

SEC Petition Evaluation Report Petition SEC-00135

Report Rev #: 0

Report Submittal Date: December 9, 2008

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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-00135	83.14	November 24, 2008	Metallurgical Laboratory

NIOSH-Proposed Class Definition
All AWE employees who worked at the Metallurgical Laboratory in Chicago, Illinois, from August 13, 1942 through June 30, 1946, 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 SEC.

Related Petition Summary Information			
SEC Petition Tracking #(s)	Petition Type	DOE/AWE Facility Name	Petition Status
None	None	None	None

Related Evaluation Report Information	
Report Title	DOE/AWE Facility Name
None	None

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Evaluation Report Summary: SEC-00135, Metallurgical 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 AWE employees who worked at the Metallurgical Laboratory in Chicago, Illinois, from August 13, 1942 through June 30, 1946, 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 SEC.

Feasibility of Dose Reconstruction Findings

NIOSH lacks sufficient information, which includes specific biological monitoring data, sufficient air monitoring information, or sufficient process and radiological source information, to allow it to estimate with sufficient accuracy the potential internal and external exposures to plutonium, radium, fission products, uranium, and uranium progeny to which the proposed class may have been subjected.

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

- Principal sources of internal radiation for members of the proposed class included exposures to plutonium, fission products, uranium, and uranium progeny associated with experimental reactor and laboratory operations. A wide variety of material forms were encountered, including uranium powder, metal, and solutions. In many cases, experiments were performed on ores from other sites, or on leach liquors and other raffinates.
- NIOSH has identified limited breath radon results, but lacks the information necessary to use the data to bound potential internal doses. No other personnel bioassay monitoring results have been located by NIOSH.
- NIOSH has obtained limited air monitoring data for one laboratory location only. None of the air sample results obtained by NIOSH represent comprehensive sampling of the site activities, and are therefore insufficient to bound potential internal exposures.
- Principal sources of external radiation for members of the proposed class included exposures to plutonium, fission products, uranium, and uranium progeny associated with experimental reactor and laboratory operations. NIOSH has external gamma dosimetry results for one energy employee. NIOSH has been unable to locate any additional external personnel monitoring data, and does not have access to sufficient individual monitoring data, process information, or source term information to enable it bound external exposures from all sources and radiation types.

- 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 radiation doses for Metallurgical Laboratory employees, NIOSH intends to use any available internal and external monitoring data that may be available for an individual claim (and that can be interpreted using existing NIOSH dose reconstruction processes or procedures). Furthermore, NIOSH has determined that occupational medical dose for all workers can be reconstructed. Therefore, dose reconstructions may be performed using these data, as appropriate, for individuals with non-presumptive cancers or fewer than 250 days employment during the class period.

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 radionuclides 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.

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SEC Petition Evaluation Report for SEC-00135

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: Larry Page; MJW Corporation, Inc. These conclusions were peer-reviewed by the individuals listed on the cover page. 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 the Metallurgical Laboratory (Met Lab) 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 NIOSH-proposed class includes all AWE employees who worked at the Metallurgical Laboratory in Chicago, Illinois, from August 13, 1942 through June 30, 1946, 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 SEC. During this period, employees at this facility were involved with production and purification of plutonium, fission product research, and nuclear reactor experimentation.

The evaluation responds to Petition SEC-00135 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. This claimant was employed as a medical technician from 1943 through 1953. 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 Metallurgical Laboratory from August 13, 1942 through June 30, 1946 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 University of Chicago was one of the focal points for activities conducted in support of atomic bomb development during World War II. The first contract with the university was initiated by the Office of Scientific Research and Development (OSRD) in January, 1942 (Summary, 1951). On August 13 of that year, the Manhattan Engineering District (MED) was established within the U.S. Army Corps of Engineers; the contract with the University of Chicago was transferred from OSRD to MED in May, 1943. This represented a consolidation of work which had been conducted by a variety of groups at several universities since 1939 (Summary, 1951).

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>.

