SEC Petition Evaluation Report
Petition SEC-00160

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Site Expert(s):	N/A

Petitioner Administrative Summary			
Petition Under Evaluation			
Petition #	Petition Type	Petition A Receipt Date	DOE/AWE Facility Name
SEC-00160	83.14	December 18, 2009	Lawrence Berkeley National Laboratory (LBNL)

NIOSH-Proposed Class Definition
All employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors who worked at the Lawrence Berkeley National Laboratory in Berkeley, California, from August 13, 1942 through December 31, 1961, 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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Evaluation Report Summary: SEC-00160, Lawrence Berkeley National Laboratory

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 Lawrence Berkeley National Laboratory in Berkeley, California, from August 13, 1942 through December 31, 1961, 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

NIOSH lacks sufficient information, which includes personnel monitoring, workplace monitoring, and source term data, to allow it to estimate with sufficient accuracy the level of radiation doses that could have been incurred by individual members of the proposed class. NIOSH's feasibility findings include the following:

Internal Dose Reconstruction Feasibility

- Principal sources of internal radiation doses for members of the proposed class included exposures to uranium, transuranic elements, and various other radioactive materials.

- Prior to 1962, internal dose monitoring data available to NIOSH are insufficient for purposes of dose reconstruction or for bounding internal doses. Consequently, NIOSH finds that it is not feasible to estimate with sufficient accuracy, or to bound, internal doses to members of the proposed class before 1962. By 1962, the internal dosimetry program at LBNL was fully operational and has remained so through the present day. Beginning in 1962, internal dosimetry data are available and sufficient to bound intakes.

External Dose Reconstruction Feasibility

- Principal sources of external radiation doses for members of the proposed class included exposures to uranium, numerous fission and activation products, cyclotrons, linear accelerators, and other radiation-generating devices.

- Prior to 1948, external dosimetry data are unavailable to NIOSH. Consequently, NIOSH finds that it is not likely feasible to estimate with sufficient accuracy, or to bound, the total external doses to members of the proposed class prior to 1948. Beginning in 1948, external dosimetry data are available for some workers.

Medical Dose Reconstruction Feasibility

- NIOSH finds that it is likely feasible to reconstruct occupational medical dose for LBNL workers with sufficient accuracy.

Although NIOSH finds that it is not possible to completely reconstruct radiation doses for the proposed class, NIOSH intends to use any internal and external monitoring data that may become available (and that can be interpreted using existing NIOSH dose reconstruction processes or procedures) for an individual claim. Therefore, dose reconstructions for individuals employed at LBNL during the period from August 13, 1942 through December 31, 1961, 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 various radionuclides and from direct exposure to radiation-producing equipment and 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.

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SEC Petition Evaluation Report for SEC-00160

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: Chris Miles, Quantaflux, LLC. 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 Lawrence Berkeley National Laboratory (LBNL) during a specified time. It provides information and analysis germane to considering a petition for adding a class of employees to the Congressionally-created Special Exposure Cohort (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

[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.

advice of the Board, the Director of NIOSH will propose a decision on behalf of HHS. The Secretary 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 NIOSH-proposed class includes all employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors who worked at the Lawrence Berkeley National Laboratory in Berkeley, California, from August 13, 1942 through December 31, 1961, 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. During this period, employees at this facility were involved with research and development activities involving work with uranium, transuranic elements, and numerous other radioactive materials, as well as work with cyclotrons, linear accelerators, and other radiation-generating devices.

The evaluation responds to Petition SEC-00160 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 LBNL from August 13, 1942 through December 31, 1961 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.

4.1 Operations Description

The first cyclotron at the University of California was a 4-inch cyclotron consisting of glass and red sealing wax made by E. O. Lawrence and N. E. Edlefsen in January 1930. Cyclotron research and development continued at the University for several decades thereafter. In 1937, the 37-inch cyclotron became operational. It was capable of accelerating deuterons to 8 MeV and alpha particles to 16 MeV. Shortly after the erection of the Crocker Laboratory in 1938, the 60-inch cyclotron magnet was installed (McMillan, 1940). The 60-inch cyclotron could accelerate deuterons to 22 MeV and alphas to 44 MeV (McMillan, 1946).

[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.

In 1941, E. O. Lawrence had the 37-inch cyclotron modified to demonstrate the feasibility of electromagnetic separation of uranium isotopes using the principle of the mass spectrograph. The cyclotron, modified in this manner for the purpose of separating uranium isotopes, became known as the calutron. This technology, developed at LBNL, was used for the calutrons built at the Y-12 facility in Oak Ridge, Tennessee, which led to the enrichment of a sufficient quantity of uranium to assemble the first uranium-based atomic bomb, which was eventually used to destroy Hiroshima (Heilbron, 1981, pp. 23-25).

Much of the early research with uranium, plutonium, and other transuranic elements was conducted in Gilman Hall at the University of California, Berkeley campus during the 1940s. This research often involved chemistry with samples that had been irradiated by the local cyclotrons and/or in the reactors in Chicago, Oak Ridge, and Hanford. The irradiated samples would often contain traces of elements or radioisotopes that had never before been discovered. The University researchers would isolate and identify these new radioisotopes and investigate their chemical and physical properties. Plutonium-239 was first discovered in Gilman Hall from a uranium sample that had been irradiated with neutrons (Seaborg, 1976). The fissionability of uranium-233 was also first demonstrated by researchers at the Berkeley campus during this time period (LBNL, 1983). Some AEC-related polonium work was performed outside Gilman Hall, in the Old Chemistry Building (Ponedel, 1956).

In July 1945, with the construction of the 184-inch cyclotron, work began to migrate above the University campus to the site now referred to as LBNL. The 184-inch cyclotron was completed in 1946 and continues to be operational today. It is now referred to as the Advanced Light Source. Other machines built in the late 1940s included a 300 MeV synchrotron, a 5 MeV Van de Graaff generator, and linear accelerators capable of accelerating protons to several hundred MeV (McMillan, 1946).

The Bevatron, which was given its name from its ability to accelerate protons to billions of eV, was completed in 1954. In 1957, the Heavy Ion Linear Accelerator (HILAC) came into operation. Later, in 1971, the HILAC was joined to the Bevatron as a heavy ion injector. This combination was referred to as the Bevalac.

These machines, in use at LBNL from 1942 through 1961 and after, were used for a variety of purposes, which included radioisotope generation, study of fundamental particles, uranium enrichment, and production of transuranic elements. Radioactive materials used and/or generated from these activities included tritium, numerous fission and activation products, isotopes of uranium and thorium, and several transuranic elements. Applications included nuclear weapons research and development, nuclear energy research, medical and biological sciences, and general physics and chemistry research.

4.2 Radiation Exposure Potential from Operations

With the generation, use, and study of various radioactive materials in unencapsulated form, there existed the potential for intakes through inhalation, ingestion, and absorption through skin or wounds. Potential sources of internal radiation exposure at the site included airborne and surface contamination from uranium, transuranic elements, tritium, and a variety of fission and activation products generated during research and development activities involving these materials, as well as from production of these materials in the cyclotrons, linear accelerators, and other high-energy radiation-generating devices.

The potential for external radiation dose also existed at locations where radioactive materials were handled or stored, and where radiation-generating devices were operated. Sources of exposure included beta and photon radiation emitted from materials containing uranium and plutonium, as well as both fission and activation products from samples that were irradiated by the local cyclotrons and/or in the reactors in Chicago, Oak Ridge, and Hanford. There was also potential for direct exposure to photons and neutrons produced by the cyclotrons and from fission studies with uranium and plutonium. Based on the site operations outlined in Section 4.1, sources of external radiation exposure included photon, neutron, and beta radiation emitted from a variety of radioactive materials and/or radiation-generating devices.

4.3 Time Period Associated with Radiological Operations

The Radiation Laboratory, which eventually became known as the Lawrence Berkeley National Laboratory, was founded in 1931 by Ernest Orlando Lawrence. Once the Manhattan Engineer District (MED) was founded in 1942, the Radiation Laboratory became part of the MED. Department of Energy (DOE)-related radiological operations have been ongoing at LBNL since the beginning of the MED, August 13, 1942, through the present. It is also clear from Dr. Glenn Seaborg's notes that radiation exposures could have been occurring within chemistry buildings on the University campus since the very beginning of the MED (Seaborg, 1976).

4.4 Site Locations Associated with Radiological Operations

Radiological operations took place in all of the accelerator buildings and associated laboratories located within the current LBNL footprint. Radiological operations also took place on the University campus; campus locations included, but were not necessarily limited to Gilman Hall, the Old Chemistry Building, the Old Radiation Laboratory, Donner Laboratory, and Crocker Hall. A list of facilities and room numbers where specific radioactive materials were used at LBNL is included in ORAUT-TKBS-0049.

