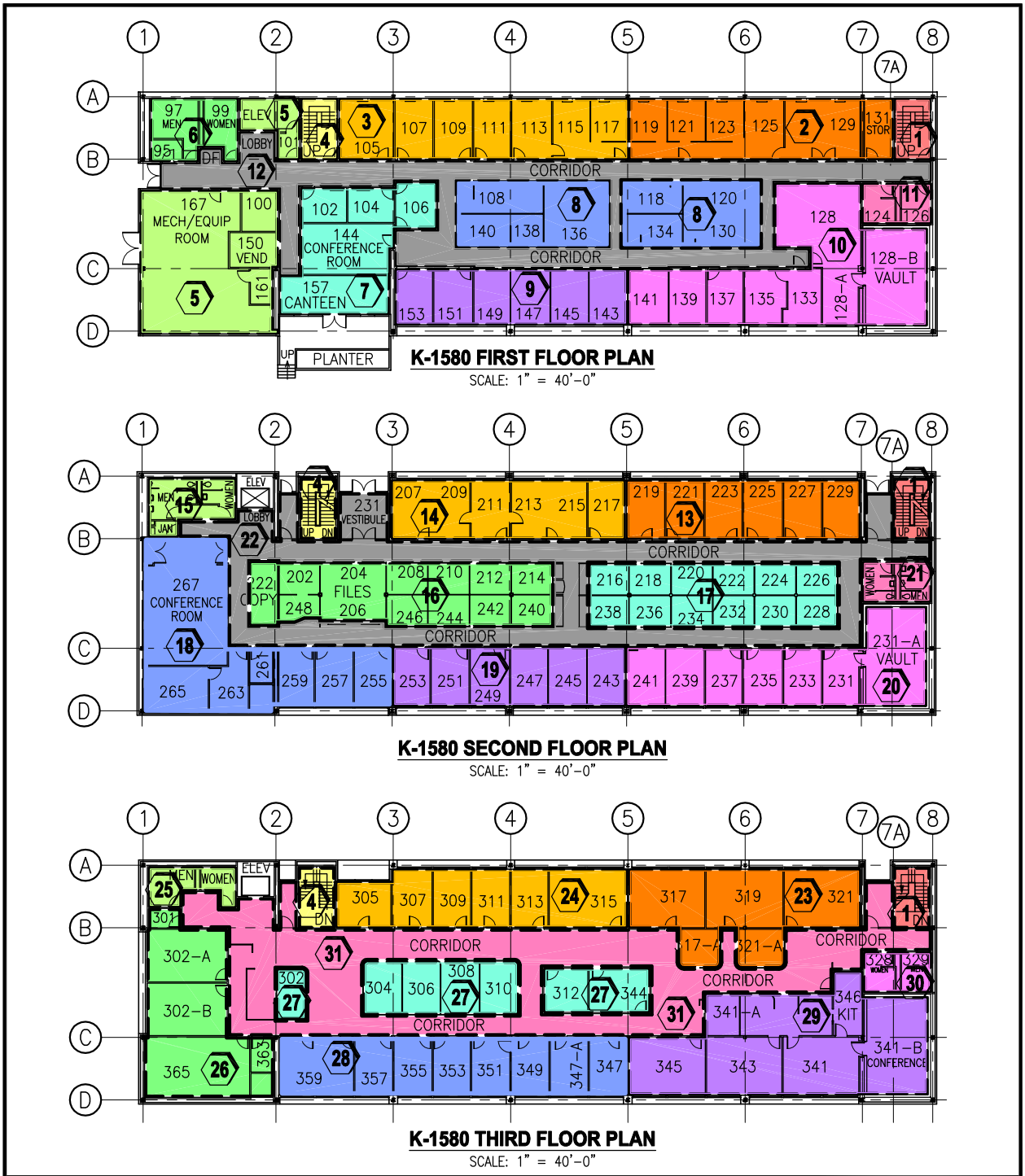

Fig. 1. K-1580 interior survey units.

