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FINAL

**Supplemental Radiological Survey
Plan for the Lease of the Rooms
Associated with C107 of
Building K-1006 at the
East Tennessee Technology Park,
Oak Ridge, Tennessee**

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9/20/10

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

**Supplemental Radiological Survey
Plan for the Lease of the Rooms
Associated with C107 of
Building K-1006 at the
East Tennessee Technology Park,
Oak Ridge, Tennessee**

Date Issued—September 2010

Prepared by
Science Applications International Corporation
Oak Ridge, Tennessee
under subcontract 23900-BA-PR007U
under work release 0012

Prepared for the
U. S. Department of Energy
Office of Nuclear Fuel Supply

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

APPROVALS

Supplemental Radiological Survey Plan for the Lease of the Rooms Associated with C107 of Building K-1006 at the East Tennessee Technology Park, Oak Ridge, Tennessee	BJC/OR-3479 September 2010
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USQD Review Determination	☐ USQD ☐ UCD ☐ CAT X ☒ Exempt (Select Criteria below.) USQD/UCD/CAT X No.: _____	
Exemption Criteria	☐ (1) Non-Intent Change ☐ (2) DOE-Approved Document ☒ (3) Clearly no impact on Nuclear Facilities ☐ (4) Chief Financial Officer, Internal Audit, Labor Relations, Legal, Public Affairs, or Project Controls Organization Document	
USQD Preparer:	 Name _____	9/22/10 Date _____
Exhibit L Mandatory Contractor Document	☒ No ☐ Yes (Requires review by the Proforma Change Control Board.)	
PCCB Reviewer:	Name _____	Date _____

Prepared by:	 M. F. Blevins, Regulatory Affairs Manager Bechtel Jacobs Company LLC	9/22/10 Date _____
Concurred By:	 R. G. Kiser, Reindustrialization Account Executive Bechtel Jacobs Company LLC	9/22/10 Date _____
Approved By:	 L. A. Birk, Reindustrialization Manager Bechtel Jacobs Company LLC	9-22-10 Date _____

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

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

All sources of information on which SAIC has relied in making its conclusions are identified in Chap. 9 of this report. Any information, regardless of its source, not listed in Chap. 9 has not been evaluated or relied upon by SAIC in the context of this report.

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ACRONYMS

BEAR	Baseline Environmental Analysis Report
BJC	Bechtel Jacobs Company LLC
CA	contamination area
CFR	<i>Code of Federal Regulations</i>
CROET	Community Reuse Organization of East Tennessee
DCGL	derived concentration guideline level
DCGL _{EMC}	derived concentration guideline level ^{elevated measurement comparison}
DOE	U. S. Department of Energy
dpm	disintegrations per minute
DQO	data quality objective
EBS	environmental baseline survey
ETTP	East Tennessee Technology Park
EU	exposure unit
HCA	high contamination area
m	meter
mg/kg	microgram per kilogram
mrem/hr	millirem per hour
NaI	sodium iodide
pCi/g	picocuries per gram
QA/QC	quality assurance/quality control
RADCON	Radiation Control (Organization)
RL	remediation level
μR/hr	microroentgen per hour

1. AREA TO BE SURVEYED

In 1998, a portion of Bldg. K-1006 was leased to the Community Reuse Organization of East Tennessee (CROET) as part of the reindustrialization efforts at the East Tennessee Technology Park (ETTP). The facility was subleased and is being used as an analytical laboratory. The 1998 lease did not include rooms C107, C107-A, C107-B, C107-C, and C107-D. The lease of these rooms is now desired. These rooms comprise the area to be surveyed.

Building K-1006 was constructed in 1960 and, as originally built, was a single-story structure with approximate dimensions of 120 ft wide by 150 ft long. It was constructed with a small basement of 1200 ft² located under a portion of the central section of the building. A two-story addition to the northeast section of the building was completed in 1985. The building now consists of five wings identified as Wings A through E.

A floor plan of Bldg. K-1006 is provided in Fig. 1.1. On the west end of Corridor C is Room C107. Additional rooms are located off of Room C107, including C107-A on the first floor and Rooms C107-B, C107-C, and C107-D located in the basement under Room C107 with access via a stairwell from Room C107. All rooms within scope are posted as one contiguous radioactive material area and contain five ventilation hoods (two in C107 and three in C107-B) that are posted as contamination areas (CAs). One piping unit in C107-C is posted as a high contamination area (HCA). The floor plans and location of the hoods and HCAs are illustrated in Figs. 1.2 and 1.3.

