# SEC Petition Evaluation Report
# Petition SEC-00202

Report Rev #: 0 Report Submittal Date: May 31, 2012

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| Subject Expert(s): | Jason Davis |
| Site Expert(s): | N/A |

| Petitioner Administrative Summary | | | |
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| **Petition Under Evaluation** | | | |
| Petition # | Petition Type | Petition A Receipt Date | DOE/AWE Facility Name |
| SEC-00202 | 83.14 | May 24, 2012 | Clarksville Modification Center, Ft. Campbell |

| **NIOSH-Proposed Class Definition** |
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| All employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors, who worked at the Clarksville Modification Center, Ft. Campbell, in Clarksville, Tennessee, from August 1, 1949 through December 31, 1967, for a number of work days aggregating at least 250 work days, occurring either solely under this employment, or in combination with work days within the parameters established for one or more other classes of employees included in the Special Exposure Cohort. |

| **Related Petition Summary Information** | | | |
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| **Related Evaluation Report Information** | |
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| **SEC Evaluation Approved By:** | [Signature on File]<br>*Stuart L. Hinnefeld* | 6/1/2012<br>*Date* |

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# Evaluation Report Summary: SEC-00202, Clarksville Modification Center, Ft. Campbell

This evaluation report by the National Institute for Occupational Safety and Health (NIOSH) addresses a class of employees proposed for addition to the Special Exposure Cohort (SEC) per the *Energy Employees Occupational Illness Compensation Program Act of 2000*, as amended, 42 U.S.C. § 7384 *et seq.* (EEOICPA) and 42 C.F.R. pt. 83, *Procedures for Designating Classes of Employees as Members of the Special Exposure Cohort Under the Energy Employees Occupational Illness Compensation Program Act of 2000*.

NIOSH-Proposed Class Definition

All employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors, who worked at the Clarksville Modification Center, Ft. Campbell, in Clarksville, Tennessee, from August 1, 1949 through December 31, 1967, for a number of work days aggregating at least 250 work days, occurring either solely under this employment, or in combination with work days within the parameters established for one or more other classes of employees included in the Special Exposure Cohort.

Feasibility of Dose Reconstruction Findings

The Clarksville Modification Center review was initiated by NIOSH based on the operational relationship between it and the Pantex Plant, and the results of the SEC-00068 evaluation for Pantex, which resulted in the recommendation of a SEC class. The Advisory Board on Radiation and Worker Health previously determined in its review of the SEC-00068 petition evaluation for the Pantex Plant in Amarillo, Texas, that there was insufficient access to process and source term information for various production activities to support estimate internal exposures for the period from January 1, 1958 to December 31, 1983. As was the case with the class evaluated in SEC-00068, NIOSH has not located any information indicating that urinalysis or other forms of internal monitoring were conducted to monitor for potential internal intakes at the Clarksville Modification Center, Ft. Campbell.

NIOSH lacks sufficient information, which includes internal personnel monitoring data, air monitoring data, process data, and radiological source term information to allow it to estimate with sufficient accuracy the potential internal exposures to uranium, plutonium, and tritium to which the proposed class may have been subjected. NIOSH finds that it is likely feasible to reconstruct external and occupational medical dose for Clarksville Modification Center workers with sufficient accuracy.

The NIOSH dose reconstruction feasibility findings are based on the following:

- Principal sources of internal radiation for members of the proposed class included exposures to tritium as a gas, weapons-grade plutonium, highly-enriched uranium, depleted uranium, Po-210 in a Po-Be neutron generator, and small activities of Cs-137 during the assembly, inspection, and disassembly of weapons components.

- NIOSH has found indications that air monitoring for tritium was called for in the plant operating procedures. However, NIOSH has been unable to locate any recorded results of this monitoring.

- NIOSH has not located any information indicating that urinalysis or other forms of internal monitoring were conducted to monitor for intakes of uranium, plutonium, or tritium.

- Principal sources of external radiation for members of the proposed class included exposures to weapons-grade plutonium, highly-enriched uranium, depleted uranium, Po-210 in a Po-Be neutron generator, a Co-60 radiography source, an Ir-192 radiography source, and small activities of Cs-137 during the assembly, inspection, and disassembly of weapons components.

- NIOSH has access to annual dosimetry reports from 1949 through 1959, and weekly reports from 1960 through the end of operations in 1965. Although it appears that NTA films were added to the dosimeters in 1958, and again from July 1962 through 1965, the results of these films do not appear on the dosimetry reports. However, NIOSH intends to use neutron-to-photon ratios based on data from similar operations to support reconstructing external neutron doses for members of the proposed class. NIOSH has also identified no information describing the medical X-ray examination requirements for the covered period at the site. NIOSH intends to use the available methodology for the era to support reconstructing medical X-ray for members of the proposed class.

- Because the monitored individuals would have been those workers with direct exposure to the devices being maintained at the plant, it is reasonable to assume that these badges represent the maximally-exposed individuals. Based on this data availability, and the available dose reconstruction methods, NIOSH believes that it is possible to either: (1) estimate the maximum external dose for every type of cancer for which radiation doses are reconstructed that could have been incurred under plausible circumstances by any member of the class; or (2) estimate the external doses to members of the class more precisely than a maximum dose estimate.

- Pursuant to 42 C.F.R. § 83.13(c)(1), NIOSH determined that there is insufficient information to either: (1) estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred under plausible circumstances by any member of the class; or (2) estimate the radiation doses of members of the class more precisely than a maximum dose estimate.

Although NIOSH found that it is not possible to completely reconstruct internal radiation doses for the proposed class, NIOSH intends to use any internal monitoring data that may become available for an individual claim (and that can be interpreted using existing NIOSH dose reconstruction processes or procedures). Therefore, dose reconstructions for individuals employed at Clarksville Modification Center, Ft. Campbell, during the period from August 1, 1949 through December 31, 1967, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate.

Health Endangerment Determination

The NIOSH evaluation did not identify any evidence supplied by the petitioners or from other resources that would establish that the class was exposed to radiation during a discrete incident likely to have involved exceptionally high-level exposures, such as nuclear criticality incidents or other

events involving similarly high levels of exposures. However, the evidence reviewed in this evaluation indicates that some workers in the class may have accumulated chronic radiation exposures through intakes of weapons-grade plutonium, highly-enriched uranium, depleted uranium, Po-210, and small activities of Cs-137, and from direct exposure to radioactive materials. Therefore, 42 C.F.R. § 83.13(c)(3)(ii) requires NIOSH to specify that health may have been endangered for those workers covered by this evaluation who were employed for a number of work days aggregating at least 250 work days within the parameters established for this class or in combination with work days within the parameters established for one or more other classes of employees in the SEC.

# Table of Contents



# Tables

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# SEC Petition Evaluation Report for SEC-00202

*ATTRIBUTION AND ANNOTATION: This is a single-author document. All conclusions drawn from the data presented in this evaluation were made by the ORAU Team Lead Technical Evaluator: Jason Davis; Oak Ridge Associated Universities. The rationales for all conclusions in this document are explained in the associated text.*

## 1.0 Purpose and Scope

This report evaluates the feasibility of reconstructing doses for employees who worked at a specific facility during a specified time. It provides information and analysis germane to considering a petition for adding a class of employees to the Congressionally-created SEC.

This report does not make any determinations concerning the feasibility of dose reconstruction that necessarily apply to any individual energy employee who might require a dose reconstruction from NIOSH, with the exception of the employee whose dose reconstruction could not be completed, and whose claim consequently led to this petition evaluation. The finding in this report is not the final determination as to whether or not the proposed class will be added to the SEC. This report will be considered by the Advisory Board on Radiation and Worker Health (the Board) and by the Secretary of Health and Human Services (HHS). The Secretary of HHS will make final decisions concerning whether or not to add one or more classes to the SEC in response to the petition addressed by this report.

This evaluation, in which NIOSH provides its findings both on the feasibility of estimating radiation doses of members of this class with sufficient accuracy and on health endangerment, was conducted in accordance with the requirements of EEOICPA and 42 C.F.R. § 83.14.