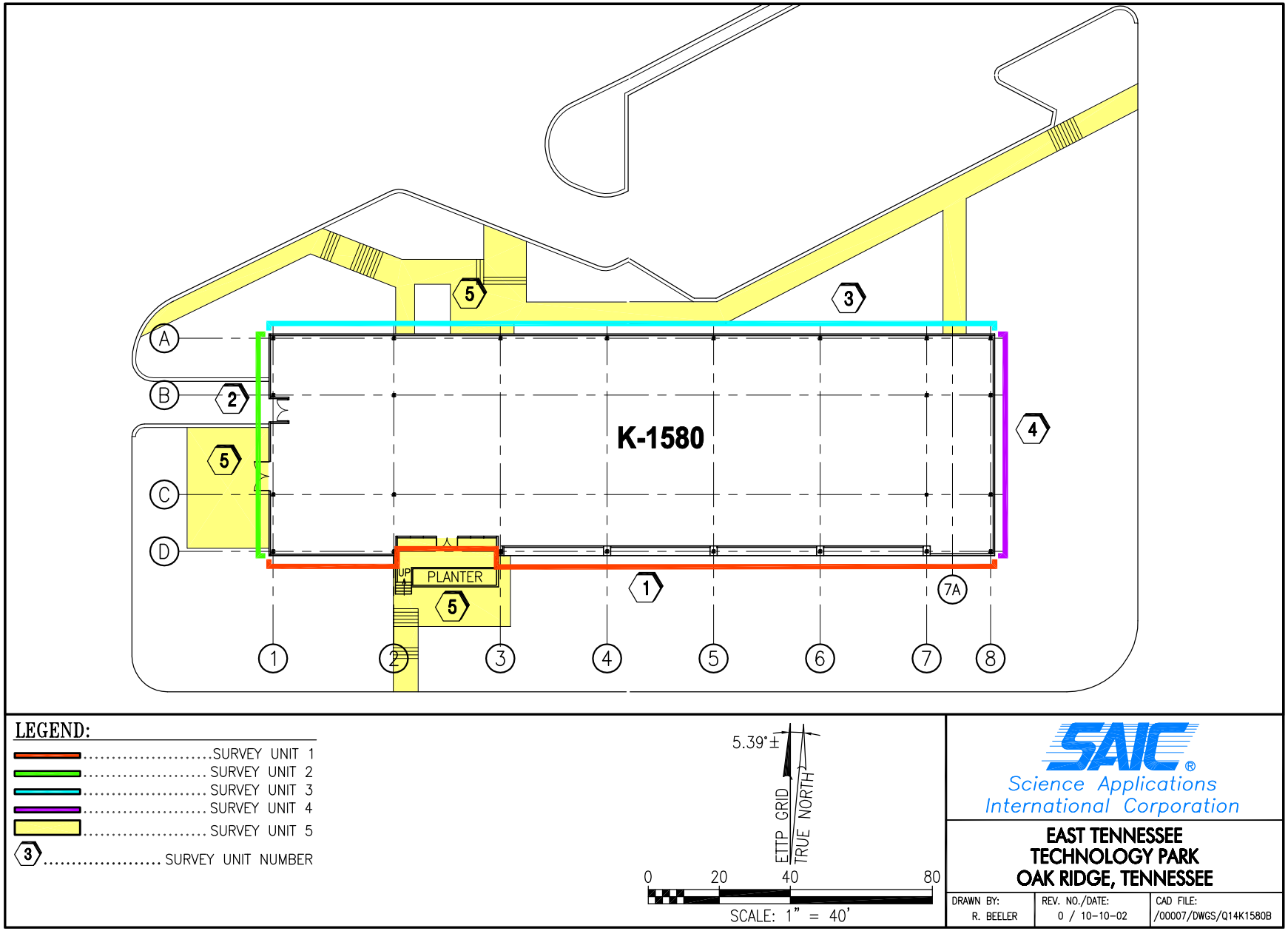

Fig. 2. K-1580 exterior survey units.

A total of 35 equipment surveys were performed in the K-1580 building. This included surveys of desks, chairs, computer equipment, carpet, and various hand tools. No activity was detected above background levels for all surveys. In 1999, as a part of the scoping survey of several buildings by another project, two statistical surveys of the furnishings were performed, with the readings given in gross (uncorrected for background) counts per minute. All readings associated with these surveys were at background levels.