4.5 Job Descriptions Affected by Radiological Operations

Given the general lack of process knowledge or detailed source term information, and the potential for airborne radioactive contamination in many of the affected locations, it is not possible 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 and is, therefore, 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

In addition to examining its Site Research Database (SRDB) to locate documents supporting the evaluation of the proposed class, NIOSH identified and reviewed numerous data sources to locate information relevant to determining the feasibility of dose reconstruction for the class of employees proposed for this petition. This included determining the availability of information on personnel monitoring, workplace monitoring, and radiological source term data.

NIOSH data capture efforts for LBNL focused on DOE record archives, including those located at LBNL and numerous other national laboratories, DOE Germantown, DOE Legacy Management offices, the Federal Records Center in San Bruno, California, National Archives and Records Administration (NARA) archives, and multiple electronic databases. Data capture efforts also included University of California record archives, including the University's Bancroft Library, other University libraries, internet searches, the Nuclear Regulatory Commission, and the State of California Department of Health Services. Additional details regarding the data sources reviewed by NIOSH are presented at the end of this document in Attachment 1.

5.2 Worker Interviews

To obtain additional information, NIOSH interviewed three individuals that were employed at LBNL during the time period covered by this evaluation.

- Personal Communication, 2008, *Personal Communication with Former University of California, Berkeley Employee*; Telephone Interview by ORAU Team; March 24, 2008, 1:00 PM EDT; SRDB Ref ID: 77694 (Personal Communication, 2008a)

- Personal Communication, 2008, *Personal Communication with Former University of California, Berkeley Employee*; Telephone Interview by ORAU Team; March 24, 2008, 3:00 PM EDT; SRDB Ref ID: 77696 (Personal Communication, 2008b)

- Personal Communication, 2008, *Personal Communication*; In-Person Interview by ORAU Team; May 20, 2008; SRDB Ref ID: 77695 (Personal Communication, 2008c)

5.3 Internal Personnel Monitoring Data

During the evaluated period, only limited bioassay information was found for workers at LBNL. NIOSH has located memos indicating that in the early days of the LBNL site (1940s and possibly 1950s) blood counts were performed for personnel working frequently with radioactive material (Barrett, 1949a; Barrett, 1949b; Barrett, 1949c; Barrett, 1949d) to determine if there were blood abnormalities caused by their exposure.

NIOSH has captured approximately 230 bioassay sample results prior to 1960 (Various, 1945-59). These results were collected in response to incidents and were primarily analyzed at other facilities, including Los Alamos Scientific Laboratory, Lawrence Livermore National Laboratory, and Argonne National Laboratory. These samples consisted primarily of urine samples, but also included feces, blood, sputum, and nasal swab samples. Analytes consisted of several transuranic radionuclides, including plutonium-239, curium-244, and americium-241. Other analytes included polonium-210, radium-226, protactinium-231, actinium-227, fission products, and isotopes of uranium and thorium. Specific sampling dates are very limited, with many of them collected in a very short timeframe (e.g., 150 of them were collected within a one-week period in 1947).

LBNL started its own in-house bioassay program in 1960, when it began sequentially numbering all of its bioassay results; they continued this practice through at least 1991. It appears that NIOSH has captured all of the results, beginning with sample number 1, which was collected in January 1960.

5.4 External Personnel Monitoring Data

During the early days, radiation exposure to workers at LBNL was measured and controlled using radiation survey instruments. Monthly reports from July and August 1944, titled *Monthly Report on Toxic Dust and Short-Wave Radiation*, include film badge dosimetry data from badges used in Buildings 2, 4, and 6, and Gilman Hall (Ballenger, 1944a; Ballenger, 1944b). Based upon this report and other information concerning availability of radiation instrumentation and dosimetry methods, it is evident that some external dose monitoring was being conducted before 1948; however, NIOSH has not found any claimant-specific external dosimetry data prior to 1948.

Based on a review of all claimant files from the 1940s, the earliest exposure records reported by DOE were from early 1948. These results were reported on a form with a version date of July 2, 1947. This form is NIOSH's earliest indication of a formal external dose records program at LBNL.

5.5 Workplace Monitoring Data

Available workplace monitoring data for LBNL from 1942 through 1961 include, but are not limited to, the following: 1950 gamma- and fast-neutron surveys of the 60-inch cyclotron, using film dosimeters (LBNL Survey, 1952-1960); a 1961 fast-neutron survey of the 60-inch cyclotron, using a cadmium-lined, paraffin-moderated, BF_3 counter (LBNL Survey, 1961); 1947 contamination surveys of the Donner Laboratory (LBNL Survey, 1947); 1946 and 1947 contamination surveys of Gilman Hall (LBNL Survey, 1946-1947); 1958 ion chamber and BF_3 counter measurements at the 184-inch cyclotron (LBNL Survey, 1958); 1948 through 1952 fast-neutron surveys at the 184-inch cyclotron (LBNL Survey, 1948-1952); 1953 to 1962 Bevatron surveys, including fast-neutron flux

measurements using indium-foil detectors within a cadmium-enclosed paraffin sphere, ion chamber measurements, and fast- and slow-neutron proportional counter measurements with and without BF_3 (LBNL Survey, 1953-1962); 1960 air sampling results for Buildings 5, 70, 71, 184-inch cyclotron, Animal House, and Crocker (LBNL Survey, 1960); 1946 through 1948 contamination surveys in Gilman Hall (LBNL Survey, 1946-1948); and 1947 and 1948 polonium contamination surveys in the Old Chemistry Building (LBNL Survey, 1947-1948).

5.6 Radiological Source Term Data

A comprehensive listing of the many radionuclides and their quantities used at LBNL over the period of this evaluation is unavailable. There are however, multiple data sources that provide snapshots in time of inventories for some radionuclides. In 1949, the uranium inventory included several hundred kilograms of multiple uranium compounds (Browne, 1949). A 1950 inventory listing of "Availability of Relatively Stable Isotopes of the Heavy Elements" included 1 mCi actinium-227; 479 mg thorium-230; 2.4 mg protactinium-231; 209.5 mg neptunium-237; 1 mCi promethium-147; 57.91 mg americium-241; and 1 mg technetium-99 (Garden, 1950). A letter to the U.S. Atomic Energy Commission, dated August 21, 1956, describes work with a batch of polonium-210 in equilibrium with about 500 mCi of lead-210 (Ponedel, 1956). These are only examples of some available source-term data. Additional source-term data are summarized in ORAUT-TKBS-0049.

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.

In accordance with § 83.14(a), NIOSH may establish a second class of co-workers at the facility for whom NIOSH believes that dose reconstruction is similarly infeasible, but for whom additional research and analysis is required. If so identified, NIOSH would address this second class in a separate SEC evaluation rather than delay consideration of the claim currently under evaluation (see Section 10). This would allow NIOSH, the Board, and HHS to complete, without delay, their consideration of the class that includes a claimant for whom NIOSH has already determined a dose reconstruction cannot be completed, and whose only possible remedy under EEOICPA is the addition of a class of employees to the SEC.

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 radiation doses to members of the proposed class, as described below.

Although there are indications that blood counts were performed in the early days of the LBNL site for personnel who were working frequently with radioactive material, NIOSH has not found the results of these blood checks and it is unlikely that NIOSH could determine annual organ doses from such measurements.

Given that the approximately 230 bioassay sample results captured by NIOSH prior to 1960 (Various, 1945-59) were primarily collected in response to incidents, and given that the specific sampling dates are very limited, with many of them collected in a very short timeframe, these data are not particularly useful for determining the exposure conditions for personnel across the site or over a 14-year period.

LBNL began sequentially numbering all of its bioassay results in 1960 and continued this practice through at least 1991. It appears that NIOSH has captured all of the results, starting with sample number 1, which was collected in January 1960. The extent of the program at the beginning is unclear. Although the numbering system began in 1960, and there are over 200 samples indicated for 1960 and 1961, the program was apparently not yet ramped up. In March 1961, the head of the Health Chemistry Department wrote a memo expressing concern over the lack of a comprehensive bioassay program for the site (Howe, 1961) stating that: "The laboratory has a clear obligation under its contract with the AEC to maintain employee exposure within the limits recommended by the National Committee on Radiation Protection. These limits include exposure from both external and internal sources, but during most of LRL's history it was always assumed that internal exposure was negligible and need not be directly measured." He then went on to write: "In light of the foregoing, we believe it only reasonable and prudent that Berkeley adopt a full-fledged bioassay program. To achieve this without a long building, staffing, and development period will likely require use of an outside service organization" (Howe, 1961).