## 2.0 Introduction

Both EEOICPA and 42 C.F.R. pt. 83 require NIOSH to evaluate qualified petitions requesting that the Department of Health and Human Services add a class of employees to the SEC. The evaluation is intended to provide a fair, science-based determination of whether it is feasible to estimate, with sufficient accuracy, the radiation doses of the proposed class of employees through NIOSH dose reconstructions.[1]

NIOSH is required to document its evaluation in a report, and to do so, relies upon both its own dose reconstruction expertise as well as technical support from its contractor, Oak Ridge Associated Universities (ORAU). Once completed, NIOSH provides the report to both the petitioners and the Advisory Board on Radiation and Worker Health. The Board will consider the NIOSH evaluation report, together with the petition, comments of the petitioner(s) and such other information as the Board considers appropriate, to make recommendations to the Secretary of HHS on whether or not to add one or more classes of employees to the SEC. Once NIOSH has received and considered the advice of the Board, the Director of NIOSH will propose a decision on behalf of HHS. The Secretary

[1] NIOSH dose reconstructions under EEOICPA are performed using the methods promulgated under 42 C.F.R. pt. 82 and the detailed implementation guidelines available at http://www.cdc.gov/niosh/ocas.

of HHS will make the final decision, taking into account the NIOSH evaluation, the advice of the Board, and the proposed decision issued by NIOSH. As part of this final decision process, the petitioner(s) may seek a review of certain types of final decisions issued by the Secretary of HHS.[2]

# 3.0 NIOSH-Proposed Class Definition and Petition Basis

The Clarksville Modification Center review was initiated by NIOSH based on the operational relationship between it and the Pantex Plant, and the results of the SEC-00068 evaluation for Pantex, which resulted in the recommendation of a SEC class. The Board previously determined in its review of the SEC-00068 petition evaluation for the Pantex Plant in Amarillo, Texas, that there was insufficient access to process and source term information for various production activities to support estimate internal exposures for the period from January 1, 1958 to December 31, 1983. As was the case with the class evaluated in SEC-00068, NIOSH has not located any information indicating that urinalysis or other forms of internal monitoring were conducted to monitor for potential internal intakes at the Clarksville Modification Center, Ft. Campbell.

The NIOSH-proposed class includes all employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors who worked at the Clarksville Modification Center, Ft. Campbell, in Clarksville, Tennessee from August 1, 1949 through December 31, 1967, for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees in the Special Exposure Cohort. During this period, employees at this facility were involved in the storage, maintenance, assembly, and disassembly of uranium and plutonium weapons.

The evaluation responds to Petition SEC-00202 which was submitted by an EEOICPA claimant whose dose reconstruction could not be completed by NIOSH due to a lack of sufficient dosimetry-related information. NIOSH's determination that it is unable to complete a dose reconstruction for an EEOICPA claimant is a qualified basis for submitting an SEC petition pursuant to 42 C.F.R. § 83.9(b).

# 4.0 Radiological Operations Relevant to the Proposed Class

The following subsections summarize the radiological operations at the Clarksville Modification Center from August 1, 1949 through December 31, 1967 and the information available to NIOSH to characterize particular processes and radioactive source materials. Using available sources, NIOSH has attempted to gather process and source descriptions, information regarding the identity and quantities of radionuclides of concern, and information describing processes through which the radiation exposures of concern may have occurred and the physical environment in which they may have occurred. The information included within this evaluation report is meant only to be a summary of the available information.

[2] See 42 C.F.R. pt. 83 for a full description of the procedures summarized here. Additional internal procedures are available at http://www.cdc.gov/niosh/ocas.

## 4.1 Operations Description

Fort Campbell consists of approximately 164.5 square miles (105,347 acres) of land located approximately 50 miles northwest of Nashville, Tennessee on the border between Kentucky and Tennessee. Fort Campbell is roughly U-shaped, with the east-west dimension being approximately 21 miles and extending 13 miles in the north-south direction (Site Summary, 1996). The Clarksville Modification Center, Ft. Campbell, also known as the Clarksville Base, is located on the eastern side of Fort Campbell and occupies a 3.2-square mile portion of the base (Guide, 2002). For the period under evaluation, the Clarksville workforce consisted of a varying number of workers. NIOSH does not have access to sufficient information to determine the size of the workforce from 1949 through 1959. In 1960, the Mason & Hanger workforce at Clarksville totaled 118 individuals (Exposure Summary, 1960). This number increased gradually to a maximum of 230 individuals in 1964, plus the addition of 14 U.S. Atomic Energy Commission (AEC) personnel stationed at the facility (Exposure Summary, 1964).

The former nuclear weapons storage area at Fort Campbell was constructed for the AEC by the U.S. Army Corps of Engineers (COE) beginning in 1947 (Fort Campbell, 1998), with the first weapons arriving in 1949. The site was originally dedicated the Campbell Air Force Base on October 19, 1948 and was later renamed Clarksville. The site became fully operational on August 19, 1949 with the transfer of the 590$^{th}$ Aviation Squadron from Sandia Base to Clarksville to serve as the Special Weapons Assembly Team (Clarksville, 1962). The Clarksville facility was jointly operated by the AEC, Sandia Corporation, and various branches of the military during its operations as a weapons storage area from 1949 to 1958. Sandia Corporation personnel worked at this facility under contract to the AEC during this time frame (Site Summary, 1996).

Building 7740 (formerly Building 318) is one of seven underground tunnel complexes previously used to store and maintain nuclear capsules (warheads). Building 7741 (formerly Building 358) is an associated underground wastewater storage tank located just outside the tunnel complex. The Building 7740 tunnel complex consists of three wings or structures. Structure A contained the nuclear capsule storage area that was secured behind a bank-type locking vault door at the end of a 600 ft-long tunnel. Structures B and C were "maintenance" wings. Maintenance activities reportedly conducted in Structure C involved dismantling the nuclear assembly system, checking the activity of the fissile material, and replacing the polonium/beryllium initiators. Structure B was originally designated as a back-up for Structure C (Fort Campbell, 1998).

In 1958, the Clarksville facility was re-designated as the Clarksville Modification Center following the construction of the gravel gertie maintenance and assembly building (Guide, 2002). Between 1958 and 1966, Clarksville was operated solely by the AEC as a weapon assembly, modification, and disassembly facility under the stewardship of contractor Mason & Hanger (Site Summary, 1996). In September 1965, the AEC transferred nuclear weapon modification duties from the Clarksville facility to the Pantex Plant, and for the next four years the Defense Atomic Support Agency (DASA) used Clarksville for storage of classified materials (Agreement, 2004). When DASA discovered a build-up of radon gas in the buildings and tunnels, it shut down Clarksville, declared it surplus, and relinquished the facilities to Fort Campbell (Guide, 2002).

## 4.2 Radiation Exposure Potential from Operations

The potential for external radiation dose existed throughout the facility. Based on the site operations outlined in Section 4.1, sources of exposure included beta, gamma and neutrons emitted from plutonium, uranium, and polonium initiators, as well as from an Ir-192 and a Co-60 radiography source.

The primary sources of internal radiation exposure at the site were airborne uranium oxide and tritium gases generated during inspection, assembly, and disassembly of weapons and components, and enhanced radon in structures that were required to safely test nuclear weapons or components. Internal exposures from plutonium were likely small, since the plutonium components were clad or plated parts. Likewise any internal exposure resulting from Cs-137 in weapons parts was likely small.

## 4.3 Time Period Associated with Radiological Operations

Per the DOE Office of Health, Safety and Security, the time period associated with DOE operations at the Clarksville Modification Center is 1949-1967 (DOE, 2010). From the available documentation, NIOSH has learned that although site construction began in 1947, classified storage operations did not begin until 1949 (Clarksville, 1962; Fort Campbell, 1998). The site became fully operational on August 19, 1949 with the transfer of the 590$^{th}$ Aviation Squadron from Sandia Base to Clarksville to serve as the Special Weapons Assembly Team (Clarksville, 1962). The AEC and its contractor appear to have transferred operations to the Pantex plant and vacated the Clarksville facility in August 1965 (Army Study, 1986). This date also corresponds to the end of external personnel monitoring at the Clarksville facility, with the last badges being issued the week of August 23, 1965 (Dosage Reports, 1965). However, some uncertainty remains as to the precise end of radiological operations at the Clarksville facility. Other documents point to an operational end date of 1966 or 1967 (Fort Campbell, 1998; Site Summary, 1996).