Room C107 contains two radiologically contaminated hoods and a workbench with a sink on the south wall that contains some radiological contamination. An overhead electrical hoist provides a heavy-lift capability into the basement through a grate-covered section of the flooring. It is known that a historical release of uranium gas occurred in Room C107.

The floors and walls of the basement are constructed of reinforced concrete. The basement is accessible by an outside concrete stairway (locked) on the west side of the building and in the interior by an open metal stairway, which connects the basement with the first floor. The basement contains radiologically contaminated hoods and a small, wall-mounted furnace that is radiologically contaminated. The furnace area is also contaminated with asbestos and is wrapped in plastic. The basement contains two sump pumps. One pump is located in the southwest corner of the basement. It is no longer in operation, but the drain is connected to the sanitary wastewater lines. Another sump pump is located in the northeast corner of the basement. The sump accumulates rainwater from a drain in the concrete floor area adjacent to the outside door of the basement, from steam condensate, and from a sink drain in the laboratory above the basement (C107).

Fig. 1.1. K-1006 building floor plan.

Fig. 1.2. C107 First Floor.

Fig. 1.3. C107 Basement.

2. HISTORY OF THE AREA

The building was constructed as a laboratory facility to support the gaseous diffusion uranium enrichment process. It also contains offices and administrative spaces for laboratory personnel. After the gaseous diffusion process was shut down in the mid-1980s, the building was used to provide research and development support to ETPP environmental, safety, and health programs; the Toxic Substances Control Act Incinerator; the Central Neutralization Facility; and other multi-site waste treatment activities. It also served as the chemistry laboratory for the Environmental Technology Technical Services Organization.

The activities currently conducted in Bldg. K-1006 utilize a variety of analytical techniques. Some of the major techniques being employed are X-ray analysis, electron microanalysis, and spectrochemical analysis.

In 1998, a portion of Bldg. K-1006 was leased to CROET as part of the reindustrialization efforts at ETPP. The facility was subleased and is being used as an analytical laboratory. The 1998 lease did not include Rooms C107, C107-A, C107-B, C107-C, and C107-D. Some demolition of furniture and decontamination activities has taken place for Rooms C107 and C107-B since the last radiological survey of those rooms.

In March 2009, a final remedial action (RA) was performed for the Bldg. K-1006 north basement sump. The Bldg. K-1006 north basement sump is a nominal 30-in.-diameter, 36-in.-deep concrete structure in the north corner of room C107B. The building receives groundwater in-leakage that is periodically pumped to the sewer system via this float-controlled pump. Solids in the bottom of the sump consisted of an estimated 1-ft³ coarse-grained material that varied in thickness from 0 to 4 in. with no suspended fraction.

The RA consisted of removing the water in the sump and then removing and sampling the solids. The solids were mixed with grout after removal and allowed to set. The solids were then disposed off-site at an approved disposal facility. The building sump will remain until the K-1006 building is demolished. The actions for the K-1006 sump are described in the revised Phased Construction Completion Report for Exposure Unit (EU) Z2-33, which received regulatory approval in December 2009.¹

3. EXISTING SURVEY DATA SUMMARY

The radiological baseline presented in the original Baseline Environmental Analysis Report (BEAR) was based on data compiled from routine radiological or down-posting surveys conducted by the Lockheed Martin Energy Systems, Inc., Radiation Control (RADCON) Organization in 1994, 1996, and 1997.

The highest radiological contamination readings recorded were 105,000 disintegrations per minute per 100 square centimeters (dpm/100 cm²) total beta/gamma on the floor of Room C107-B and 500,000 dpm/100 cm² total beta/gamma with 2400 dpm/100 cm² removable beta/gamma for Room C107-C (note: it is not clear if these readings are for the floor or wall since both are posted as HCAs). The locations of the 1996 survey total measurements are shown in Figs. 1.2 and 1.3. No elevated readings were seen in C107-D in the 1997 survey although previous survey data in 1994 indicated a

¹ DOE 2009, *Fiscal Year 2008 Phased Construction Completion Report for EU 22-33 in Zone 2, East Tennessee Technology Park, Oak Ridge, Tennessee*, DOE/OR/012368&D1/D2, U. S. Department of Energy, Oak Ridge, TN, August.

measurement of 101,000 dpm/100 cm² total beta/gamma and 9300 dpm/100 cm² removable beta/gamma. No down-posting surveys of this area were found; therefore, it is unknown whether the 1994 measurements of contamination were indicative of the building structure, or another source of contamination, such as a sample that was later removed.