According to a 1963 memo titled *Report on Bioassay Program for 1962*, the bioassay program increased significantly from 1961 to 1962. The memo reports that double the gross alpha determinations were made and that these accounted for less than half of the analyses for the year (Parker, 1963). Another memo from the Health Chemistry Department details a "revision to the bioassay schedule" and lists more than 200 participants and includes the criteria and frequency for participation (Soule, 1962). The listed criteria include the following:

- General annual frequency for radiochemists and health chemistry personnel;
- A semi-annual frequency for radiochemists and health chemistry personnel most highly exposed to alpha emitters;
- Annual sampling of selected members of the building trades frequently assigned maintenance work in active areas; and
- Annual sampling of selected administrative personnel whose exposures were essentially zero and would be considered control samples.

NIOSH has determined that by 1962 there was an active bioassay program with specific criteria that encompassed a range of job functions, with sampling on a prescribed frequency. Original records for all of the collected samples from 1960 through 1991 are available.

The workplace monitoring data that are available for the site from 1942 through 1961 are insufficient for dose reconstruction purposes, or to bound doses.

The available source term data for LBNL, some of which are summarized in ORAUT-TKBS-0049, are not sufficient to bound doses for the site.

NIOSH does not have access to sufficient personnel monitoring, workplace monitoring, or source term data to estimate potential internal radiation doses to workers from the various radioactive materials handled at LBNL during the period under evaluation (August 13, 1942 through December 31, 1961). Consequently, NIOSH finds that it is not feasible to estimate, with sufficient accuracy, the level of internal radiation doses that could have been incurred by members of the class of employees covered by this evaluation. By 1962, the internal dosimetry program was fully operational and has remained so through the present day.

Although it is not possible to completely reconstruct internal radiation doses for the period from August 13, 1942 through December 31, 1961, 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 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 doses to various radioactive materials handled at LBNL 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 doses for the class of workers covered by this report.

It is clearly evident from the available data that there was a significant potential for exposure to external radiation sources during the period under evaluation, from both radioactive material use and from direct exposure to radiation-producing equipment (e.g., cyclotrons). Although it is also evident that some external personnel monitoring was being conducted at least as early as 1944, NIOSH has found that external dosimetry data are generally unavailable prior to 1948, in the claims submitted for evaluation. Consequently, it is not feasible to estimate external doses for the class of employees prior to 1948.

Although it is not possible to reconstruct external radiation doses for the period from August 13, 1942 through December 31, 1947, NIOSH intends to use any external 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 who do not qualify for inclusion in the SEC may be performed using these data, as appropriate.

Adequate reconstruction of medical dose for LBNL workers is likely to be feasible by using claimant-favorable assumptions in the complex-wide Technical Basis Document, *Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures* (ORAUT-OTIB-0006) and applicable site profile guidance.

6.3 Class Parameters Associated with Infeasibility

It is clear that radiation exposures could have been occurring at LBNL since the very beginning of the MED on August 13, 1942 (Seaborg, 1976). Although DOE-related radiological operations have been ongoing at LBNL from the beginning of the MED in 1942 through the present, sufficient personnel dosimetry data are available for the purposes of dose reconstruction beginning in 1962. NIOSH has therefore recommended that the class include the time period from August 13, 1942 through December 31, 1961.

Radiological operations at LBNL were widespread and potentially included all buildings on "the Hill" as well as all LBNL affiliated buildings on the Berkeley university campus, which included but were not limited to the Old Radiation Laboratory, Donner Laboratory, Crocker Hall, LeConte Hall, Gilman Hall and the Old Chemistry Building. NIOSH has therefore recommended that the class definition include all buildings during the specified time period.

Given the general lack of process knowledge or detailed source term information, and the potential for airborne radioactive contamination in many of the affected locations, it is not possible to determine that any specific work group was not potentially exposed to radioactive material releases or possible subsequent contamination. No specific job titles or occupations for the class definition can be identified; NIOSH has therefore recommended that the class include all workers.

7.0 Summary of Feasibility Findings for Petition SEC-00160

This report evaluates the feasibility for completing dose reconstructions for employees at LBNL from August 13, 1942 through December 31, 1961. NIOSH determined that members of this class may have been exposed to radiation from uranium, transuranic elements, and numerous other radioactive materials, as well as from cyclotrons, linear accelerators, and other radiation-generating devices. NIOSH lacks sufficient information, which includes personnel monitoring, workplace monitoring, or source term data that would allow it to estimate the potential internal radiation doses from radioactive materials to which the proposed class may have been exposed.

In addition, prior to 1948, NIOSH lacks sufficient information to allow it to estimate potential external radiation doses from radioactive materials or from the radiation-generating devices in use at that time.

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.

After 1947, the adequate reconstruction of external dose is considered likely to be feasible. Reconstruction of medical dose for LBNL workers for all time periods is also considered likely to be feasible.

8.0 Evaluation of Health Endangerment for Petition SEC-00160

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 various radionuclides and from direct exposure to radiation-producing equipment and 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-00160

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 Lawrence Berkeley National Laboratory in Berkeley, California, from August 13, 1942 through December 31, 1961, 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.

10.0 Evaluation of Second Similar Class

In accordance with § 83.14(a), NIOSH may establish a second class of co-workers at the facility, similar to the class defined in Section 9.0, for whom NIOSH believes that dose reconstruction may not be feasible, and for whom additional research and analyses is required. If a second class is identified,

it would require additional research and analyses. Such a class would be addressed in a separate SEC evaluation rather than delay consideration of the current claim. At this time, NIOSH has not identified a second similar class of employees at LBNL for whom dose reconstruction may not be feasible.

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11.0 References

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42 C.F.R. pt. 82, *Methods for Radiation Dose Reconstruction Under the Energy Employees Occupational Illness Compensation Program Act of 2000*; Final Rule; May 2, 2002; SRDB Ref ID: 19392

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

42 U.S.C. §§ 7384-7385 [EEOICPA], *Energy Employees Occupational Illness Compensation Program Act of 2000*; as amended; OCAS website

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LBNL Survey, 1947, *Contamination Surveys of the Donner Laboratory*; Lawrence Berkeley National Laboratory (LBNL); March through December 1947; SRDB Ref ID: 20954

LBNL Survey, 1947-1948, *Polonium Contamination Surveys in the Old Chemistry Building*; Lawrence Berkeley National Laboratory (LBNL); various dates from 1947 through 1948; SRDB Ref ID: 30348

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LBNL Survey, 1952-1960, *Gamma and Fast Neutron Surveys of the 60-Inch Cyclotron Using Film Dosimeters*; Lawrence Berkeley National Laboratory (LBNL); various dates from 1952 through January 1960; SRDB Ref ID: 13999

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Attachment 1: Data Capture Synopsis

Since Lawrence Berkeley National Laboratory (LBNL) and the University of California – Berkeley campus were previously listed as separate covered facilities, data capture efforts for each site have been summarized separately in the tables below. As discussed in the introduction to this document, both of these sites are now covered as LBNL.

Table A1-1: Summary of Holdings in the SRDB for Lawrence Berkeley National Laboratory

Data Capture Information	General Description of Documents Captured	Completed	Uploaded into SRDB
Primary Site/Company Name: Lawrence Berkeley National Laboratory; DOE 1942-present Other Site Names: Radiation Laboratory LBL Lawrence Radiation Laboratory University of California California Resources & Development	Environmental reports, internal dosimetry TBDs, dose levels around accelerators, x-ray machine surveys, incident reports, personnel contamination reports, exposure summaries, contracts, Gilman Hall reports, individual employee exposure records, bioassay cards, bioassay logbooks, film badge reports, bioassay results, bioassay annual reports, process knowledge interviews, and records transmittals.	06/11/2009	358
State Contacted: California Radiologic Health Branch Paul Lavely (916) 650-0561	No records were available from the California Radiologic Health Branch.	03/26/2008	0
Argonne National Laboratory - East	Proposals for the National Nucleonics Committee.	04/02/2008	2
Brookhaven National Laboratory	Brief discussion on fast neutron dosimetry and DOELAP accreditation, brief account of collaboration with Brookhaven on SSC magnet design, a DOE rad con manual implementation, and site history.	08/20/2008	4
CDC Interlibrary Loan	A history of Manhattan Engineer District radiation control practices and Seaborg's plutonium project journals.	05/15/2008	2
Claimant	Review of links between DOE occupational exposures and illness and the results of an FOIA request for bevatron survey data with the requestor's dose history.	10/09/2008	2
University of Colorado at Boulder	Report of neutron dosimetry studies.	09/01/2005	1
DOE Germantown	Certification docket for Gilman Hall.	NA	1
DOE Legacy Management - Grand Junction Office	LBNL accelerator project requiring increased production rate at Fernald, LOOW imports Eldorado sources for LBNL, and changing requirements for dumping radioactive waste at sea.	05/12/2009	3