4. DATA QUALITY OBJECTIVES/PURPOSE

The purpose of this survey plan is to obtain additional radiological survey data to determine the presence and quantity of residual contamination in the area. The data gathered will be used to make a decision regarding the release of the K-1580 building and contents to CROET.

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-1580 building. Its introduction into the building would have been 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%. If contamination is located in Bldg. 1580, it is expected that enrichments of less than 3% would be present.[19] 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 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 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)[20] (both ratios are process buildings weighted averages).[21]

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

[20]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.

[21]*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.

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[22] and also in DOE Order 5400.5,[23] is less than that from the dose and risk criteria, as explained in the Design of Radiological Surveys document[24] (hereafter referred to as the "design document"). (See Appendix A of 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 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 square meter (m^2) maximum size area.

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 $\text{level}_{\text{elevated measurement comparison}}$.
dpm = disintegrations per minute.
N/A = not applicable.

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

5.3 IDENTIFICATION OF BUILDING 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, process knowledge, and previous radiological surveys conducted for the facility, all areas are initially classified as

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

[23]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."

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

Class 3 areas. The K-1580 building will be composed of a total of 37 Class 3 survey units, as shown in Table 2 in this appendix. See Fig. 1 in this appendix for the locations of the first, second, and third floor interior survey units (ISUs) and Fig. 2 in this appendix for the exterior survey units (ESUs).

Table 2. Survey units classification

Area	Class	
	Interior areas	Exterior areas
K-1580, 1st floor, northeast stairway up to third floor (ISU 1)	Class 3	N/A
K-1580, 1st floor, northeast corner by NE stairway (ISU 2)	Class 3	N/A
K-1580, 1st floor, middle offices north side by northwestern stairway (ISU 3)	Class 3	N/A
K-1580, 1st floor, northwestern stairway up to third floor (ISU 4)	Class 3	N/A
K-1580, 1st floor, elevator, vending, and mechanical room areas (ISU 5)	Class 3	N/A
K-1580, 1st floor, northwestern restrooms (ISU 6)	Class 3	N/A
K-1580, 1st floor, offices and canteen north of patio (ISU 7)	Class 3	N/A
K-1580, 1st floor, center cubicles (configuration shown not exact) (ISU 8)	Class 3	N/A
K-1580, 1st floor, south central offices (ISU 9)	Class 3	N/A
K-1580, 1st floor, southeastern offices and vault (ISU 10)	Class 3	N/A
K-1580, 1st floor, southeastern restrooms (ISU 11)	Class 3	N/A
K-1580, 1st floor, hallways and corridor (ISU 12)	Class 3	N/A
K-1580, 2nd floor, northeastern offices (ISU 13)	Class 3	N/A
K-1580, 2nd floor, northwestern offices by vestibule (ISU 14)	Class 3	N/A
K-1580, 2nd floor, northwestern restrooms (ISU 15)	Class 3	N/A
K-1580, 2nd floor, west center cubicles (ISU 16)	Class 3	N/A
K-1580, 2nd floor, east center cubicles (ISU 17)	Class 3	N/A
K-1580, 2nd floor, southwestern offices and conference room (ISU 18)	Class 3	N/A
K-1580, 2nd floor, south central offices (ISU 19)	Class 3	N/A
K-1580, 2nd floor, southeastern offices and vault (ISU 20)	Class 3	N/A
K-1580, 2nd floor, eastern restrooms (ISU 21)	Class 3	N/A
K-1580, 2nd floor, hallways and corridor (ISU 22)	Class 3	N/A
K-1580, 3rd floor, northeastern offices (ISU 23)	Class 3	N/A
K-1580, 3rd floor, north central offices by NW stairway (ISU 24)	Class 3	N/A
K-1580, 3rd floor, northwestern restrooms (ISU 25)	Class 3	N/A
K-1580, 3rd floor, southwestern offices (ISU 26)	Class 3	N/A
K-1580, 3rd floor, center cubicles (ISU 27)	Class 3	N/A
K-1580, 3rd floor, south center offices (ISU 28)	Class 3	N/A
K-1580, 3rd floor, northwestern offices (ISU 29)	Class 3	N/A
K-1580, 3rd floor, eastern restrooms (ISU 30)	Class 3	N/A
K-1580, 3rd floor, hallways and corridor (ISU 31)	Class 3	N/A
K-1580 building exterior walls (entire wall) (ESUs 1 through 4)	N/A	Class 3
K-1580 building sidewalk and patio areas (entire walk) (ESU 5)	N/A	Class 3
K-1580 building roof (ESU 6 – not pictured)	N/A	Class 3