The primary goal of the University of Chicago work was the development of methods for the production and purification of plutonium. Since plutonium production occurs when uranium absorbs neutrons, a facility was needed to provide a self-sustaining nuclear chain reaction. The first such "pile," later called CP-1, was constructed of uranium and graphite beneath the west stands of Stagg Field, under the direction of Dr. Enrico Fermi. A self-sustaining chain reaction occurred in December, 1942 (Chronology, 1944). In early 1943, CP-1 was dismantled and materials from that pile were moved to the Argonne Forest (later Argonne National Laboratory [ANL]). CP-1 materials were used to construct CP-2, which was designed for continuing research into neutron capture probabilities and instrumentation systems (Final Reactor Design, 2008).

Additional research and development programs were conducted for the MED throughout World War II in support of the atomic bomb project (Decontamination, 1983). In January 1947, the Atomic Energy Commission (AEC) succeeded the MED as the governmental organization in charge of nuclear programs.

The Metallurgical Laboratory site occupied part of the University of Chicago, primarily using seven locations on the campus:

- New Chemistry Laboratory and Annex and Ricketts Laboratory: These facilities were used for plutonium and uranium research. They were decontaminated and demolished after establishment of ANL. Soil samples were taken in these areas in 1977. Earlier survey and air sample results were available, but only for 1946, and they were incomplete regarding radionuclide information (Wynveen, 1977).
- West Stands: The area where CP-1 was constructed and the first self-sustaining chain reaction was created. CP-1 operated into early 1943, when it was disassembled and reconstructed at ANL as CP-2. Soil samples were taken in this area in 1977. Records indicate that neptunium work was conducted in this location after removal of CP-1. Additional radiological work may have occurred (Wynveen, 1977).
- Ryerson Physical Laboratory: According to information obtained by the ANL MED/AEC Resurvey Group, this facility performed research with radium-226. The lab was surveyed in 1977. No earlier survey results were available (Decontamination, 1983).
- Eckhardt Hall: According to information obtained by the ANL MED/AEC Resurvey Group, this facility performed research with radium-226. It was surveyed in 1977. NIOSH has been unable to locate any earlier survey results (Decontamination, 1983).
- Kent Chemical Laboratory: According to information obtained by the ANL MED/AEC Resurvey Group, this facility performed research with plutonium, radium, and uranium. It was surveyed in 1977. No earlier survey results were available (Resurvey, 1977).

- Jones Chemical Laboratory: According to information obtained by the ANL MED/AEC Resurvey Group, this facility performed research with radium-226. It was surveyed in 1977. No earlier survey results were available (Resurvey, 1977).

Other University of Chicago locations appear to have been used for medical radiological experimentation and radiological storage facilities (Buildings, 1980).

4.2 Radiation Exposure Potential from Operations

The potential for radiation exposure existed at all locations where radioactive materials were handled or stored. ORAUT has identified some documentation describing a variety of projects involving raffinates from different sites (Samples, 1943), but with no specific information regarding their physical storage, use location, or the length of time that the material from each site remained at the Met Lab.

NIOSH has minimal information detailing the quantities of radioactive materials maintained or generated on site. Most available information is in the form of monthly progress reports. Available records indicate that a wide variety of material forms were used during research, including uranium powder, metal, and solutions (Samples, 1943). In many cases, experiments were performed on ores from other sites, or on leach liquors and other raffinates (Samples, 1943). Available records indicate that research was ongoing, but they do not indicate when research was started or discontinued, or when materials were removed from the site (if at all) during the covered period.

Experimental activities were conducted in which uranium and decay chain radionuclides were chemically separated from each other and reconcentrated so that they were frequently not in equilibrium; the degree of disequilibrium usually unknown. Due to the separation of uranium and uranium progeny radionuclides, uranium urinalysis methods would not be sufficient to quantify intakes of non-uranium radionuclides. The only bioassay records found by NIOSH were a small set of breath radon analyses performed in February and May, 1945 (Mears, 1945).

The primary mission at the Met Lab was determining methods for producing and purifying plutonium (Summary, 1951). NIOSH has been unable to locate information describing the actual amount of plutonium produced per unit time. There are no bioassay results for plutonium available in the records.

Biological research and research into potential military applications was performed using fission products; this included injection of animals and long-term dust exposure tests (Plutonium, 1945; Reports, 1943). NIOSH has found no external dose data, air sampling data, or bioassay data related to the use of these radionuclides.