Table A1-1: Summary of Holdings in the SRDB for Lawrence Berkeley National Laboratory			
Data Capture Information	**General Description of Documents Captured**	**Completed**	**Uploaded into SRDB**
DOE Legacy Management - MoundView (Fernald Holdings, includes Fernald Legal Database)	Waste treatment reports, evaluation of health and safety programs, a nationwide survey of normal uranium scrap materials, transfers of thorium to the Colonie Site, and a report on the 1952 bioassay and analytical chemistry conference.	04/10/2008	10
Federal Records Center, San Bruno	Tritium reports, effluent data, thorium-229 experiment, employee medical report, incident reports, environmental reports, fallout sampling, progress reports, air sampling reports, individual employee exposure histories, instrument development reports, survey reports, source inventories, film badge results, activity hazard documents, bioassay reports, safety procedures, bioassay program specifications, TRIGA Mark III annual reports, surveys of 184" cyclotron, demolition of 60" cyclotron, shielding studies, dosimetry procedures, 1995 internal dosimetry TBD, radiation worker rosters, facility and equipment design specifications, radiological protection procedures, materials inventories, waste disposal, ALARA program review, neutron surveys, 88" cyclotron studies, ES&H operational guides, and urinalysis record cards.	09/16/2009	1,197
Hanford	Operations plan for Operation Henre.	01/23/2008	1
Internet - DOE Hanford Declassified Document Retrieval System (DDRS)	Hanford monthly reports with LBNL references, typically relating to visiting staff.	10/17/2008	7
Internet - DOE OpenNet	Histories of transuranic elements research, reports to Congress, and a brief mention of metallurgical research.	12/31/2007	8
Internet - DOE OSTI Energy Citations	Hanford monthly report with LBNL references.	01/05/2008	1
Internet - DOE OSTI Information Bridge	Stannard's Radioactivity and Health, boundary doses from bevatron operations, environmental assessments, Marvin Goldman oral history, and human radiation experiments.	08/31/2009	7
Internet - DOE OSTI Science Accelerator	Transuranic element reports.	03/14/2008	4
Internet - Google	Complex-wide environmental reports, DOE finding aid, history of the development of the atomic bomb, and information on the chemistry of polonium.	05/29/2008	5
Internet - Lawrence Berkeley National Laboratory	Environmental reports, air emissions reports, and a history of the lab.	05/17/2007	21
Internet - repositories.cdlib.org	1950 quarterly report.	02/07/2008	1
Internet - University of California Bancroft Library	Interview with Anne Dettner.	04/01/2008	1

Table A1-1: Summary of Holdings in the SRDB for Lawrence Berkeley National Laboratory			
Data Capture Information	**General Description of Documents Captured**	**Completed**	**Uploaded into SRDB**
Lawrence Livermore National Laboratory	Results and data for bioassay test samples, exposures of Pacific Test Group, and Building 171 air sample cards.		4
Los Alamos National Laboratory	Photodosimetry Evaluation Book "Bible" Volume VIII Procedures 1996-2001.	09/01/2004	1
Mound Museum	1948 and 1949 quarterly reports and a Mound transfer voucher.	11/26/2008	3
NARA Atlanta	Bioassay procedures, employee medical examination observations, field progress reports, and a DOE indoor radon study.	02/23/2007	5
NARA Kansas City	Certification docket and surveys for Gilman Hall.	01/12/2005	3
NARA Laguna Niguel	Plans for Project Dribble.	10/21/2008	1
NARA San Bruno	Incident reports, 60" cyclotron surveys and monitoring reports, environmental reports, health chemistry reports, fallout reports, air, water, and stack sampling reports, and dose rates from neutron sources.	11/17/2008	47
Oak Ridge National Laboratory	Proposal for production of Fe-55 and Fe-59 at the Berkeley 60" cyclotron.	08/30/2004	1
Office of Scientific and Technical Information	A test of the oxidation resistance of a zirconium-vanadium alloy and proceedings of a 1962 nuclear propulsion conference.	09/17/2008	3
ORAU Team	Documented communication regarding Gilman Hall, definition of daily dose in LBNL records, and an LBNL site profile.	04/04/2007	4
ORISE	Chelation DTPA data for DOE employees.	08/06/2009	3
SAIC	Annual radiation exposure summaries.	09/02/2004	5
Savannah River Site	1950s dosimetry visitor cards and LBNL experiments in the 100 Area.	08/26/2008	7
SC&A	Trip reports, reassessment of bevatron exposures, bioassay lab reports, neutron dosimetry reports, transuranic chemistry reports, accelerator shielding reports, effluent monitoring reports, incident reports, tritium air dispersion modeling, health physics notes, epidemiological studies, personnel dosimetry procedures, and radioisotope inventories.	07/22/2009	157
Southern Illinois University	AEC construction cost differentials.	10/15/2008	1
Unknown	Beryllium reports, LBNL facility list, environmental reports, progress reports, Gilman Hall study, and information from a neutron dosimetry workshop.	04/08/2004	17
Washington University Libraries - St. Louis	Research reports including plutonium chelation, a pulsed neutron source, paraffin decontamination of concrete surfaces, and quarterly reports.	04/27/2007	15

Table A1-1: Summary of Holdings in the SRDB for Lawrence Berkeley National Laboratory			
Data Capture Information	**General Description of Documents Captured**	**Completed**	**Uploaded into SRDB**
TOTAL			**1,913**

Table A1-2: Internet Database Searches for Lawrence Berkeley National Laboratory			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
Note: The normally prescribed publicly accessible internet database searches were not performed for LBNL. These searches were not performed due to LBNL being an active DOE site. Limited internet searches were conducted to attempt to locate data not available via the site's resources.			

Table A1-3: OSTI Documents Requested for Lawrence Berkeley National Laboratory			
DOCUMENT NUMBER	**DOCUMENT TITLE**	**REQUESTED**	**RECEIVED**
No documents ordered.	N/A	N/A	N/A

Table A1-4: Summary of Holdings in the SRDB for University of California, Berkeley, CA			
Data Capture Information	**General Description of Documents Captured**	**Completed**	**Uploaded into SRDB**
Primary Site/Company Name: University of California Other Site Names: California Resources and Development, University of California Bancroft Library, Gilman Hall Contacts: Site EEOICPA contact; Archivist; retired site nurse, aids with EEOICPA; Dosimetry Supervisor; Physics Instrumentation, 1940's; Superintendent of Electronic Shops, 1940's	Treating contaminated wounds, note from Seaborg's journal, and a building floor plan.	06/05/2008	7
State Contacted: California Radiologic Health Branch	No records were available from the California Radiologic Health Branch. Additionally, the former Radiation Safety Officer at UC Berkeley (currently an employee of California's Radiologic Health Branch) was contacted to discuss relevant buildings and potential location of records.	03/26/2008	0
CDC Interlibrary Loan	The plutonium story.	05/12/2008	1
Claimant	Miscellaneous Linde material from an FOIA request including mention of University of California medical records.	04/18/2005	1
Comprehensive Epidemiologic Data Resource (CEDR)	No relevant data identified.	03/29/2008	0
Department of Energy	Methods of separating U-233 from thorium.	06/18/2008	1
DOE Germantown	Facility list, exposure hazard and safety procedures, and a certification docket for Gilman Hall.	05/01/2009	5
DOE Hanford	Spectral and output measurements of a monoenergetic wide beam K-fluorescence x-ray unit.	09/18/2006	1
DOE Hanford Declassified Document Retrieval System (DDRS)	1943 progress reports, Hanford progress reports with University of California issues, and trip reports including a Crocker Hall report.	10/17/2008	10
DOE Lawrence Berkeley National Laboratory	Gilman Hall area surveys, personnel assignments, exposure records, radiological surveys, remedial actions reports, and various internal exposure and bioassay samples.	08/26/2008	47
DOE Lawrence Livermore National Laboratory	1958 gamma exposure summaries and a high exposure alert list.	05/11/2007	4