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

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. Sodium iodide (NaI) meters and Bicron MicroRem® meters[25] 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 or total measurement is taken. All removable contamination survey smears will be counted on a gas-proportional counter, or equivalent, 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 Class 2 areas, 100% of the accessible floor area will be scanned, if any are determined to be present in the building. Other surfaces that are classified as Class 2 areas, such as walls, ceilings, or 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, if any are determined to be present in the building. Emphasis will be placed upon entrances and 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). Presently, the ETTP DOE contractor is BJC.

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 in feet.

[25]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.

If any of the Class 3 survey units have to be upgraded to Class 2 or Class 1 survey units, a sample grid and systematic measurements taken based upon a random starting point would be required. 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

Using the prescribed statistical testing methodology found in the design document (Sign test), a Δ/σ value (also known as the "relative shift") was computed (7.33) using the historical survey results, where Δ is the DCGL – LBGR, the LBGR is 50% of the DCGL, and σ is the standard deviation of the data. (*Note*: The majority of the readings were less than the instrument's L_c, the critical value at which there is 95% confidence that the value can be distinguished from background, or were recorded as "NEAD" (No Elevated Activity Detected); therefore, σ was assigned the value of the highest L_c value for the set of instruments divided by 1.65). The *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM)[26] recommends, however, that the relative shift be between one and three; however, adjusting the LBGR so as to obtain a relative shift that follows the MARSSIM recommendation results in an alpha LBGR of 4900 dpm/100 cm^2 (2.55 relative shift) and a beta LBGR of 4300 dpm/100 cm^2 (2.83 relative shift). These values are approaching levels that are very difficult to distinguish from the DCGL; therefore, 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 existing historical area survey data that for the vast majority was below background levels, 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 (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.

[26](NRC 1997a). Nuclear Regulatory Commission, Nuclear Regulatory Guide (NUREG)-1575, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Final Edition*, December 1997.

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 HP 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 will also 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[27]) 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 naturally occurring radioactive materials (NORMs) 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 area) 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, second, and third 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 usage 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. The emphasis will be placed on the primary traffic areas and the work

[27]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 • 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.

areas, i.e., 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 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, distance the dose rate was taken from the wall or floor, and 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.

6.3.1.2 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 would require additional investigation.

6.3.1.3 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

Refer to 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 with 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 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.[28] 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.

[28] *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[29]
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-1580 survey dataset was unusable to determine the number of measurements required independently because of the minimum 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 27.8 dpm/100 cm^2 and 547.8 dpm/100 cm^2, respectively, with alpha and beta-gamma standard deviations of 45.9 dpm/100 cm^2 and 903.9 dpm/100 cm^2, respectively),[30] there is 95% confidence that the alpha readings will be within the interval -63 to 118 dpm/100 cm^2 and that the beta-gamma readings will be within the interval of -1224 to 2320 dpm/100 cm^2, of which the upper bounds of the 95% confidence intervals for both are well 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 that case,

[29]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.

[30]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).

the items can be combined from the entire building to make a survey unit. The individual FSUs will be 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 above 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.

Within the Class 3 FSUs, if residual radioactivity 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.

ADDENDUM D.1

EXTERIOR GROUNDS

EXTERIOR GROUNDS

After the initial survey of exterior equipment was completed, it was determined that grounds located on the exterior of Bldg. K-1580 and that surround the exterior equipment will be included in the title transfer. Therefore, this addendum is being added to provide a plan for the survey of those grounds.

The grounds include all other areas included in the new title transfer area, shown as Grounds Survey Unit (GSU) 1 on Fig. Addendum.D.1. The GSU 1 will be classified as Class 3. GSU 1 will be surveyed following the direction given below.