The piles (later called reactors) were used to prove that self-sustaining chain reactions were possible and that neutron radiation and plutonium could be produced. The piles were also used as a method to generate fission products for further experimentation (Plutonium, 1945). Limited information could be located regarding potential external radiation exposure at the pile reactors; no information regarding potential internal exposure could be located.

While it is clear that the Met Lab worked with a wide variety of radioactive materials and processes, without additional documentation NIOSH can make no assumption about particular radionuclides, and quantities or forms of the source materials used. The NIOSH review does verify that work at the Met Lab during the period from August 13, 1942 through June 30, 1946 involved potential internal and external exposures associated with reactor operation and the handling of plutonium, fission products, uranium, and uranium progeny in unknown states of disequilibrium with uranium.

4.3 Time Period Associated with Radiological Operations

Per the DOE Office of Health, Safety and Security, the time period associated with Atomic Weapons Employer (AWE) operations at the Metallurgical Laboratory is from 1942 through 1952 (DOE, 2008). NIOSH has determined, and DOL has concurred (DOL, 2008), that Argonne National Laboratory, which began operation on July 1, 1946, took control of all Met Lab facilities and that the Met Lab effectively ceased to exist on June 30, 1946. This evaluation assumes that Met Lab operations ended on June 30, 1946. Covered AWE radiological operations at the Met Lab are therefore assumed to have started with the creation of the MED on August 13, 1942, and to have continued through June 30, 1946.

4.4 Site Locations Associated with Radiological Operations

The potential for radiation dose existed in all locations at the Met Lab where radioactive materials were handled, used, transported, disposed, or stored. While some buildings and areas are specifically noted for the use of radiological materials, as outlined in Sections 4.1 and 4.2, documentation available to NIOSH does not sufficiently indicate any definite boundaries between radiological and non-radiological areas. NIOSH has no documentation to confirm that all radioactive materials were restricted to identified areas or that contamination was adequately controlled. As a result, NIOSH must assume that the potential for exposure to radioactive materials existed in all Met Lab buildings and areas.

4.5 Job Descriptions Affected by Radiological Operations

Given the general lack of process knowledge, and the potential for workplace radioactive contamination in 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 found no documentation associating job titles and/or job assignments with specific radiological operations or conditions. Without such information, NIOSH is unable to define the proposed SEC class 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 the Met Lab focused on the DOE (Legacy Management; OpenNet repository; Office of Scientific and Technical Information [OSTI], and the Argonne National Laboratory), the State of Illinois, the Nuclear Regulatory Commission (ADAMS electronic records repository), and the National Archives record centers. NIOSH found documents detailing Met Lab history, operations, and some very limited personnel monitoring data. Attachment 1 contains a summary of Mat Lab documents. The summary specifically identifies specific data capture details for each document retrieved. In addition, NIOSH verified that requests for dosimetry-related information were made directly to DOE for all claimants.

5.2 Worker Interviews

NIOSH has reviewed the computer-assisted telephone interviews conducted for claims filed with NIOSH for energy employees who worked at the Met Lab during the period from 1942 through 1946. These interviews provided no information to change NIOSH's feasibility determination.

Based on the sparse data available for the Metallurgical Laboratory facility, NIOSH determined that additional worker interviews would neither change the feasibility determination nor allow NIOSH to limit the class to specific locations. Therefore, no additional interviews were pursued.

5.3 Internal Personnel Monitoring Data

NIOSH has obtained very limited bioassay monitoring results for Met Lab workers. The available data consist of 18 radon (breath) results corresponding to 15 persons in February and three in May 1945 (Mears, 1945). DOE supplied no internal monitoring data for any claims associated with Met Lab employment. NIOSH has been unable to locate any additional internal personnel monitoring data for workers at the Mat Lab for the period from August 13, 1942 through June 30, 1946.