Table A1-4: Summary of Holdings in the SRDB for University of California, Berkeley, CA			
Data Capture Information	**General Description of Documents Captured**	**Completed**	**Uploaded into SRDB**
DOE Legacy Management Considered Sites	General site information, long-term surveillance needs assessment, letter stating Gilman Hall was only California MED site qualified for FUSRAP, and site fact sheets.	03/20/2008	4
DOE Legacy Management - Grand Junction Office	Status of the University of California under AEC revised accounting practices in 1948.	01/28/2009	1
DOE Legacy Management - MoundView (Fernald Holdings, includes Fernald Legal Database)	Final transfer in April 1966 to University of California Lawrence Radiation Lab and Los Alamos Scientific Lab and a DOE annual radionuclide air emission report.	01/20/2009	2
DOE Los Alamos National Laboratory	Scheduling University of California employee urinalyses and Operation Teapot air sampling.	08/02/2007	2
DOE OpenNet	Early history of heavy isotope research at Berkeley and health problems of workers at Berkeley Metallurgical Project.	03/27/2008	21
DOE OSTI Energy Citations	No relevant data identified.	04/06/2008	0
DOE OSTI Information Bridge	Stannard's Radioactivity and Health and oral histories of Nello Pace and Cornelius Tobias.	06/02/2009	3
Google	Gilman Hall historical information, FUSRAP description of site, and an AEC report to Congress.	04/06/2008	6
Missouri Department of Natural Resources	A report citing the completion of remediation at the University of California.	10/03/2008	1
Mound Museum	Transfer vouchers.	06/29/2008	1
NARA Atlanta	Physical and laboratory examination, preliminary survey, urine results, dosimetry data, HP practices, summary of work done at Berkeley, reactor development, accountability reports, and weekly reports.	06/17/2008	13
NARA College Park	AEC beryllium documents from 1947 to 1950.	Unknown	1
NARA Kansas City	Gilman Hall surveys and certification docket.	01/12/2005	3
NARA San Bruno	Finger film dosimeters, MED era researchers' logbooks from Gilman Hall, spill report, and a 1944 toxic dust report.	02/06/2007	5
National Academies Press (NAP)	No relevant data identified.	04/02/2008	0
National Institute of Health	No relevant data identified.	04/02/2008	0
National Nuclear Security Administration (NNSA) - Nevada Site Office	No relevant data identified.	04/02/2008	0
NRC Agencywide Document Access and Management (ADAMS)	FUSRAP sites review.	04/16/2008	1
ORAU Team	Documented communications and project spreadsheets.	03/26/2008	7

Table A1-4: Summary of Holdings in the SRDB for University of California, Berkeley, CA			
Data Capture Information	**General Description of Documents Captured**	**Completed**	**Uploaded into SRDB**
SAIC	Radiation exposure of AEC and contractor personnel.	09/02/2004	2
Southern Illinois University	Disposal of radioactive wastes in the metropolitan St. Louis area and a description of the 1949 cryptographic telecommunications net.	10/16/2008	2
University of Rochester	Completing arrangements to receive a Cm-244 source from the University of California.	08/20/2008	1
Unknown	Completion of decontamination of Gilman Hall, collection of letters, lists and pages from a Gilman Hall study, surveys, and reports of polonium and beryllium.	03/09/2004	19
Washington State University (U.S. Transuranium and Uranium Registries)	No relevant data identified.	03/29/2008	0
Washington University Libraries - St. Louis	No relevant data identified.	04/26/2008	0
TOTAL			**172**

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
CEDR http://cedr.lbl.gov/ COMPLETED 03/29/2008	University of California Gilman Hall California Resources and Development California Resources & Development	0	0
Department of Energy http://www.doe.gov/ COMPLETED 06/18/2008	University California "Gilman Hall" -ORAU -NIOSH –EEOICPA Gilman Hall AND plutonium -ORAU -NIOSH Gilman Hall AND neutron flux -ORAU -NIOSH Wendell Latimer -ORAU -NIOSH Ernest Lawrence AND "Gilman Hall" -ORAU -NIOSH Glenn Seaborg AND "Gilman Hall" -ORAU -NIOSH Gilman Hall uranium -ORAU -NIOSH Gilman Hall Room 307 -ORAU -NIOSH California Resources and Development -ORAU -NIOSH California Resources & Development -ORAU -NIOSH	161	1

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
DOE Hanford DDRS http://www2.hanford.gov/declass/ COMPLETED 10/17/2008	"Gilman Hall" AND plutonium Glenn Seaborg "Gilman Hall" AND uranium Wendell Latimer Ernest Lawrence University of California Gilman Hall California Resources and Development Berkeley	10	10
DOE Legacy Management Considered Sites http://csd.lm.doe.gov/ COMPLETED 03/20/2008	N/A	N/A	4
DOE OpenNet http://www.osti.gov/opennet/advancedsearch.jsp COMPLETED 03/27/2008	Wendell Latimer (author) 1/1/1942 - 12/31/1983 Wendell Latimer (full text) 1/1/1942 - 12/31/1983 Glenn Seaborg AND Gilman Hall plutonium AND Gilman Hall uranium AND Gilman Hall Ernest Lawrence AND Gilman Hall	104	21
	neutron flux AND Gilman Hall solvent extraction AND Gilman Hall California Resources and Development California Resources & Development Atomic Energy Commission AND "Gilman Hall" Manhattan Engineer District AND Gilman Hall Room 307 AND Gilman Hall Berkeley AND plutonium AND Gilman radiation AND Gilman contamination AND Gilman		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
DOE OSTI Energy Citations http://www.osti.gov/energycitations/ COMPLETED 04/06/2008	University of California AND Gilman Hall 1/1/1942 - 12/31/1983 "Gilman Hall" AND plutonium 1/1/1942 - 12/31/1983 "Gilman Hall" AND uranium 1/1/1942 - 12/31/1983 "Gilman Hall" AND solvent extraction 1/1/1942 - 12/31/1983 "California Resources and Development" 1/1/1942 - 12/31/1983 California Resources & Development 1/1/1942 - 12/31/1983	13	0
DOE OSTI Information Bridge http://www.osti.gov/bridge/advancedsearch.jsp COMPLETED 06/02/2009	Gilman Hall 1/1/1942 - 12/31/1983 Wendell Latimer 1/1/1942 - 12/31/1983 Glenn Seaborg 1/1/1942 - 12/31/93 Ernest Lawrence 1/1/1942 - 12/31/1943 Berkeley AND plutonium AND Gilman 1/1/1942 - 12/31/1983 Gilman AND "Room 307" 1/1/1942 - 12/31/1983 Gilman AND "neutron flux" 1/1/1942 - 12/31/1983 Gilman Hall AND "solvent extraction" 1/1/1942 - 12/31/1983 Gilman Hall AND uranium 1/1/1942 - 12/31/1983 Gilman Hall AND "Atomic Energy Commission" 1/1/1942 - 12/31/1983 Gilman Hall AND "Manhattan Engineer District" 1/1/1942 - 12/31/1983 Gilman Hall AND contamination 1/1/1942 - 12/31/1983 Gilman Hall AND radiation 1/1/1942 - 12/31/1983 California Resources 1/1/1942 - 12/31/1983	68	3
	Gilman Hall AND americium 1/1/1942 - 12/31/1983 Manhattan Engineer District AND "Gilman Hall" 1/1/1942 - 12/31/1983		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
Google http://www.google.com COMPLETED 04/06/2008	University of California AND "Gilman Hall" plutonium AND "Gilman Hall" uranium AND "Gilman Hall" Gilman Hall California Resources and Development California Resources & Development University of California Berkeley americium OR Am241 OR Am-241 "Gilman Hall" -ORAU -NIOSH –EEOICPA University of California Berkeley Am-241 OR 241-Am OR 241Am "Gilman Hall" -ORAU -NIOSH -EEOICPA University of California Berkeley "Am 241" OR ionium OR Th230 "Gilman Hall" -ORAU -NIOSH –EEOICPA University of California Berkeley Th-230 OR "Th 230" OR 230Th "Gilman Hall" -ORAU -NIOSH -EEOICPA University of California Berkeley "230 Th" OR 230-Th "Gilman Hall" -ORAU -NIOSH -EEOICPA University of California neptunium Gilman Hall "Atomic Energy Commission" -ORAU -NIOSH -EEOICPA University of California Np237 OR Np-237 OR "Np 237" "Gilman Hall" -ORAU -NIOSH -EEOICPA University of California 237Np OR 237-Np OR "237 Np" "Gilman Hall" -ORAU -NIOSH -EEOICPA	7,514	6