## 4.4 Site Locations Associated with Radiological Operations

A Structures

"A" Structures were designed for the storage of nuclear capsules. Three types of "A" Structures are present at Clarksville: (1) those located within the tunnel complex; (2) those in converted, below-ground storage igloos; and (3) those within reinforced concrete above-ground structures (Site Summary, 1996).

The "A" Structure in the tunnel complex (Building 7740) consists of four small storage rooms, each approximately 10 feet wide, 13 feet deep, and 9 feet high and protected by a bank-type vault door. The entrance to the hallway leading to the four rooms is also protected by a vault door. Each room in a typical "A" Structure was capable of holding about 30 nuclear capsules at "critically" safe distances (Fort Campbell, 1998).

The storage containers were designed to prevent criticality from occurring. These containers consisted of a cylinder approximately 14 inches in diameter and 25 inches in height. Steel braces, welded to the top, bottom, and sides of the cylinders created a frame of much larger volume than the cylinder. These container assemblies were called "bird cages." The bird cages were slightly

pressurized to keep out moisture and sealed with lead-and-wire seals to ensure that their contents were not disturbed between authorized maintenance actions. Maintenance activities always took place in the "C" Structure, never in the vault where the capsules were stored. Therefore, no nuclear material was ever exposed in the storage vaults, and there was little or no potential for any release of radioactive material within the "A" Structures (Site Summary, 1996).

Two above-ground "A" Structures (Buildings 7877 and 7724) also contain four independent vault rooms entered through bank vault-type doors. The walls are 10-foot-thick reinforced concrete. The second story of the building is a solid layer of concrete that disguised the use of the building. The thick walls were designed to shield capsules stored in the vaults from external attacks, as opposed to containing accidental detonations within the building (Site Summary, 1996).

The remaining seven "A" Structures (Buildings 7704, 7708, 7726, 7728, 7732, 7734, and 7746) consist of earth-covered storage igloos set in excavated hillsides. These "A" Structures were converted from storage igloos for added capacity (Site Summary, 1996).

"C" Structures

Two "C" Structures were present at Clarksville; one was located within the tunnel complex and one was a surface structure. Building 7874, the surface "C" Structure, was used as a nuclear materials inspection laboratory/maintenance building for the first nuclear components stored at Fort Campbell. The building was constructed prior to the arrival of the special weapons in summer 1949. The "C" Structure provided bench space to perform required maintenance operations, storage locations for neutron calibration and assay sources, and support facilities that included a change room and storage areas. A back-up "C" Structure designated as a "B" Structure was also present in the tunnel complex. In addition, each "C" Structure had a ventilation system that prevented the release of uranium oxides into the atmosphere (Site Summary, 1996).

Nuclear capsules, in their critically-safe bird cages, were stored in the "A" Structures when they were not being maintained. Capsules removed for maintenance were transported in their bird cages. The lead security seals were removed in the "C" Structure prior to maintenance; following maintenance, the capsules were placed in their bird cages, sealed and returned to storage in the "A" Structure. Early weapons used polonium-beryllium initiators to generate neutrons during the explosion sequence. Because Po-210 has a half-life of approximately 138 days, the initiators had to be replaced periodically. According to former Sandia National Laboratory (SNL) personnel, these devices were maintained under precise quality control methods, using the following steps (Site Summary, 1996):

1. Release pressure from the bird cage container through a filter and check the filter for alpha activity; if no activity, remove the capsule from the container using a handling tool.

2. Place the capsule on a table top with an alpha probe at one end. (The table was covered with a large piece of butcher paper to contain any spalling of uranium oxides.)

3. Place a Plexiglas glove box over the capsule.

4. Disassemble the capsule parts and check the integrity of the coatings.

5. Remove the glove box.

6. Remove uranium oxide deposits from the threads using a small cloth or paper swipe and trichloroethylene (TCE). Wipe off the threads with ethyl alcohol to dry the components.

7. Use acetone to remove previous markings made with blue machinist's dye and make new markings. (Later components had serial numbers etched on the surface of the components.)

8. Check the activity of the fissile material using beta and gamma radiation measurements.

9. Assay the nuclear material by accurately weighing it and perform sub-critical multiplication measurements using external neutron sources.

10. Replace the polonium-beryllium initiators. (These were later replaced with non-radioactive initiators.)

11. Reassemble the capsule.

12. Place the capsule and a sack of desiccant in the bird cage container.

13. Screw on the bird cage container top. Re-pressurize and wire-seal the bird cage container. (Positive pressure was maintained to ensure dryness and to keep the O-rings in place).

After maintenance activities in the "C" Structure were completed, the used initiators were sent to Los Alamos National Laboratory (LANL) in New Mexico for storage, regeneration, or disposal. The spalled uranium oxides, swipes contaminated with solvents, lead-wire seals, and gloves were wrapped in the butcher paper and placed in 18 x 18 x 24-inch cardboard boxes. The boxes were presumably disposed of in the dry Low-Level Radioactive Waste (LLRW) disposal area (currently RW-17). Documentation indicates that this area received no free liquid waste (Site Summary, 1996).

Between 1954 and 1957, the polonium/beryllium initiators were replaced with a newer type of sealed neutron initiator that did not require routine replacement. Maintenance activities were reduced to annual disassembly of capsules to verify the integrity of the fissile materials. Maintenance of the newer capsules generated the same types of waste but in smaller quantities because of the infrequent maintenance schedule. By approximately 1960, capsules had been phased out of the stockpile and the maintenance activities at the "C" Structure ceased. After the "C" Structure operations were phased out, AEC maintenance activities did not involve any exposed nuclear material (Site Summary, 1996).

The external neutron sources used for fissile material assay were hermetically sealed and stored in a cylindrical-shaped source safe. The safe was located in a pit below the floor surface in the corner of the laboratory room of the "C" Structure. The sources were used approximately once a month. The concrete floor around the pit, along with a polyethylene plug placed directly above the stored sources, served as shielding. Below the neutron absorber, the source safe contained a tray for storing check sources used to verify the activity of the fissile material in the weapons. Source materials included radium, plutonium, and beryllium, and they imposed the same risk as the weapons' internal neutron sources if improperly discarded in the dry waste disposal area. The final disposition of the neutron sources is not known (Site Summary, 1996).

Assembly/Maintenance Buildings

The Assembly/Maintenance Buildings, known as "The Plants," were constructed to maintain non-nuclear weapons components. Two of these buildings were built at Clarksville (Buildings 7834 and 7811). Both buildings contain large bays and overhead rails capable of supporting weapons sub-assemblies for routine maintenance. These buildings featured heavy blast doors and earthworks that would have deflected the effects of an explosion upward. This design is typical for facilities in which large amounts of chemical explosives are handled. A battery storage room was located on the side of the main bay (Site Summary, 1996).

Activities included inspection and testing of mechanical and electrical systems. The bays used to test mechanical systems were equipped with explosion-proof fixtures and heavy vault doors. Both the mechanical and electrical maintenance areas contained a copper grounding strip along the walls and a spark-proof floor finish (Site Summary, 1996).

A former Sandia Corporation employee stated that, under direction of the AEC, weapons brought in for maintenance would first have their electrical components removed. Spark gap tubes containing Cs-137 were removed in the electrical maintenance bay and sent as classified material to Sandia or Los Alamos along with the polonium-beryllium initiators. Sandia personnel, using disposable gloves, tissues, and TCE, would then remove uranium oxide corrosion from the internal weapon spheres. These waste materials were subsequently placed in cardboard boxes and disposed of along with the low-level wastes from Buildings 7740 and 7874, the "C" Structures (Personal Communication, 2005).

Modification/Disassembly Plant

The AEC built a modification/disassembly plant at Clarksville for modifying and disassembling weapons. This facility consisted of a gravel gertie and an underground storage tank. These structures were added to the existing Plant 2 (Building 7811). High-explosive shells were removed from nuclear assemblies within the gravel gertie. Several tons of gravel were suspended on a wire mesh above the ceiling of the structure. The energy of an accidental explosion would be dissipated in lifting the gravel which would also act as a filter where the radioactive materials would be captured rather than being released into the air. The high-explosive portion of the weapon was a casting that contained paper and felt materials. Toluene was used to partially dissolve the high explosive to separate it from the paper and felt during the disassembly process. The solvent-and-explosives mixture was burned at a site outside of the Clarksville facility (Site Summary, 1996).