Additional historical data exist for Rooms C107, C107-A, C107-B, C107-C, and C107-D for surveys conducted from 1998 to 2006. The surveys that were reviewed to develop this survey plan are listed in Table 3.1. The results are summarized in the following paragraphs.

Table 3.1. ETPP radiological surveys reviewed

120000207KA38022002	20010117KA36147001	2002200210290029339001
20031008K1SDESK003	20060410FPVDESK001	

ETPP = East Tennessee Technology Park.

Surveys of the basement Rooms C107-B, C107-C, and C107-D, including 10% scanning of floor surface, 14 random direct measurements, 9 smear sample measurements, and 4 dose rate measurements, were performed in 2000 while samples were being taken from the drains (Survey Number 20000207KA38022002). The highest direct measurement was 65,191 dpm/100 cm² beta/gamma. However, the HCAs were not surveyed.

Surveys of the first-floor Rooms C107 and C107-A, including 10% scans of the floors and walls and 19 direct measurements and 19 smear sample measurements of floors, walls, counter tops, and hoods, were performed in 2001 (Survey Number 20010117KA36147001). Surveys of the basement rooms C107-B, C107-C, and C107-D, including 10% scans of the floors and walls, 31 direct measurements of floors, walls, counter tops, and hoods, and 7 smear samples of hoods, were also performed in 2001. The highest direct measurement was 445,773 dpm/100 cm² beta/gamma. No dose rate measurements were performed in any areas.

Fifteen dose rate measurements were performed in Rooms C107, C107-A, C107-B, and C107-D in 2002 (Survey Number 2002200210290029339001). The highest dose rate measurement was 0.04 millirem per hour (mrem/hr). No measurements were performed in C107-C where there is an HCA.

Thirty-five smear sample measurements were performed of the flooring for the first-floor Rooms C107 and C107-A, and of the stairs in 2003 (Survey Number 20031008K1SDESK003). No removable contamination was detected.

Sixty-four direct measurements and 68 smear sample measurements were performed on the 5 hoods contained in Rooms C107 and C107-B in 2006 (Survey Number 20060410FPVDESK001). The highest direct measurement was 350,529 dpm/100 cm² beta/gamma, and 4 of the 64 direct measurements were greater than 220,000 dpm/100 cm². The highest smear measurement was 306 dpm/100 cm² alpha and 2809 dpm/100 cm² beta/gamma.

Two samples taken from floor drains in the basement rooms in 2000 were analyzed for uranium, ⁹⁹Tc, ¹³⁷Cs, and ⁶⁰Co. The detected sample results are shown in Table 3.2. Cobalt-60 was not detected. Technetium-99 was only detected at 0.16 picocuries per gram (pCi/g) in one of the samples and, therefore, was not included in the dose/risk analysis. The fraction of the calculated total alpha and total beta activity is also shown.

Table 3.2. Floor drain sample results

Radionuclide	Drain 1 (pCi/g)	Drain 2 (pCi/g)	Total alpha (pCi/g)	Total beta (pCi/g)	Fraction alpha	Fraction beta
Cs-137	66	288	0	354	0.000	0.570
U-234	40.6	38.1	78.7	0	0.367	0.127
U-235	2.56	2.45	5.01	5.01	0.023	0.008
U-238	44	87	131	262	0.610	0.211
Total			214.71	621.01		

pCi/g = picocuries per gram.

During the Bldg. K-1006 north basement sump RA, the solids removed from the sump were sampled for analysis. Solids sampling at location Z2-EU33B-327 revealed the presence of an Ra-Th decay series Max remediation level (RL) exceedance (41.64 pCi/g) and Avg RL exceedances for PCB-1254 (23,000 micrograms per kilogram [$\mu\text{g/kg}$]) and U-238 (116 pCi/g).