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	University of California polonium OR Po210 OR Po-210 "Gilman Hall" -ORAU -NIOSH –EEOICPA University of California 210Po OR 210-Po "Gilman Hall" -ORAU -NIOSH -EEOICPA University of California Berkeley Gilman Hall "210 Po" "Po 210 " -ORAU -NIOSH -EEOICPA University of California Berkeley thorium OR Th232 OR Th-232 "Gilman Hall" -ORAU -NIOSH -EEOICPA University of California 232Th OR 232-Th OR thorium "Gilman Hall" -ORAU -NIOSH -EEOICPA University of California Gilman Hall "Th 232" OR "232 Th" "Z metal" -ORAU -NIOSH -EEOICPA University of California Gilman Hall myrnalloy OR "chemical 10-12" "chemical 10-66" -ORAU -NIOSH -EEOICPA University of California Gilman Hall ionium OR UX1 OR UX2 -ORAU -NIOSH –EEOICPA University of California Gilman Hall Th230 OR Th-230 -ORAU -NIOSH -EEOICPA University of California Gilman Hall "Th 230 " -ORAU -NIOSH –EEOICPA University of California Gilman Hall 230Th OR 230-Th "230 Th" -ORAU -NIOSH -EEOICPA University of California Gilman Hall Th234 OR Th-234 "Th 234" -ORAU -NIOSH -EEOICPA		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	Gilman Hall 234Th OR 234-Th OR "234 Th" "University of California " -ORAU -NIOSH -EEOICPA Gilman Hall tritium Berkeley "University of California" -ORAU -NIOSH -EEOICPA Gilman Hall Berkeley H3 Atomic Energy Commission "University of California" -ORAU -NIOSH -EEOICPA HTO OR H-3 "Gilman Hall" -ORAU -NIOSH –EEOICPA Berkeley mint "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley uranium Atomic Energy Commission "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission U-233 OR U233 OR "U 233" "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission 233U OR 233-U OR "233 U" "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission U234 OR U-234 OR "U 234" "Gilman Hall" -ORAU -NIOSH –EEOICPA Berkeley Atomic Energy Commission 234U OR 234-U OR "234 U" "Gilman Hall " -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission U235 OR U-235 OR "U 235" "Gilman Hall" -ORAU -NIOSH –EEOICPA Berkeley Atomic Energy Commission 235-U OR 235U OR "235 U" "Gilman Hall" Berkeley Atomic Energy Commission U238 OR U-238 OR "U 238" "Gilman Hall"		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	Berkeley Atomic Energy Commission 238U OR 238-U OR "238 U" "Gilman Hall" Berkeley Atomic Energy Commission U308 OR U-308 OR "U 308" "Gilman Hall" Berkeley Atomic Energy Commission 308U OR 308-U OR "308 U" "Gilman Hall" Berkeley Gilman Hall "uranium extraction" Berkeley "black oxide" OR "brown oxide" OR "green salt" "Gilman Hall" Berkeley "orange oxide" OR "yellow cake" OR UO2 "Gilman Hall" Berkeley UO3 OR UF4 OR UF6 "Gilman Hall " Berkeley C-216 OR C-615 OR C-65 "Gilman Hall" -NIOSH, -ORAU, -EEOICPA Berkeley U308 OR C-211 "Gilman Hall" -NIOSH -ORAU -EEOICPA Berkeley Atomic Energy Commission plutonium "Gilman Hall" -NIOSH -ORAU -EEOICPA Berkeley Atomic Energy Commission Pu-238 OR Pu238 OR "Pu 238" "Gilman Hall" -NIOSH -ORAU -EEOICPA Berkeley Atomic Energy Commission 238Pu OR 238-Pu OR "238 Pu" "Gilman Hall" -NIOSH -ORAU -EEOICPA Berkeley Atomic Energy Commission Pu-239 OR Pu239 OR "Pu 239" "Gilman Hall" -NIOSH -ORAU –EEOICPA		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	Berkeley Atomic Energy Commission 239Pu OR 239-Pu OR "239 Pu" "Gilman Hall" -NIOSH -ORAU –EEOICPA Berkeley Atomic Energy Commission Pu240 OR Pu-240 OR "Pu 240" "Gilman Hall" -NIOSH -ORAU -EEOICPA Berkeley Atomic Energy Commission 240Pu OR 240-Pu OR "240 Pu" "Gilman Hall" -NIOSH -ORAU -EEOICPA Berkeley Atomic Energy Commission Pu-241 OR Pu241 OR "Pu 241" "Gilman Hall" -NIOSH -ORAU -EEOICPA Berkeley Atomic Energy Commission 241Pu OR 241-Pu OR "241 Pu" "Gilman Hall " -NIOSH -ORAU –EEOICPA Berkeley Atomic Energy Commission radium OR Ra-226 OR Ra226 "Gilman Hall" -NIOSH -ORAU -EEOICPA Berkeley Atomic Energy Commission "Ra 226" OR 226-Ra OR 226Ra "Gilman Hall" -NIOSH -ORAU –EEOICPA Berkeley Atomic Energy Commission "226 Ra" OR Ra-228 OR Ra228 "Gilman Hall" -NIOSH -ORAU -EEOICPA Berkeley Atomic Energy Commission "Ra 228" OR 228Ra OR 228-Ra "Gilman Hall " -NIOSH -ORAU -EEOICPA Berkeley Atomic Energy Commission "228 Ra" OR radon OR Rn-222 "Gilman Hall" -NIOSH -ORAU –EEOICPA Berkeley Atomic Energy Commission Rn222 OR "Rn 222" OR 222Rn "Gilman Hall" -NIOSH -ORAU –EEOICPA Berkeley Atomic Energy Commission 222-Rn OR "222 Rn" OR thoron "Gilman Hall" -NIOSH -ORAU –EEOICPA		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	Berkeley Atomic Energy Commission Rn-220 OR Rn220 OR "Rn 220" "Gilman Hall" -NIOSH -ORAU –EEOICPA Berkeley Atomic Energy Commission 220Rn OR 220-Rn OR "220 Rn" "Gilman Hall" -NIOSH -ORAU -EEOICPA Berkeley protactinium OR Pa-234m OR Pa234m "Gilman Hall" -NIOSH -ORAU -EEOICPA Berkeley 234mPa OR 234m-Pa OR "Pa 234m" "Gilman Hall" -NIOSH -ORAU -EEOICPA Berkeley strontium OR Sr-90 OR Sr90 "Gilman Hall" -NIOSH -ORAU –EEOICPA Berkeley "Sr 90" OR 90-Sr OR 90Sr "Gilman Hall" -NIOSH -ORAU -EEOICPA Berkeley oralloy OR postum OR tuballoy "Gilman Hall" -NIOSH -ORAU -EEOICPA Berkeley "uranyl nitrate hexahydrate" OR UNH OR K-65 "Gilman Hall" -NIOSH -ORAU -EEOICPA Berkeley "sump cake" OR "uranium dioxide" OR "uranium tetrafluoride" "Gilman Hall" -NIOSH -ORAU -EEOICPA Berkeley "uranium hexafluoride" OR "uranium trioxide" "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley accident "Gilman Hall" -ORAU -NIOSH -EEOICPA –iowa Berkeley Gilman-Hall air-dust OR air-filter "air count " -ORAU -NIOSH –EEOICPA		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	Berkeley "airborne test" OR "belgian congo ore" "Gilman Hall" -ORAU -NIOSH –EEOICPA Berkeley alpha Atomic Energy Commission "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley "breathing zone" OR BZ OR calibration "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission columnation OR contamination OR bio-assay "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley "chest count" OR curie OR denitration "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley "denitration pot" OR derby OR regulus "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission dose OR dosimeter OR dosimetric "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission dosimetry OR electron "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission beta OR "body burden" OR bioassay "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission environment OR "Ether-Water project" "GIlman Hall" Berkeley Atomic Energy Commission exposure OR "exposure investigation" OR "radiation exposure" "Gilman Hall" Berkeley Atomic Energy Commission external OR fecal "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	Berkeley "F machine" OR "feed material" "Gilman Hall" -ORAU -NIOSH -EEOICPA –iowa Berkeley Atomic Energy Commission femptocurie OR film "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa Berkeley Atomic Energy Commission fission OR fluoroscopy "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Gilman Hall "Formerly Utilized Sites Remedial Action Program" -ORAU -NIOSH -EEOICPA Berkeley FUSRAP OR gamma-ray OR "gas proportional" "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission health OR "health physics" OR "health instrument" "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission "gaseous diffusion" OR H.I. "Gilman Hall " -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission HI OR HP OR HEU "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley hydrofluorination OR "highly enriched uranium" "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission "in vitro" OR "in vivo" OR incident "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission ingestion OR inhalation OR internal "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission investigation OR isotope OR isotopic "Gilman Hall" -ORAU -NIOSH –EEOICPA		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	Berkeley Atomic Energy Commission "isotopic enrichment" OR "JS Project" OR Landauer "Gilman Hall" -ORAU -NIOSH –EEOICPA Berkeley Atomic Energy Commission "liquid scintillation" OR log OR "log sheet" "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission "log book" OR "low enriched uranium" OR LEU "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission "maximum permissible concentration" OR MPC OR metallurgy "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission microcurie OR millicurie OR "mixed fission product" "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley MFP OR monitor OR "air monitoring" "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission nanocurie OR neutron OR "nasal wipe" "Gilman Hall " -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission nose wipe "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission nuclear "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa Berkeley Atomic Energy Commission Chicago-Nuclear OR "nuclear fuels" "Gilman Hall" -ORAU -NIOSH -EEOICPA –Iowa Berkeley Atomic Energy Commission "type A; NTA" OR "nuclear track emulsion" "Gilman Hall" -ORAU -NIOSH -EEOICPA –Iowa		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	Berkeley Atomic Energy Commission "occupational radiation exposure" OR occurrence "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa Berkeley Atomic Energy Commission "ore concentrate" OR "PC project" OR permit "Gilman Hall " -ORAU -NIOSH -EEOICPA -iowa Berkeley Atomic Energy Commission "radiation work permit" OR "safe work permit" "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa Berkeley Atomic Energy Commission Gilman-Hall "special work permit" RWP OR SWP –ORAU –NIOSH –EEOICPA Berkeley Atomic Energy Commission picocurie OR "phosphate research" OR photon "Gilman Hall" -ORAU -NIOSH –EEOICPA Berkeley Atomic Energy Commission pitchblende OR "pocket ion chamber" OR PIC "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission problem OR procedure "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission "derived air concentration" OR DAC OR "gamma ray" "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley Atomic Energy Commission radeco OR "lung count" "Gilman Hall" -ORAU -NIOSH –EEOICPA Berkeley Atomic Energy Commission radiation "Gilman Hall" -ORAU -NIOSH -EEOICPA –iowa Berkeley Atomic Energy Commission radioactivity OR radiograph OR radiological "Gilman Hall" -ORAU -NIOSH -EEOICPA –iowa		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	Berkeley "radiological survey data sheet" OR RSDR "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa Berkeley radionuclide OR rafffinate "Gilman Hall" -ORAU -NIOSH -EEOICPA Berkeley reactor Atomic Energy Commission "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa Berkeley Atomic Energy Commission respiratory OR "retention schedules" OR roentgen "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa Berkeley Atomic Energy Commission sample OR "air sample" OR "dust sample" "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa Berkeley Atomic Energy Commission "general area air sample" OR sampling OR "air sampling" "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa Berkeley Atomic Energy Commission "dust sampling" OR "general area air sampling" "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa Berkeley Atomic Energy Commission source OR "sealed source" "Gilman Hall" -ORAU -NIOSH -EEOICPA –iowa Berkeley "solvent extraction" OR spectra OR spectrograph "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa Berkeley Atomic Energy Commission spectrography OR spectrum OR standard "Gilman Hall" -ORAU -NIOSH -EEOICPA –iowa		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	Berkeley Atomic Energy Commission "operating standard" OR "processing standard" "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa Berkeley Atomic Energy Commission survey OR "building survey" OR "routine survey" "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa Berkeley Atomic Energy Commission "special survey" OR "technical basis" "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa Berkeley "thermal diffusion" OR "thermoluminescent dosimeter" "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa Berkeley TLD OR "Tiger Team" OR "tolerance dose" "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa Berkeley urinalysis OR urine OR WBC "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa Berkeley "whole body count" OR "working level" OR WL "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa Berkeley x-ray OR xray OR "x ray" "Gilman Hall" -ORAU -NIOSH -EEOICPA -iowa "California Resources and Development" americium OR Am241 OR Am-241 "California Resources and development" -ORAU -NIOSH -EEOICPA "Am 241" OR 214Am OR 241-Am "California Resources and Development" -ORAU -NIOSH –EEOICPA		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	"241 Am" OR ionium OR Th230 "California Resources and Development " -ORAU -NIOSH -EEOICPA Th-230 OR "Th 230" OR 230Th "California Resources and Development" -ORAU -NIOSH -EEOICPA 230-Th OR "230 Th" OR neptunium "California Resources and Development" -ORAU -NIOSH -EEOICPA Np 237 "California Resources and Development" -ORAU -NIOSH -EEOICPA 237Np OR 237-Np OR "237 Np" "California Resources and Development" -ORAU -NIOSH -EEOICPA palm OR palmolive OR polonium "California Resources and Development" -ORAU -NIOSH -EEOICPA Po210 OR Po-210 OR "Po 210" "California Resources and Development" -ORAU -NIOSH -EEOICPA 210Po OR 210-Po OR "210 Po" "California Resources and Development" -ORAU -NIOSH -EEOICPA thorium OR thoria OR Th232 "California Resources and Development" -ORAU -NIOSH -EEOICPA Th-232 OR "Th 232" OR 232Th "California Resources and Development" -ORAU -NIOSH –EEOICPA 232-Th OR "232 Th" OR "Z metal" "California Resources and Development"		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	Z-metal OR myrnalloy OR "chemical 10-66" "California Resources and Development" -ORAU, -NIOSH -EEOICPA "chemical 1066" OR "chemical 10 66" OR "chemical 18-12" "California Resources and Development" -ORAU -NIOSH -EEOICPA "chemical 1812" OR "chemical 18 12" OR "chemical 10-12" "California Resources and Development" -ORAU -NIOSH -EEOICPA "chemical 1012" OR "chemical 10 12" OR UX1 "California Resources and Development" -ORAU -NIOSH -EEOICPA UX2 OR Th-234 OR Th234 "California Resources and Development" -ORAU -NIOSH -EEOICPA "Th 234" OR 234-Th OR 234Th "California Resources and Development" -ORAU -NIOSH -EEOICPA "234 Th" OR tritium OR H3 "California Resources and Development" -ORAU -NIOSH -EEOICPA H-3 OR mint OR HTO "California Resources and Development" -ORAU -NIOSH -EEOICPA uranium OR U233 OR U-233 "California Resources and Development" -ORAU -NIOSH -EEOICPA "U 233" OR 233U OR 233-U "California Resources and Development" -ORAU -NIOSH -EEOICPA "233 U" OR U234 OR U-234 "California Resources and Development" -ORAU -NIOSH -EEOICPA "U 234" OR 234U OR 234-U "California Resources and Development" -ORAU -NIOSH –EEOICPA		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	"234 U"' OR U235 OR "U 235" "California Resources and Development" U-235 OR 235-U OR 235U "California Resources and Development" -ORUA -NIOSH "235 U" OR U238 OR U-238 "California Resources and Development" -ORAU -NIOSH "U 238" OR 238-U OR 238U "California Resources and Development " -ORAU -NIOSH "238 U" OR U308 OR U-308 "California Resources and Development" -ORAU -NIOSH "U 308" OR 308-U OR 308U "California Resources and Development " -ORAU -NIOSH "308 U" OR "black oxide" OR "brown oxide" "California Resources and Development " -ORAU -NIOSH "green salt" OR "orange oxide" OR "yellow cake" "California Resources and Development" -ORAU -NIOSH UO2 OR UO3 OR UF4 "California Resources and Development" -ORAU –NIOSH UF6 OR C-216 OR C-616 "California Resources and Development" -ORAU -NIOSH C-65 OR C-211 OR U308 "California Resources and Development" -ORAU -NIOSH		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	"uranium extraction" OR "uranium dioxide" OR "uranium hexafluoride" "California Resources and Development" -ORAU –NIOSH "uranium tetrafluoride" OR "uranium trioxide" OR plutonium "California Resources and Development" -ORAU -NIOSH Pu-238 OR Pu238 OR "Pu 238" "California Resources and Development" -ORAU -NIOSH 238Pu OR 238-Pu OR "238 Pu" "California Resources and Development" -ORAU -NIOSH Pu-239 OR Pu239 OR "Pu 239" "California Resources and Development" -ORAU -NIOSH 239Pu OR 239-Pu OR "239 Pu" "California Resources and Development" -ORAU -NIOSH Pu-240 OR Pu240 OR "Pu 240" "California Resources and Development" -ORAU -NIOSH 240Pu OR 240-Pu OR "240 Pu" "California Resources and Development" -ORAU -NIOSH Pu-241 OR Pu241 OR "Pu 241" "California Resources and Development" -ORAU -NIOSH 241Pu OR 241-Pu OR "241 Pu" "California Resources and Development" -ORAU –NIOSH radium OR Ra-226 OR Ra226 "California Resources and Development" -ORAU -NIOSH "Ra 226" OR 226-Ra OR 226Ra "California Resources and Development" -ORAU -NIOSH		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	"226 Ra" OR Ra-228 OR Ra228 "California Resources and Development" -ORAU –NIOSH "Ra 228" OR 228Ra OR 228-Ra "California Resources and Development" -ORAU -NIOSH "228 Ra" OR radon OR Rn-222 "California Resources and Development" -ORAU -NIOSH Rn222 OR "Rn 222" OR 222Rn "California Resources and Development" -ORAU -NIOSH 222-Rn OR "222 Rn" OR thoron "California Resources and Development" -ORAU -NIOSH Rn-220 OR Rn220 OR "Rn 220" "California Resources and Development" -ORAU -NIOSH 220Rn OR 220-Rn OR "220 Rn" "California Resources and Development" -ORAU -NIOSH protactinium OR Pa234m OR Pa-234m "California Resources and Development" -ORAU -NIOSH "Pa 234m" OR 234mPa OR 234m-Pa "California Resources and Development" -ORAU -NIOSH "234m Pa" OR strontium OR Sr-90 "California Resources and Development " -ORAU –NIOSH Sr90 OR "Sr 90" OR 90-Sr "California Resources and Development" -ORAU -NIOSH 90Sr OR "90 Sr" OR oralloy "California Resources and Development" -ORAU -NIOSH		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	postum OR tuballoy OR "uranyl nitrate hexahydrate" "California Resources and Development" -ORAU –NIOSH UNH OR K-65 OR "sump cake" "California Resources and Development" -ORAU -NIOSH accident OR "air count" OR "air dust" "California Resources and Development" -ORAU -NIOSH "air filter" OR "airborne test" OR alpha "California Resources and Development" -ORAU -NIOSH "belgian congo ore" OR beta OR bioassay "California Resources and Development" -ORAU -NIOSH bio-assay OR breath OR "breathing zone" "California Resources and Development" -ORAU –NIOSH BZ OR "body burden" OR calibration "California Resources and Development" -ORAU -NIOSH "chest count" OR collimation OR contamination "California Resources and Development" -ORAU -NIOSH curie OR denitration OR "denitration pot" "California Resources and Development" -ORAU -NIOSH derby OR regulus OR "derived air concentration" "California Resources and Development" -ORAU –NIOSH DAC OR dose OR dosimeter "California Resources and Development" -ORAU -NIOSH dosimetric OR dosimetry OR electron "California Resources and Development" -ORAU -NIOSH		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	environment OR "Ether-Water Project" OR exposure "California Resources and Development" -ORAU –NIOSH "exposure investigation" OR "radiation exposure" OR external "California Resources and Development" -ORAU -NIOSH "F machine" OR fecal OR "feed material" "California Resources and Development" -ORAU -NIOSH femptocurie OR film OR fission "California Resources and Development" -ORAU -NIOSH fluoroscopy OR "Formerly Utilized Sites Remedial Action Program:" OR FUSRAP "California Resources and Development" -ORAU -NIOSH gamma-ray OR "gamma ray" OR "gas proportional" "California Resources and Development" -ORAU –NIOSH gaseous diffusion OR health OR "health instrument" "California Resources and Development" -ORAU -NIOSH "health physics" OR H.I. OR HI "California Resources and Development" -ORAU –NIOSH HP OR "highly enriched uranium" OR HEU "California Resources and Development" -ORAU -NIOSH hydrofluorination OR "in vitro" OR "in vivo" "California Resources and Development" -ORAU -NIOSH incident OR ingestion OR inhalation "California Resources and Development" -ORAU -NIOSH internal OR investigation OR isotope "California Resources and Development" -ORAU -NIOSH		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	isotopic OR "isotopic enrichment" OR "JS Project" "California Resources and Development" -ORAU –NIOSH Landauer OR "liquid scintillation" OR log "California Resources and Development" -ORAU -NIOSH "log sheet" OR "log book" OR "low enriched uranium" "California Resources and Development" -ORAU -NIOSH LEU OR "lung count" OR "maximum permissible concentration" "California Resources and Development" -ORAU -NIOSH MPC OR metallurgy OR microcurie "California Resources and Development" -ORAU –NIOSH millicurie OR "mixed fission product" OR MFP "California Resources and Development" -ORAU -NIOSH monitor OR "air monitoring" OR nanocurie "California Resources and Development" -ORAU –NIOSH "nasal wipe" OR neutron OR "nose wipe" "California Resources and Development" -ORAU -NIOSH nuclear OR Chicago-Nuclear OR "nuclear fuels" "California Resources and Development" -ORAU -NIOSH "nuclear track emulsion type A" OR NTA OR "occupational radiation exposure" "California Resources and Development" -ORAU -NIOSH occurrence OR "ore concentrate" OR "PC project" "California Resources and Development" -ORAU -NIOSH permit OR "radiation work permit" OR "safe work permit" "California Resources and Development" -ORAU -NIOSH		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	"special work permit" OR RWP OR SWP "California Resources and Development" -ORAU –NIOSH "phosphate research" OR photofluorography OR photon "California Resources and Development" -ORAU -NIOSH picocurie OR pitchblende OR "pocket ion chamber" "California Resources and Development" -ORAU -NIOSH PIC OR problem OR procedure "California Resources and Development" -ORAU -NIOSH radeco OR radiation OR radioactive "California Resources and Development" -ORAU -NIOSH radioactivity OR radiograph OR radiological "California Resources and Development" -ORAU -NIOSH "Radiological Survey Data Sheet" OR RSDS OR radionuclide "California Resources and Development" -ORAU -NIOSH raffinate OR reactor OR respiratory "California Resources and Development" -ORAU -NIOSH "retention schedules" OR roentgen OR sample "California Resources and Development" -ORAU -NIOSH "air sample" OR "dust sample" OR "general area air sample" "California Resources and Development" -ORAU -NIOSH "air sampling" OR "dust sampling" OR "general area air sampling" "California Resources and Development" -ORAU -NIOSH "solvent extraction" OR source OR "sealed source" "California Resources and Development" -ORAU -NIOSH		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
	spectra OR spectrograph OR spectroscopy "California Resources and Development" -ORAU –NIOSH spectrum OR standard OR "operating standard" "California Resources and Development" -ORAU -NIOSH "processing standard" OR survey OR "building survey" "California Resources and Development" -ORAU -NIOSH "routine survey" OR "special survey" OR "technical basis" "California Resources and Development" -ORAU -NIOSH "thermal diffusion" OR "thermoluminescent dosimeter" OR TLD "California Resources and Development" -ORAU –NIOSH "Tiger Team" OR "tolerance dose" OR "uranium aluminum alloy" "California Resources and Development" -ORAU -NIOSH UAlx OR "uranium aluminide" OR urinalysis "California Resources and Development" -ORAU –NIOSH urine OR "whole body count" OR WBC "California Resources and Development" -ORAU -NIOSH "working level" OR WL OR X-ray "California Resources and Development" -ORAU -NIOSH "X ray" OR Xray OR "x-ray screening" "California Resources and Development" -ORAU -NIOSH		