“S” Structure

Building 7825 was constructed for quality assurance inspections of stockpiled weapons. Quality assurance (QA) activities were the responsibility of the Sandia Corporation Quality Assurance Inspection Agency (QAIA). This "S" (or Surveillance) Structure was constructed in order to separate QA activities from the routine maintenance and assembly functions performed in Plants 1 and 2. Duties in this area included verifying that modifications to weapons were completed properly, and ensuring the functionality of electrical systems, mechanical systems, and limited-life components. Building 7825 contained electrical and mechanical bays, a calibration room, and a photographic darkroom. No wastes of concern would have been generated in this building with the possible exception of silver residue from the photographic darkroom (Site Summary, 1996).

Storage Igloos

A number of igloos were constructed for storage of weapon components, assembled weapons, and weapons casings. No maintenance activities took place in these igloos; therefore, there was virtually no potential for any release of radioactive or hazardous materials (Site Summary, 1996).

Low-Level Radioactive Waste Disposal Area

LLRW generated by maintenance activities in the "C" Structure (e.g., swipes, butcher paper, and gloves) typically was contained in 18 x 18 x 24-inch cardboard boxes. During the 1949-1958 period of operation, these boxes were presumably disposed of on site in the area identified as a waste burial ground on the Clarksville Facility Master Plan Basic Information Map. Documentation of the disposition of wastes generated from the Clarksville facility burial area has not been located (Site Summary, 1996).

Although the above-listed areas are specifically identified for the use of AEC-related radiological materials, documentation available to NIOSH does not indicate any definite boundaries between radiological and non-radiological areas for the period being evaluated.

NIOSH has determined that the site-specific and claimant-specific data available for the time period of this evaluation are insufficient to allow NIOSH to characterize worker movements across the Clarksville facility. NIOSH is therefore unable to define individual worker exposure scenarios based on specific work locations within the Clarksville facility during the period under evaluation.

## 4.5 Job Descriptions Affected by Radiological Operations

NIOSH has determined that the site-specific and claimant-specific data available for the Clarksville Modification Center for the time period under evaluation are insufficient to allow NIOSH to determine that any specific work group was not potentially exposed to radioactive material releases or possible subsequent contamination.

NIOSH has insufficient information associating job titles and/or job assignments with specific radiological operations or conditions. Without such information, NIOSH is unable to define potential radiation exposure conditions based on worker job descriptions.

# 5.0 Summary of Available Monitoring Data for the Proposed Class

The primary data used for determining internal exposures are derived from personal monitoring data, such as urinalyses, fecal samples, and whole-body counting results. If these are unavailable, the air monitoring data from breathing zone and general area monitoring are used to estimate the potential internal exposure. If personal monitoring and breathing zone area monitoring are unavailable, internal exposures can sometimes be estimated using more general area monitoring, process information, and information characterizing and quantifying the source term.

This same hierarchy is used for determining the external exposures to the cancer site. Personal monitoring data from film badges or thermoluminescent dosimeters (TLDs) are the primary data used to determine such external exposures. If there are no personal monitoring data, exposure rate surveys, process knowledge, and source term modeling can sometimes be used to reconstruct the potential exposure.

A more detailed discussion of the information required for dose reconstruction can be found in OCAS-IG-001, *External Dose Reconstruction Implementation Guideline,* and OCAS-IG-002, *Internal Dose Reconstruction Implementation Guideline*. These documents are available at: http://www.cdc.gov/niosh/ocas/ocasdose.html.

## 5.1 Data Capture Efforts and Sources Reviewed

As a standard practice, NIOSH completed an extensive database and Internet search for information regarding the Clarksville Modification Center, Ft. Campbell. The database search included the DOE Legacy Management Considered Sites database, the DOE Office of Scientific and Technical Information (OSTI) database, the Energy Citations database, and the Hanford Declassified Document Retrieval System. In addition to general Internet searches, the NIOSH Internet search included OSTI OpenNet Advanced searches, OSTI Information Bridge Fielded searches, Nuclear Regulatory Commission (NRC) Agency-wide Documents Access and Management (ADAMS) web searches, the DOE Office of Human Radiation Experiments website, and the DOE-National Nuclear Security Administration-Nevada Site Office-search. Attachment 1 contains a summary of Clarksville documents. The summary specifically identifies data capture details and general descriptions of the documents retrieved.

NIOSH is awaiting responses from the Fort Worth Federal Records Center, DOE Hanford, and Mason and Hanger Corporation for access to some information regarding the Clarksville Modification Center, Ft. Campbell. However, after review of the outstanding document titles by the DCAS Health Physics Lead Evaluator and DCAS Director, NIOSH feels that these documents would not provide any information that would change the feasibility determination for this site.

In addition to the database and Internet searches listed above, NIOSH identified and reviewed numerous data sources to determine information relevant to determining the feasibility of dose reconstruction for the class of employees under evaluation. This included determining the availability of information on personal monitoring, area monitoring, industrial processes, and radiation source materials. The following subsections summarize the data sources identified and reviewed by NIOSH.

## 5.2 Worker Interviews

To obtain additional information and confirm available information, NIOSH reviewed four interviews from its Site Research Database (SRDB). These interviews were conducted by telephone by Pacific Northwest National Laboratory staff with former Clarksville Modification Center employees or contractors temporarily working at the site.

- Personal Communication, 2005, *Personal Communication with Trainer*; Telephone Interview by Pacific Northwest National Laboratory; December 29, 2005 SRDB Ref ID: 46684

- Personal Communication, 2006a, *Personal Communication with Material Handler*; Telephone Interview by Pacific Northwest National Laboratory; February 2, 2006 SRDB Ref ID: 22290

- Personal Communication, 2006b, *Personal Communication with Material Handler/Mechanical Inspector*; Telephone Interview by Pacific Northwest National Laboratory; February 10, 2006 SRDB Ref ID: 22291

- Personal Communication, 2006c, *Personal Communication with Trainer*; Telephone Interview by Pacific Northwest National Laboratory; March 7, 2006 SRDB Ref ID: 22750

## 5.3 Internal Personnel Monitoring Data

NIOSH has access to the results of five urinalysis samples obtained for a single individual following a dust ingestion event on January 11, 1962. These samples were analyzed for depleted uranium (Urine, 1962). However, these samples seem to be a response to a single incident and do not appear to be indicative of a routine internal monitoring program.

There are indications that tritium urinalysis may have been conducted in-house at the Clarksville facility (Personal Communication, 2005). However, NIOSH has been unable to locate any documentation regarding this practice. To date, documentation available to NIOSH does not provide any indication that a routine bioassay monitoring program existed at the Clarksville Modification Center during the period under evaluation.

The NOCTS database was reviewed for claimants whose work history included the Clarksville facility during part or all of the covered period (1949 through 1967). A total of 92 claimants were identified. The files for 92 claimants were thoroughly reviewed and no internal monitoring data were found. This is consistent with above determination that insufficient monitoring existed.

## 5.4 External Personnel Monitoring Data

Sandia provided film badges for Clarksville radiation workers from July 1949 through 1960. NIOSH has access to a listing of annual summaries for 136 individuals spanning 1949 to 1960 (Exposures, 1949-1960).

The SNL radiation workers were monitored by film badges provided by SNL. Initially, the "film badge" consisted of a piece of dental X-ray film in a plastic pouch with a pin for clipping to clothing. Later, a lead filter was added to the plastic pouch. The Oak Ridge metal film badge holder with three filters was used from 1957 through 1958. NTA film for neutron dosimetry was added in 1958; there were no personal neutron dose measurements prior to 1958. Results from the film badges were likely reported on "cardex" dosimetry records, but the results of the NTA films do not appear on the dosimetry reports (Personal Communication, 2005).