Grounds Survey Unit

The purpose of the grounds survey is to identify any areas that might require sampling and laboratory analysis of soil samples based on a sodium iodide (NaI) detector walkover scan. If areas of potential contamination are identified, a separate sampling plan will be prepared to evaluate soil contamination. Many of the radionuclides found on the Oak Ridge Reservation have natural background concentrations. Therefore, background subtraction will be required for all direct field measurements and laboratory analyses. Some comparison to background levels will also be required for the scanning because only a gross signal will be measured. Locations of biased sampling for laboratory analysis and timed measurements of total alpha, beta-gamma, and dose rate will be "pin flagged" at any location that has an NaI survey reading greater than three times the established background. The basis for the "three times rule" stems from the fact that natural backgrounds vary by up to a factor of three, depending on geology, topography, and other geometric factors such as closeness to brick buildings. However, the data for each GSU will be reviewed to determine if other areas exist where there is a clear elevation in count rate as compare to surrounding areas. Professional judgment will be used to evaluate if the specific geology, topography, and matrix (e.g., rock outcroppings, pavement, severe slopes, and brick buildings) could have caused the elevated readings. If not, additional samples may be recommended.

Class 3 grounds survey unit

For a Class 3 area, only judgment scans are required by the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM). Judgment measurements are defined by MARSSIM as follows: "... measurements performed at locations selected by professional judgment based on unusual appearance, location relative to known contamination areas, high potential for residual radioactivity, general supplemental information, etc." Suspect areas should be walked over using an NaI detector in a serpentine pattern. Furthermore, a series of timed measurements will be done at randomly chosen points throughout the GSU. Because of the small area of the GSUs, these points will be chosen in the field by the surveyor based on the highest areas determined during the walkover scan. Additionally, timed measurements will be performed at any location determined during the NaI walkover survey as being greater than three times the background (or lower trigger level based on professional judgment and evaluation of field-determined background variations and the geological and topographical conditions), and the location will be "pin flagged" for soil sampling. Only timed, 1-min-count NaI and dose rate measurements will be made and recorded at these locations. Since the derived concentration guideline limits (DCGLs) for surface measurements do not apply to soil areas and direct readings are not used in the dose and risk assessment for soil areas, no upgrade of the survey unit will be made based on the timed NaI measurements. However, upgrades may be necessary based on the results of the soil sampling and analysis. Any Class 3 areas reclassified as Class 2 areas will be resurveyed accordingly. All reclassified areas will be discussed in the survey report and the Environmental Baseline Survey (EBS) Chap. 6, "Survey Results."

Class 2 grounds survey units

Although there are no Class 2 grounds areas currently, the potential exists for having a Class 3 upgraded to a Class 2. Therefore, Class 2 survey protocols are as follows: scan with an NaI meter according to the percentages listed in Table 3 and the values found in Chap. 6 of this plan or the values obtained during the Class 3 survey. Timed, 1-min-count NaI and dose rate measurements will be made and recorded at eleven locations. The static survey measurement locations will be systematically chosen per survey grid. Additionally, timed measurements will be performed at any location flagged during the NaI walkover survey as being greater than three times the background or other trigger level. Since the DCGLs for surface measurements do not apply to soil areas, direct readings are not used in the dose and risk assessment for soil areas, and soil samples are already being collected in these areas for analysis, no upgrade of the survey unit will be made based on the timed NaI measurements. However, upgrades may be necessary based on the results of the soil sampling and laboratory analysis. Any Class 2 areas reclassified as Class 1 areas will be resurveyed accordingly. All reclassified areas will be discussed in the survey report and the EBS Chap. 6, "Survey Results."

Class 1 grounds survey units

Although there are no Class 1 ground areas currently, 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 scanned with the NaI meter. Timed, 1-min-count NaI and dose rate measurements will be made and recorded at eleven locations. The static survey measurement locations will be systematically chosen per survey grid. Additionally, timed measurements will be performed at any location flagged during the NaI walkover survey as being greater than three times the background or other trigger level. Any Class 3 or 2 areas that exceed the DCGL based on soil sampling and laboratory analysis will be reclassified as Class 1 areas and surveyed accordingly. All reclassified areas will be discussed in the survey report and in the EBS Chap. 6, "Survey Results."