4. DATA QUALITY OBJECTIVES/PURPOSE

The conditions of Rooms C107, C107-A, C107-B, C107-C, and C107-D have changed since the period of time the surveys were made. Some equipment and furnishings were removed from the rooms in the 2006 time frame. There is now some exposed floor space that was not available for survey at the time the previous surveys were performed, and some contamination may have been removed. Furthermore, the size of the high contamination spots is unknown and could be important in the dose/risk modeling. Also, the analytical results for the samples taken from the floor drains may not be representative of the radionuclide distribution and activity ratios for the C107, C107-A, C107-B, C107-C, and C107-D rooms. The dose rate measurements performed in the rooms show a higher dose (40 microRoentgen per hour [$\mu\text{R/hr}$] = 77 mrem/yr max location) than is predicted by the models (4 mrem/yr max location). The difference may be at least partially explained if the dose measurements were made by placing the meter next to, or on top of, the contaminated spots rather than 1 meter (m) away as modeled. However, it may also be due to faulty assumptions for the radionuclide distribution and/or the size of the contaminated spots. The purpose of this supplemental survey is to collect additional data that will decrease the uncertainty in the dose and risk estimates. The additional measurements will be for the purpose of identifying the extent and activity distribution of the CAs, measurement of the dose rates to someone standing in front of the contaminated hoods with the sash down, and to identify either through in-field spectroscopic measurement or by sampling the radionuclide speciation of the major activity and external dose contributors. In addition, the area of the exposed floor that has not previously been surveyed will be scanned for radioactive contamination.

The data quality objectives have been detailed in the "Design of Radiological Surveys" document² (hereafter referred to as the "design document").

²BJC 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.

5. MEASUREMENT TECHNIQUES/SURVEY APPROACH

5.1 RADIONUCLIDES OF CONCERN

Process history of the ETTP site indicates that uranium (natural, depleted, and/or enriched uranium) would be the most prominent radiological contaminant potentially present in the K-1006 building due to analysis of process samples. Uranium-235 enrichment levels expected from operations since the early 1960s would be anticipated to be between 0.2 to 5.0. Other radionuclides (^{60}Co , ^{137}Cs , $^{89/90}\text{Sr}$, ^{237}Np , ^{99}Tc , and $^{238/239/240}\text{Pu}$) have also been detected on-site at ETTP. These other radionuclides originated from the introduction of contaminated materials from Oak Ridge National Laboratory and/or from the Hanford and Savannah River reactor returns uranium reprocessing program.

5.2 DETERMINATION OF THE RESIDUAL RADIOACTIVITY LIMITS (DCGLs)

The overall goal of this survey is to characterize the existing contamination for purposes of dose and risk modeling. As shown by modeling, the dose and risk obtained from exposure to radioactivity at the U. S. Department of Energy (DOE) surface contamination limits, as set forth in Title 10 *Code of Federal Regulations* (CFR) 835³ and also in DOE Order 5400.5,⁴ is less than that from the dose and risk criteria, as explained in 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 5.1), 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 level^{elevated measurement comparison} (DCGL_{EMC}), is normally 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. However, the DCGL_{EMC} will be set to three times the appropriate contamination limit, which equates to the contamination averaging criteria as set forth by DOE in 5400.5 for an elevated reading within a 1 square meter (m²) maximum size area.

Table 5.1. Contamination limits (DCGLs) for all survey units

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

DCGL = derived concentration guideline level.

DCGL_{EMC} = derived concentration guideline level^{elevated measurement comparison}

N/A = not applicable.

5.3 IDENTIFICATION OF SURVEY LOCATIONS

Areas to be surveyed include the HCA hoods and the contaminated sink/countertop in Room C107, the HCA hoods and the contaminated countertop and floor areas in room C107-B, and the exposed floor that has not previously been surveyed in room C107-B. No further examination of the contamination

³ CFR 1999. 10 *Code of Federal Regulations*, entitled *Occupational Radiation Protection*; the values are taken from Appendix D, "Surface Radioactivity Values."

⁴ 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."

found in Room C107-C is anticipated since it is expected that room will be closed and locked to prevent access under the lease. The locations of the identified CAs can be obtained by review of the historical radiological survey records.

5.4 INSTRUMENTATION SELECTION AND SURVEY TECHNIQUES

Refer to the design document for details on instrumentation selection. In general, alpha scintillation and beta-gamma Geiger-Müller detectors 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 to detect both alpha and beta-gamma radiations, will be used for as much of the scan surveys as possible, including the primary work surfaces, walls, and ceilings. Sodium iodide (NaI) meters and Bicron MicroRem[®] meters⁵ will also be used, as specified in this survey plan. Removable contamination surveys (i.e., smear surveys) may be conducted at locations where a fixed/total measurement is taken. All removable contamination survey smears will be counted on a gas-proportional counter calibrated to detect both alpha and beta-gamma radiations.