Mason & Hanger assumed management responsibility for the Clarksville facility in 1959. No dosimetry records for 1959 through September 1960 could be found for Mason & Hanger workers. Weekly dosimetry reports from Tracerlab have been compiled from October 1, 1960 through June 30, 1962 with a few exceptions. The available dosimetry reports are summarized below in chronological order:

- 10/1/60 to 12/31/60: One control film badge and six worker film badges (with no IDs), weekly exchange frequency, results are all less than Minimum Recordable Dose (MRD) except one. Badge No. 6 was used as a test badge during the week of 12/26/60 and it recorded a gamma dose of 60 mrem. Dosimetry reports were addressed to the attention of G. R. Merchant. (Dosimetry, 2005)

- 10/1/60-12/31/60: AEC Form C-144, *Summary of Whole Body Radiation Exposures to External Penetrating Radiation Accumulated During the Year 1960*: 115 Mason & Hanger staff were not monitored, and three Mason & Hanger staff were monitored. All received doses less than 1 rem. Report was submitted by W. L. Kennedy. (Exposure Summary, 1960)

- 1961: AEC Form C-144, *Summary of Whole Body Radiation Exposures to External Penetrating Radiation Accumulated During the Year 1961*: 13 AEC-TONAO-CBO staff were not monitored, 143 Mason & Hanger staff were not monitored, and 25 Mason & Hanger staff were monitored and all received doses less than 1 rem. Report was submitted by W. L Kennedy. (Exposure Summary, 1961)

- 1/1/61 to 6/30/61: One control film badge and six worker film badges (with no IDs), weekly exchange frequency, results are all less than MRD. Report for week beginning 2/6/61 is missing. (Dosimetry, 2005)

- 7/1/61 to 12/31/61: One control film badge, six worker film badges (with no IDs), and four visitor film badges (with no IDs), weekly exchange frequency, results were all less than MRD except one. Worker No. 2 received 20 mrem gamma during the third quarter (but not reported on any weekly report). (Dosimetry, 2005)

- 1962: AEC Form AEC-190, *Summary of Whole Body Radiation Exposures to External Penetrating Radiation Accumulated During the Year 1962*: 14 USAEC-CBO staff were not monitored, 174 Mason & Hanger staff were not monitored, 27 Mason & Hanger staff were monitored and all received doses less than 1 rem. Report submitted by R. M. Kopansky. (Exposure Summary, 1962)

- 1/1/62 to 6/30/62: One control film badge, six worker film badges (with no IDs), and four visitor film badges (with no IDs), weekly exchange frequency. (Dosimetry, 2005)

- 7/2/62 to 12/31/62: Two control film badges, six worker film badges (with no IDs), and four visitor film badges (with no IDs), weekly exchange frequency. (Dosage Reports, 1962)

- 1963: AEC Form AEC-190, *Summary of Whole Body Radiation Exposures to External Penetrating Radiation Accumulated During the Year 1963*: 14 USAEC/CBO staff were not monitored, 213 Mason & Hanger staff were not monitored, 17 Mason & Hanger staff were monitored and all received doses less than 1 rem. Report submitted by R. M. Kopansky. (Exposure Summary, 1963)

- 1/7/63 to 12/30/63: Two control film badges, six worker film badges (with no IDs), and four visitor film badges (with no IDs), weekly exchange frequency. (Dosage Reports, 1963)

- 1964: AEC Form AEC-190, *Summary of Whole Body Radiation Exposures to External Penetrating Radiation Accumulated During the Year 1964*: 14 USAEC/CBO staff were not monitored, 203 Mason & Hanger staff were not monitored, 22 Mason & Hanger staff were monitored and all received doses less than 1 rem. Report submitted by R. M. Kopansky. (Exposure Summary, 1964)

- 1/6/64 to 12/28/64: Two control film badges, six worker film badges (with no IDs), and four visitor film badges (with no IDs), weekly exchange frequency. Weekly report summaries are missing for the dates from 7/27/64 through 9/14/64. Starting on 3/3/64 and continuing through the end of the year, the number of visitor badges increased to nine per week. (Dosage Reports, 1964)

- 1/4/65 to 8/23/65: One control film badges, six worker film badges (with no IDs), and nine visitor film badges (with no IDs), weekly exchange frequency. (Dosage Reports, 1965)

## 5.5 Workplace Monitoring Data

No records on environmental releases from the Clarksville Modification Center have been discovered. Prior to 1959, complete disassemblies were not performed at the Clarksville facility, only storage, maintenance, and inspection. Maintenance included replacement of major components. Plutonium and enriched-uranium sources in the weapons were always sealed, as were polonium in the initiators and other radionuclides in the radiography sources. There was risk of DU oxide contamination in the cells. The underground "C" Structure had exhaust vents at the top of the hillside over the tunnel. A blower system in each of the far rooms of both structures pulled air from these rooms and exhausted it through these outside vents (Fort Campbell, 1998).

According to an interview conducted by PNL in 2006, portable glove boxes with HEPA-filtered exhausts were used to contain oxidized DU when weapons underwent inspections, maintenance, and refurbishment during the Sandia years (Personal Communication, 2006c). The DU was cleaned from the nuclear components and deposited as solid waste on cleaning rags.

After tritium reservoirs became part of the weapons, tritium leaks into the disassembly cell and out the cell exhaust duct were possible. Safety procedures required that tritium monitoring be performed during tritium operations (Tritium, 1960). However, no documentation of these monitoring results has been found.

Procedures used for maintenance of uranium weapons described steps during which there were checks for alpha contamination on the outside of containers, indicating knowledge of the potential for contamination. A procedure described the use of a Plexiglas glove box, presumably to minimize or prohibit airborne contamination; other procedures described removing the oxidized DU during maintenance (Site Summary, 1996). NIOSH has not discovered any documentation of the results of these alpha checks.

The plutonium handled during Clarksville operations was plated and nothing was purposely done to compromise the barrier between the plutonium and the workspace. During the process of removing the Po-Be initiators, the parts were smeared and counted for alpha contamination (Site Summary, 1996). NIOSH has been unable to locate any record of the results of these swipes.

NIOSH has access to several uranium contamination surveys performed during the operational period. Surveys were conducted of 14 areas on May 26, June 25, July 24, and December 15, 1964 (Survey, 1964; Survey, 1965). Eleven samples were taken in five buildings on February 8, March 9, April 9, June 12, and August 9, 1965 (Survey, 1965). Although building and room numbers are listed on the survey reports, it is unclear exactly where in the buildings the samples were acquired, what types of operations were common to those areas, and what methods were used to acquire the measurements.

The 1996 site assessment states that during the years that Clarksville performed modifications and disassemblies:

> *The high explosive portion of the weapon was a casting that contained paper and felt materials. Toluene was used to partially dissolve the high explosive to separate it from the paper and felt during the disassembly process. The solvent and explosives mixture was burned at a site outside of Clarksville Base.* (Site Summary, 1996)

There is no information concerning the quantity of high explosives or DU contamination burned at Clarksville, nor has NIOSH been able to locate any records indicating that air monitoring was performed during these burns.

NIOSH has not uncovered any evidence of a routine radon monitoring program at Clarksville for the period under evaluation. Radon concentrations were measured at the Clarksville facility on several occasions from 1971 through 1986. A listing of all radon measurements up to March 1984 is provided in a memorandum from the Chief of the Fort Campbell Preventive Medicine Service to the Deputy Post Commander (Radon, 1984). The radon levels in the underground tunnel building (7740) are listed in Table 5-1.

**Table 5-1: Radon concentrations in the 7740 Building**

| Date Sampled | Agency Performing Sampling | Sample Results (pCi/L) |
|---|---|---|
| June 7-17, 1971 | AEHA | 152.48 |
| April 5-6, 1976 | USAPMS | 14.6<br>43.4 |
| November 20, 1981 | USAPMS | 21.4<br>33.4 |

Source: Fort Campbell, 1998

Another set of radon measurements was made by the U.S. Army Environmental Hygiene Agency (AEHA) in 1986 (Army Study, 1986). A summary discussion of these measurements is provided in *Relative Risk Site Evaluation for Buildings 7740 and 7741 Fort Campbell, Kentucky* (Fort Campbell, 1998). Building 7740 was not sampled in the 1986 study; it was unoccupied and sealed at the time. Neither the sampling method nor the time of day was mentioned in the previously-cited memorandum. However, with the tunnel complex sealed and unventilated, it is probable that diurnal fluctuations were dampened. The three sets of sampling were conducted in different seasons (November, April, June). Table 5-2 lists results of sampling in other Clarksville structures. The AEHA sampling

technique in 1986 was a 1-L grab sample of air obtained about 1 m above the floor with laboratory analysis conducted at the Aberdeen Proving Ground.