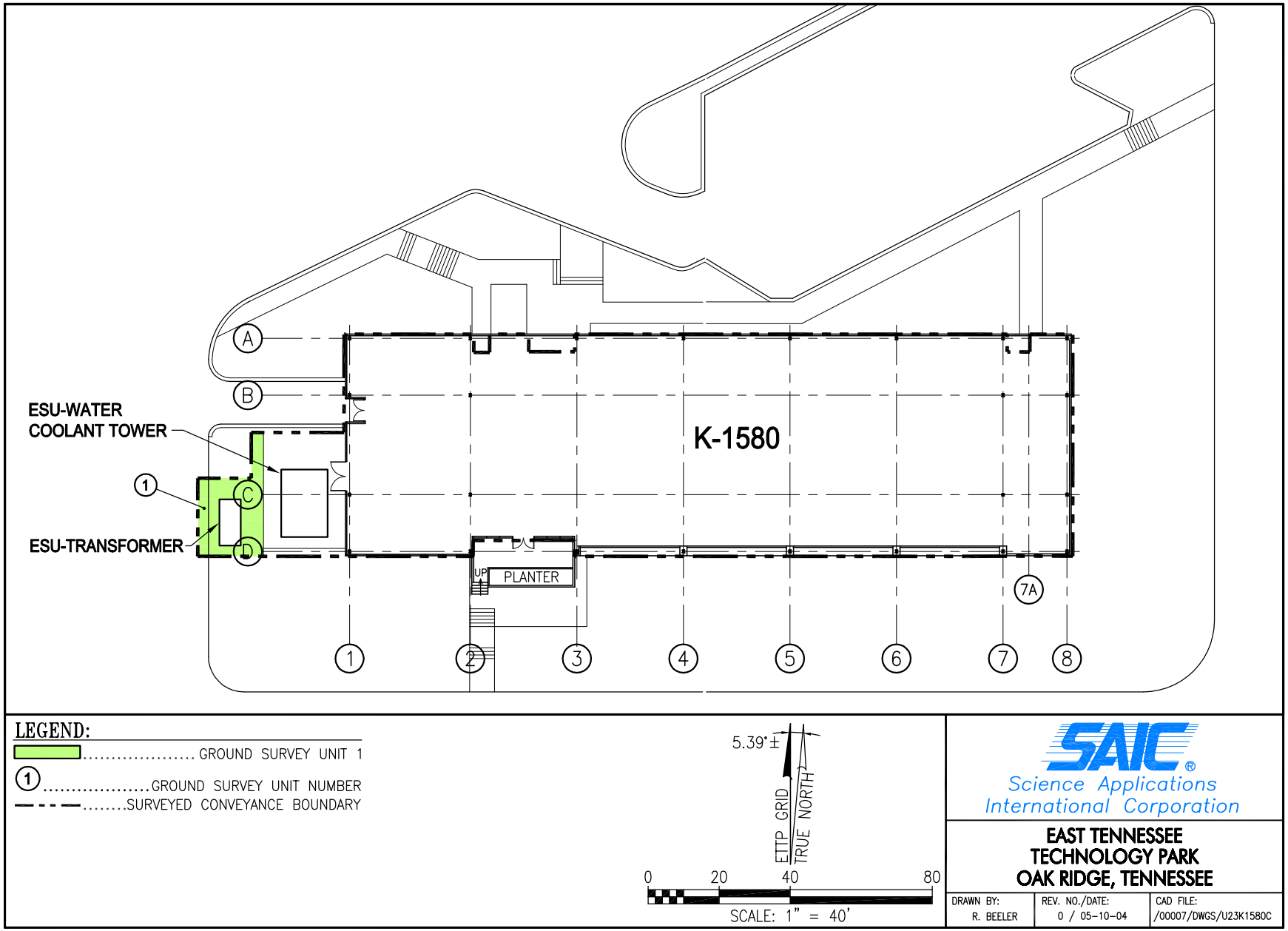

Fig. Addendum.D.1. K 1580 exterior survey units.

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