In addition, it is proposed that spectroscopic analysis of the gamma radiation from the major CAs be conducted to identify the radionuclide speciation. Either an NaI detector or a germanium detector may be used with a multi-channel analyzer to identify spectral energies of the gamma emitters. However, a germanium detector is preferred if available.

All surveys will be performed in accordance with established Bechtel Jacobs Company LLC (BJC) RADCON procedures (i.e., scan rate, probe distance, source checks, etc.).

6. SURVEY DESIGN

6.1 SURVEY PROCEDURES

All surveys are to be performed in accordance with this survey plan, the design document, and BJC RADCON procedures.⁶ Note: Survey technique is covered in the design document and will not be repeated in this plan. However, variations or clarifications of the design document will be included.

In any area where the survey indicates activity exceeding 5000 dpm/100 cm², direct alpha and beta-gamma measurements will be made following the establishment of a 1-m² grid as per DOE Order 5400.5 release criteria. The extent of the area that exceeds the release criteria will be determined and the maximum and average of each 1-m² grid will be recorded. 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 (1 m).

Any asbestos-controlled areas will be identified with any pertinent information on whether radiological contamination is suspected (i.e., ventilation hood, exhaust vents, posted radiological area,

⁵ 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.

⁶ Primarily EH-4516, "Radioactive Contamination Control and Monitoring," found in BJC-EH-4000, *Radiation Protection Program Description for Bechtel Jacobs Company LLC, Oak Ridge, Tennessee*.

etc.) but not entered as part of this survey. Any ventilation exhausts and air intakes in the survey footprint will be surveyed for contamination.

6.1.1.1 Survey of existing identified areas of contamination

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 and/or floor, and dose rate at that location are to be recorded. Dose rate measurements will be obtained at a minimum of in front of each hood with the sash closed and at 1 m from any identified CAs on counter tops and floors.

6.1.1.2 Survey of the exposed floor that has not previously been surveyed in Room C107-B

One hundred percent of the newly accessible floor surface will be scan surveyed using a floor monitor, NaI meter, or hand-held meters, as appropriate. At least one static measurement location will be chosen. In addition, smears and direct readings will be obtained from locations of the highest contamination with results greater than 25% of the DCGL as indicated by the scanning surveys. Any Class 2 areas that exceed the DCGL will be reclassified as Class 1 areas and surveyed accordingly.

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, describe the materials surveyed and their condition, and justify the contamination potential 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, will also 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 detection of surface contamination at levels that meet the requirements of this protocol. Supporting data are provided on each survey form.

A DOE Contractor RADCON Certified Health Physicist, or another designated health physicist, will review, evaluate, and validate the survey results, including assessment of the QA/QC information and data, prior to generation of the radiological survey report. The final radiological survey report will include the details of this assessment. It 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 BEAR.

9. REFERENCES

- BJC (Bechtel Jacobs Company LLC) 2000. *Design of Radiological Surveys of Potential Lease Space at East Tennessee Technology Park, Oak Ridge, Tennessee*, BJC/OR-554, Oak Ridge, TN, March.
- BJC 2002. *Design of Radiological Survey and Sampling to Support Title Transfer or Lease of Property on the Department of Energy Oak Ridge Reservation*, BJC/OR-554-R1, Oak Ridge, TN, September.
- BJC 2009. *Radiation Protection Program Description for Bechtel Jacobs Company LLC, Oak Ridge, Tennessee*, BJC-EH-4000/R3, Oak Ridge, TN, December 2009; available online at <http://www.bechteljacobs.com/pdf/proc/bjceh4000.pdf>.
- CFR 1999. *Occupational Radiation Protection*, 10 CFR 835, Appendix D, "Surface Radioactivity Values."
- DOE (U. S. Department of Energy) 1990a. *Radiation Protection of the Public and the Environment*, DOE Order 5400.5, Fig. IV-1, "Surface Contamination Guidelines," p. IV-6, Washington, D.C., February.
- DOE 1990b. *Radiation Protection of the Public and the Environment*, DOE Order 5400.5, Sect. IV.4.C, Washington, D.C.
- DOE 2009. *Fiscal Year 2008 Phased Construction Completion Report for EU 22-33 in Zone 2, East Tennessee Technology Park, Oak Ridge, Tennessee*, DOE/OR/012368&D1/D2, U. S. Department of Energy, Oak Ridge, TN, August.

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