**Table 5-2: Radon concentrations in Clarksville Structures**

| Type of Structure | Building Number | Date Sampled | Sample Results (pCi/L) |
|---|---|---|---|
| Igloo | 7704 | June 7-17, 1971 | 8.60[a] |
| | | November 20, 1981 | 3.90[a] |
| Igloo | 7708 | June 7-17, 1971 | 4.53[a] |
| | | October 30, 1981 | 3.20[a] |
| Igloo | 7726 | June 7-17, 1971 | 15.86[a] |
| | | October 30, 1981 | 9.70[a] |
| Igloo | 7728 | February 26-27, 1979 | 0.60, 0.50, 0.20, 0.10[a] |
| Above-ground, concrete ceiling, and 10-ft thick concrete walls | 7724 | September 29, 1981 | 3.30[a] |
| Hallway outside Gravel Gertie | 7811 | March 3, 1986 | 8.9 ±0.3[b] |
| Inside Gravel Gertie | 7811 | March 3, 1986 | 10±0.4[b] |

[a] Radon, 1984
[b] Army Study, 1986

## 5.6 Radiological Source Term Data

Early weapons designs were of the in-flight insertable variety. Weapons of this type had removable nuclear capsules (also known as the physics package or pit) and were stored in a bird cage. The bird cage ensured storage in a criticality-safe manner. The capsules were pressure-sealed. The bird cages would hold the nuclear weapon, comprised of plutonium, highly enriched uranium (HEU), and Po-Be initiator. Periodic maintenance was required on these early weapon pits to exchange the Po-Be initiators due to the short half-life of Po-210.

Later weapon designs did not use the in-flight insertable concept or the Po-Be initiator, thereby eliminating the need to disassemble the weapon pit for modification. The Po-Be initiator was phased out over time until 1956 and replaced by external neutron generators. These weapon pits are referred to as sealed pit designs and they included the potential for tritium exposure. The introduction of tritium could have occurred as early as 1954 (Personal Communication, 2006c).

Another source of radioactive material used in early nuclear weapons was the spark gap tube. These tubes were part of the firing circuits and were used to switch large amounts of electrical current. A small amount of Cs-137 was used in spark gap tubes to stabilize the electrical properties. These tubes, which were manufactured of thick glass to prevent breakage, would be a minor exposure pathway (Personal Communication, 2006c).

As part of the maintenance activities, Clarksville personnel performed radiographs of the weapon components using a large Co-60 source. The exact location of this source was not discovered but the newer "C" Structure is a likely candidate (Personal Communication, 2006c).

In summary, the radioactive materials of interest at the Clarksville facility are tritium as a gas, weapons-grade plutonium, HEU, depleted uranium (DU; also used in weapons construction), radon, Po-210 in a Po-Be neutron generator, a Co-60 radiograph source, and small activities of Cs-137. However, the documentation does not provide sufficient information on specific radionuclides, quantities, or forms of the source materials used at any given time during the period under evaluation. NIOSH is unable to make reasonable assumptions about source terms, concentrations, or radiological equilibrium conditions at the Clarksville facility.

# 6.0 Feasibility of Dose Reconstruction for the Proposed Class

42 C.F.R. § 83.14(b) states that HHS will consider a NIOSH determination that there was insufficient information to complete a dose reconstruction, as indicated in this present case, to be sufficient, without further consideration, to conclude that it is not feasible to estimate the levels of radiation doses of individual members of the class with sufficient accuracy.

In the case of a petition submitted to NIOSH under 42 C.F.R. § 83.9(b), NIOSH has already determined that a dose reconstruction cannot be completed for an employee at the DOE or AWE facility. This determination by NIOSH provides the basis for the petition by the affected claimant. Per § 83.14(a), the NIOSH-proposed class defines those employees who, based on completed research, are similarly affected and for whom, as a class, dose reconstruction is similarly not feasible.

This section of the report summarizes research findings by which NIOSH determined that it lacked sufficient information to complete the relevant dose reconstruction and on which basis it has defined the class of employees for which dose reconstruction is not feasible. NIOSH's determination relies on the same statutory and regulatory criteria that govern consideration of all SEC petitions.

## 6.1 Feasibility of Estimating Internal Exposures

NIOSH has evaluated the available personnel and workplace monitoring data and source term information and has determined that there are insufficient data for estimating internal exposures, as described below.

The few uranium urinalysis records available to NIOSH for the period under evaluation seem to be a response to a single incident and do not appear to be indicative of a routine internal monitoring program. There are indications that tritium urinalysis may have been conducted in-house at the Clarksville Modification Center (Personal Communication, 2005). However, NIOSH has been unable to locate any documentation regarding this practice. To date, documentation available to NIOSH does not provide any indication that a routine bioassay monitoring program existed at Clarksville during the period under evaluation.

Although NIOSH has indications that routine tritium air monitoring and contamination swipes were performed at Clarksville, NIOSH has been unable to locate the results of any of these monitoring practices (Personal Communication, 2005; Site Summary, 1996; Tritium, 1960). NIOSH has no indications that a routine radon air monitoring program was in place during the years of operation.

NIOSH has located very little documentation as to quantities of radiological materials shipped to Clarksville for processing or testing. It is clear from reports and worker communications that the Clarksville employees worked with uranium, tritium, and plutonium. However, without additional documentation, ORAUT can make no assumption about the quantities or forms of the source materials that may have been used or stored on site at any time during the period under evaluation.
In the absence of adequate internal dose monitoring criteria and adequate personnel monitoring data, NIOSH has not found sufficient general area air sampling, breathing zone air sampling, site survey, or source term information to allow it to bound potential exposures, or to demonstrate that workers were adequately monitored for potential exposures to radioactive materials at Clarksville during the AEC operational period. NIOSH has determined that reconstruction of the total internal doses received from exposures to uranium, uranium progeny, plutonium, and tritium is not feasible using the information available to NIOSH for the period under evaluation from August 1, 1949 through December 31, 1967.

Although NIOSH found that it is not possible to completely reconstruct internal radiation doses for the period from August 1, 1949 through December 31, 1967, NIOSH intends to use any internal monitoring data that may become available for an individual claim (and that can be interpreted using existing NIOSH dose reconstruction processes or procedures). Dose reconstructions for individuals employed at Clarksville Modification Center during the period from August 1, 1949 through December 31, 1967, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate.

## 6.2 Feasibility of Estimating External Exposures

This evaluation responds to a petition based on NIOSH determining that internal radiation exposures to tritium as a gas, weapons-grade plutonium, radon, highly-enriched uranium, and depleted uranium could not be reconstructed for a dose reconstruction referred to NIOSH by the Department of Labor (DOL). As noted above, HHS will consider this determination to be sufficient without further consideration to determine that it is not feasible to estimate the levels of radiation doses of individual members of the class with sufficient accuracy. Consequently, it is not necessary for NIOSH to fully evaluate the feasibility of reconstructing external radiation exposures for the class of workers covered by this report.

NIOSH has access to annual dosimetry reports from 1949 through 1959 and weekly reports from 1960 through the end of operations in 1965. Although it appears that NTA films were added to the dosimeters in 1958, and again from July 1962 through 1965, the results of these films do not appear on the dosimetry reports. However, NIOSH intends to use neutron-to-photon ratios based on data from similar operations to support reconstructing external neutron doses for members of the proposed class. NIOSH has also identified no information describing the medical X-ray examination requirements for the covered period at the site. NIOSH intends to use the available methodology for the era to support reconstructing medical X-ray for members of the proposed class.

The routine practice at the Clarksville Modification Center appears to have required assigning dosimeters to personnel designated as radiation workers who could receive an external radiation dose greater than 10% of the Radiation Protection Guidelines in effect. Because these individuals would have been those workers with direct exposure to the devices being maintained at the plant, it is reasonable to assume that these badges represent the maximally-exposed individuals.