Table A1-5: Internet Database Searches for University of California, Berkeley, CA			
Database/Source	**Keywords / Phrases**	**Hits**	**Uploaded into SRDB**
National Academies Press http://www.nap.edu/ COMPLETED 04/02/2008	University of California and "Gilman hall" California resources and development	537	0
National Institute of Health http://www.nih.gov COMPLETED 04/02/2008	University of California "Gilman Hall" -ORAU –NIOSH California Resources and Development -ORAU -NIOSH California Resources & Development -ORAU -NIOSH Gilman Hall plutonium -ORAU -NIOSH Gilman Hall uranium -ORAU -NIOSH	17	0
NNSA - Nevada Site Office www.nv.doe.gov/main/search.htm COMPLETED 04/02/2008	Gilman Hall California Resources & Development	0	0
NRC ADAMS Reading Room http://www.nrc.gov/reading-rm/adams/web-based.html COMPLETED 04/16/2008	"California Resources and Development" University of California filtered with "Gilman Hall"	5	1
U.S. Transuranium & Uranium Registries http://www.ustur.wsu.edu/ COMPLETED 03/29/2008	University of California Gilman Hall AND plutonium Gilman Hall AND uranium Gilman Hall AND "neutron flux" Gilman Hall AND "solvent extraction" Wendell Latimer Gilman Hall California Resources and Development California Resources & Development	14	0
Washington University Libraries - St. Louis http://library.wustl.edu/units/westcampus/govdocs/nukes/index.html COMPLETED 04/26/2008	"Gilman Hall" "California Resources and Development" "University of California AND Berkeley" "California Resources & Development"	50	0

Table A1-6: OSTI Documents Requested for University of California, Berkeley, CA			
Document Number	**Document Title**	**Requested**	**Received**
No documents ordered.	N/A	N/A	N/A