Based on this data availability, and the available dose reconstruction methods, NIOSH believes that it is possible to either: (1) estimate the maximum external dose for every type of cancer for which radiation doses are reconstructed that could have been incurred under plausible circumstances by any member of the class; or (2) estimate the external doses to members of the class more precisely than a maximum dose estimate.

## 6.3 Class Parameters Associated with Infeasibility

NIOSH has learned that although construction of the site began in 1947, classified storage operations did not begin until 1949 (Clarksville, 1962; Fort Campbell, 1998). The site became fully operational on August 19, 1949 with the transfer of the 590th Aviation Squadron from Sandia Base to Clarksville to serve as the Special Weapons Assembly Team (Clarksville, 1962). The AEC and its contractor transferred operations to the Pantex plant and vacated the Clarksville facility in August 1965 (Army Study, 1986). This date also corresponds to the end of external personnel monitoring at Clarksville, with the last badges being issued the week of August 23, 1965 (Dosage Reports, 1965). However, NIOSH does not have access to specific documentation indicating the exact dates of the removal of all radiological materials from the facility. Some uncertainty remains as to the precise end of radiological operations at the Clarksville Modification Center. Other documents point to an operational end date of 1966 or 1967 (Fort Campbell, 1998; Site Summary, 1996). NIOSH therefore recommends that the class include the time period from August 1, 1949 through December 31, 1967.

As stated in Section 4.4, documentation available to NIOSH does not indicate any definite boundaries between radiological and non-radiological areas at the Clarksville facility for the period under evaluation. NIOSH is therefore unable to define individual worker exposure scenarios based on specific work locations. NIOSH recommends that the class definition include all areas of the Clarksville Modification Center, Ft. Campbell, during the time period under evaluation.

Documentation available to NIOSH suggests a distinction between which job functions would have occasion to be exposed to radioactive materials. However, this documentation does not clearly indicate that any class of workers would have had no potential for exposure to radiological materials during routine operations at Clarksville. NIOSH therefore recommends that the class include all employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors.

# 7.0 Summary of Feasibility Findings for Petition SEC-00202

This report evaluates the feasibility for completing dose reconstructions for employees at Clarksville Modification Center, Ft. Campbell, from August 1, 1949 through December 31, 1967. NIOSH determined that members of this class may have received radiation exposures from uranium, plutonium, and tritium. NIOSH lacks sufficient information, which includes monitoring data, sufficient air monitoring information, or sufficient process and radiological source information, that would allow it to estimate the potential neutron exposures or concentrations of plutonium, uranium, and tritium to which the proposed class may have been exposed.

NIOSH has documented herein that it cannot complete the dose reconstruction related to this petition. The basis of this finding demonstrates that NIOSH does not have access to sufficient information to

estimate either the maximum radiation dose incurred by any member of the class or to estimate such radiation doses more precisely than a maximum dose estimate.

Based on this data availability, NIOSH believes that it is possible to either: (1) estimate the maximum external dose for every type of cancer for which radiation doses are reconstructed that could have been incurred under plausible circumstances by any member of the class; or (2) estimate the external doses to members of the class more precisely than a maximum dose estimate.

Although NIOSH found that it is not possible to completely reconstruct radiation doses for the proposed class, NIOSH intends to reconstruct external exposures and use any internal monitoring data that may become available for an individual claim (and that can be interpreted using existing NIOSH dose reconstruction processes or procedures). Therefore, dose reconstructions for individuals employed at the Clarksville Modification Center, Ft. Campbell, during the period from August 1, 1949 through December 31, 1967, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate.

NIOSH is awaiting responses from the Fort Worth Federal Records Center and Mason and Hanger Corporation for access to some information regarding the Clarksville Modification Center, Ft. Campbell. However, after review of the outstanding document titles by the DCAS Health Physics Lead Evaluator and DCAS Director, NIOSH feels that these documents would not provide any information that would change the feasibility determination for this site.

# 8.0 Evaluation of Health Endangerment for Petition SEC-00202

The health endangerment determination for the class of employees covered by this evaluation report is governed by EEOICPA and 42 C.F.R. § 83.14(b) and § 83.13(c)(3). Pursuant to these requirements, if it is not feasible to estimate with sufficient accuracy radiation doses for members of the class, NIOSH must determine that there is a reasonable likelihood that such radiation doses may have endangered the health of members of the class. The regulations require NIOSH to assume that any duration of unprotected exposure may have endangered the health of members of a class when it has been established that the class may have been exposed to radiation during a discrete incident likely to have involved levels of exposure similarly high to those occurring during nuclear criticality incidents. If the occurrence of such an exceptionally high-level exposure has not been established, then NIOSH is required to specify that health was endangered for those workers who were employed for a number of work days aggregating at least 250 work days within the parameters established for the class or in combination with work days within the parameters established for one or more other classes of employees in the SEC.

NIOSH has determined that members of the class were not exposed to radiation during a discrete incident likely to have involved levels of exposure similarly high to those occurring during nuclear criticality incidents. However, the evidence reviewed in this evaluation indicates that some workers in the class may have accumulated chronic radiation exposures through intakes of radionuclides and from direct exposure to radioactive materials. Consequently, NIOSH is specifying that health was endangered for those workers covered by this evaluation who were employed for a number of work days aggregating at least 250 work days within the parameters established for this class or in

combination with work days within the parameters established for one or more other classes of employees in the SEC.

# 9.0 NIOSH-Proposed Class for Petition SEC-00202

The evaluation defines a single class of employees for which NIOSH cannot estimate radiation doses with sufficient accuracy. This class includes all employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors, who worked at the Clarksville Modification Center, Ft. Campbell, in Clarksville, Tennessee, from August 1, 1949 through December 31, 1967, for a number of work days aggregating at least 250 work days, occurring either solely under this employment, or in combination with work days within the parameters established for one or more other classes of employees included in the Special Exposure Cohort.

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42 C.F.R. pt. 83, *Procedures for Designating Classes of Employees as Members of the Special Exposure Cohort Under the Energy Employees Occupational Illness Compensation Program Act of 2000*; Final Rule; May 28, 2004; SRDB Ref ID: 22001

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# Attachment 1: Data Capture Synopsis

| Table A1-1: Data Capture Synopsis for the Clarksville Modification Center, Ft. Campbell | | | |
|---|---|---|---|
| **Data Capture Information** | **General Description of Documents Captured** | **Date Completed** | **Uploaded To SRDB** |
| Primary Site / Company Name: Clarksville Facility; DOE 1949-1967<br><br>Alternate Site Names:<br>Ft. Campbell<br>Mason & Hanger - Clarksville Base<br><br>Physical Size of the Site: 2600 Acres<br>Site Population: ~200 during 1958-1965 period | No relevant documents identified at Ft. Campbell. Continuing effort with Mason & Hanger Corporation, Government Services, no records identified at this time. | OPEN | NA |
| State Contacted: TN Division of Radiological Health (615) 532-0364, KY Cabinet for Health Services-Radiation Health Branch [Phone no. redacted] | No relevant documents identified. | 04/18/2012 | 0 |
| Clarksville County Library | No relevant documents identified. | 04/06/2012 | 0 |
| DOE Albuquerque Operations Office | An environmental impact statement and neutron dose threshold detectors. Awaiting response to data request Sandia-FY12-004 (keyword search). | OPEN | 2 |
| DOE Germantown | Site summary. | 11/07/2005 | 1 |
| DOE Hanford | Relative risk evaluation for buildings 7740/7741 and ventilation for indoor air quality. Awaiting response to Hanford Data Capture Activity 67. | 5/16/2012 | 3 |
| DOE Legacy Management - Grand Junction Office | Radioactive monuments for posterity. | 02/10/2010 | 2 |
| DOE Legacy Management - MoundView (Fernald Holdings, includes Fernald Legal Database) | Article indicating Clarksville pending shutdown. | 05/18/2010 | 1 |
| DOE Oak Ridge Operations Office | Awaiting response to data request ORO-FY12-008 (involves one box of information). | OPEN | NA |
| DOE Pacific Northwest National Laboratory (PNNL) | Personnel interview, analysis of indoor radon and evaluation and control of radon in soil. | 03/02/2006 | 4 |
| DOE Pantex | A radiological investigation, exposure reports, and building 12-26 evacuation. Working with Department of Energy Point of Contact and site to access records at Fort Worth Federal Records Center and onsite. | OPEN | 7 |

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|---|---|---|---|
| **Data Capture Information** | **General Description of Documents Captured** | **Date Completed** | **Uploaded To SRDB** |
| DOE Pantex / SC&A | Annual report of radiation exposures, Contract AT(29-2)-756 "Scope of Work", change in tritium safety and air monitoring requirements, contamination survey, film, x-ray, calibration and neutron procedures, organization chart and position descriptions, and radiation protection reports. | 06/30/2011 | 14 |
| DOE Sandia National Laboratories, NM | Radiation exposure information and site visit notes. | 01/12/2011 | 4 |
| Eastern Kentucky University Library | Safety policy program and operations manual, criticisms of Clarksville, and the Nuclear Weapon Safety Program for AEC owned facilities. | 05/06/2009 | 5 |
| Internet - Defense Technical Information Center (DTIC) | No relevant documents identified. | 04/04/2012 | 0 |
| Internet - DOE Comprehensive Epidemiologic Data Resource (CEDR) | No relevant documents identified. | 04/17/2012 | 0 |
| Internet - DOE Hanford Declassified Document Retrieval System (DDRS) | No relevant documents identified. | 03/28/2012 | 0 |
| Internet - DOE Legacy Management Considered Sites | No relevant documents identified. | 03/28/2012 | 0 |
| Internet - DOE National Nuclear Security Administration (NNSA) - Nevada Site Office | No relevant documents identified. | 03/28/2012 | 0 |
| Internet - DOE OpenNet | AFSWP history, annual report to Congress of the Atomic Energy Commission, history of the defense atomic support agency summary, human radiation research Ft. Campbell, KY, HUMPRO research during four Army training exercises involving atomic weapons, manufacturing statement for weapons production schedule of transfers, overexposure to ionizing radiation, progress report, records of human radiation research, shipping report for assemblies to Mason and Hanger, summary of purchase order status report, and volunteers for atomic effects experiments. NOTE: 6 documents were added by Site Association Review. | 03/28/2012 | 40 |
| Internet - DOE OSTI Energy Citations | Design progress report roof mounted shield. | 03/28/2012 | 1 |
| Internet - DOE OSTI Information Bridge | No relevant documents identified. | 03/28/2012 | 0 |

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|---|---|---|---|
| **Data Capture Information** | **General Description of Documents Captured** | **Date Completed** | **Uploaded To SRDB** |
| Internet - Google | Abandoned secret underground nuclear base, annual report to Congress of the Atomic Energy Commission, Clarksville base history, conditional approval of release characterization final RCRA facility investigation report, decision and order of the Department of Energy regarding appeal, deconstructing buildings at Fort Campbell, Pantex Plant fact sheet, environmental assessment, scientific basis for managing DOE's excess nuclear materials, groundwater monitoring and contamination report, NRC licensing actions, Pantex plant history, weapons of mass destruction, radiation exposure information request, Leaf Chronicle article, verification of the status of excess warhead production capacity, and weapons storage sites/Q area. | 04/14/2012 | 38 |
| Internet - Health Physics Journal | No relevant documents identified. | 04/17/2012 | 0 |
| Internet - Journal of Occupational and Environmental Hygiene | No relevant documents identified. | 04/17/2012 | 0 |
| Internet - National Academies Press (NAP) | Deactivating and decommissioning Department of Energy facilities. NOTE: this document was added by Site Association Review. | 04/04/2012 | 1 |
| Internet - NIOSH | Advisory Board review of Clarksville and Medina Site Profiles. | 03/26/2012 | 1 |
| Internet - NRC Agencywide Document Access and Management (ADAMS) | Letha leftovers - future in storing plutonium. NOTE: 1 document added by Site Association Review. | 04/05/2012 | 2 |
| Internet - USACE/FUSRAP | No relevant documents identified. | 04/17/2012 | 0 |
| Internet - US Transuranium and Uranium Registries | No relevant documents identified. | 04/16/2012 | 0 |
| Mound Museum | Stockpile sampling program and weapons production schedule of transfers. | 07/14/2008 | 3 |
| ORAU Team | Personnel interview, dosimetry records, contamination levels or limits, and a site profile. | 07/28/2008 | 6 |
| SAIC | Annual summary of whole body exposure. | 09/02/2004 | 1 |
| Sandy Cohen & Associates (SC&A) | A receiving inspection. | 07/02/2008 | 1 |
| Unknown | Dosimetry reports, articles on nuclear weapons, and a request for special quota-enriched uranium. | 09/11/2002 | 5 |
| Unknown / SC&A | Dosimetry reports. | 08/09/2003 | 1 |
| **TOTAL** | | | **143** |

| Table A1-2: Databases Searched for the Clarksville Modification Center, Ft. Campbell | | | |
|---|---|---|---|
| **Database/Source** | **Keywords / Phrases** | **Hits** | **Selected** |
| NOTE: Database search terms employed for each of the databases listed below are available in the Excel file called "Clarksville Facility Rev 00, (83.14) 04-20-12" | | | |
| Defense Technical Information Center (DTIC)<br>https://www.dtic.mil/<br>COMPLETED 04/04/2012 | See Note above | 6 | 0 |
| DOE CEDR<br>http://cedr.lbl.gov/<br>COMPLETED 04/17/2012 | See Note above | 0 | 0 |
| DOE Hanford DDRS<br>http://www2.hanford.gov/declass/<br>COMPLETED 03/28/2012 | See Note above | 0 | 0 |
| DOE Legacy Management Considered Sites<br>http://csd.lm.doe.gov/<br>COMPLETED 03/28/2012 | See Note above | 0 | 0 |
| DOE NNSA - Nevada Site Office<br>www.nv.doe.gov/main/search.htm<br>COMPLETED 03/28/2012 | See Note above | 0 | 0 |
| DOE OpenNet<br>http://www.osti.gov/opennet/advancedsearch.jsp<br>COMPLETED 03/28/2012 | See Note above | 138 | 34 |
| DOE OSTI Energy Citations<br>http://www.osti.gov/energycitations/<br>COMPLETED 03/28/2012 | See Note above | 161 | 1 |
| DOE OSTI Information Bridge<br>http://www.osti.gov/bridge/advancedsearch.jsp<br>COMPLETED 03/28/2012 | See Note above | 62 | 0 |
| Google<br>http://www.google.com<br>COMPLETED 04/14/2012 | See Note above | 21,717,792 | 38 |
| HP Journal<br>http://journals.lww.com/health-physics/pages/default.aspx<br>COMPLETED 04/17/2012 | See Note above | 0 | 0 |

| Table A1-2: Databases Searched for the Clarksville Modification Center, Ft. Campbell | | | |
|---|---|---|---|
| **Database/Source** | **Keywords / Phrases** | **Hits** | **Selected** |
| Journal of Occupational and Environmental Health<br>http://www.ijoeh.com/index.php/ijoeh<br>COMPLETED 04/17/2012 | See Note above | 0 | 0 |
| National Academies Press<br>http://www.nap.edu/<br>COMPLETED 04/04/2012 | See Note above | 16 | 0 |
| NRC ADAMS Reading Room<br>http://www.nrc.gov/reading-rm/adams/web-based.html<br>COMPLETED 04/05/2012 | See Note above | 69 | 1 |
| USACE/FUSRAP<br>http://www.lrb.usace.army.mil/fusrap/<br>COMPLETED 04/17/2012 | See Note above | 6 | 0 |
| U.S. Transuranium & Uranium Registries<br>http://www.ustur.wsu.edu/<br>COMPLETED 04/16/2012 | See Note above | 0 | 0 |

| Table A1-3: Interlibrary Loan Documents Requested for the Clarksville Modification Center, Ft. Campbell | | | |
|---|---|---|---|
| **Document Number** | **Document Title** | **Requested Date** | **Received Date** |
| NA | Atomic Audit: The Costs and Consequences of U. S. Nuclear Weapons Since 1940 | 04/13/2012 | |