5.4 External Personnel Monitoring Data

DOE has provided external gamma dosimetry results for one energy employee, a physicist involved with the operation of CP-1 and CP-2. There were no neutron monitoring data for this individual. DOE supplied no other external monitoring data nor any occupational medical X-ray data for any claims submitted to NIOSH for dose reconstruction. NIOSH has been unable to locate any additional external personnel monitoring data for workers at the Met Lab for the period from August 13, 1942 through June 30, 1946.

5.5 Workplace Monitoring Data

NIOSH has obtained air sampling data for the New Chemistry Laboratory for 1946 (Air, 1946). None of the air samples represent comprehensive sampling of the site activities. Isolated radiation and contamination surveys have been discovered for brief periods within the New Chemistry Laboratory (Chemistry, 1946), and one (gamma only) survey has been found for CP-2 (Samples, 1943). NIOSH has been unable to locate any additional workplace monitoring data for the Met Lab for the period from August 13, 1942 through June 30, 1946.

5.6 Radiological Source Term Data

NIOSH has obtained minimal information detailing the quantities of radioactive materials maintained or generated on site. Most available information is in the form of monthly progress reports (Monthly, 1943). Available records indicate that a wide variety of material forms were used for research, including uranium powder, metal, and solutions. In many cases, experiments were performed on ores from other sites, or on leach liquors and other raffinates (Samples, 1943). Based on the information outlined in Sections 4.1 and 4.2, the work at the Met Lab during the period from August 13, 1942 through June 30, 1946 involved potential internal and external exposures associated with reactor operation, and the handling of plutonium, fission products, uranium, and uranium progeny in unknown states of disequilibrium with uranium

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 identified 18 breath radon results during the AWE operating period, but has not found documentation that describes the sampling or analysis protocols used with that dataset. Beyond those results, no other personnel bioassay monitoring results have been located. NIOSH has obtained limited air monitoring data for one laboratory location only. None of the air sample results represent comprehensive sampling of the site activities, and are therefore insufficient for bounding potential internal exposures. In the absence of personnel monitoring data, NIOSH has insufficient workplace and source term data with which to bound potential internal doses at the Met Lab for the period from August 13, 1942 through June 30, 1946.

NIOSH does not have access to sufficient personnel monitoring, workplace monitoring, or source term data to estimate potential internal exposures at the Met Lab during the period of AWE operations from August 13, 1942 through June 30, 1946. Consequently, NIOSH finds that it is not feasible to estimate, with sufficient accuracy, total internal exposures and resulting doses for the class of employees covered by this evaluation.

Although NIOSH found that it is not possible to completely reconstruct internal radiation doses for the proposed class, NIOSH intends to use any available 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 the Metallurgical Laboratory, but not qualifying 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 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.

NIOSH has external gamma dosimetry results for one energy employee; no neutron monitoring data are available for this individual. NIOSH has been unable to locate any additional external personnel monitoring data for workers at the Mat Lab for the period from August 13, 1942 through June 30, 1946.

Based on the evaluation conducted for this report, NIOSH does not consider it feasible to estimate potential external exposures during the period from August 13, 1942 through June 30, 1946. NIOSH does not have access to sufficient individual monitoring data, nor is there sufficient information on site radiological monitoring practices and source terms to be able to bound external exposures from all sources and radiation types. However, adequate reconstruction of medical dose for Met Lab workers is likely to be feasible by using claimant-favorable assumptions, as well as the applicable protocols in the complex-wide TBD *Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures* (ORAUT-OTIB-0006)

Although NIOSH found that it is not possible to completely reconstruct radiation doses for the proposed class, NIOSH intends to use any available external 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 Metallurgical Laboratory, but not qualifying for inclusion in the SEC, may be performed using these data as appropriate.

6.3 Class Parameters Associated with Infeasibility

As outlined in Section 4.3, NIOSH has determined, and DOL has concurred, that Argonne National Laboratory, which began operation on July 1, 1946, took control of all Metallurgical Laboratory facilities and that the Met Lab effectively ceased to exist on June 30, 1946. This evaluation assumes that Met Lab operations ended on June 30, 1946. Covered AWE radiological operations at the Met Lab are therefore assumed to have started with the creation of the Manhattan Engineer District on August 13, 1942, and to have continued through June 30, 1946. NIOSH therefore recommends that the proposed class include the period from August 13, 1942 through June 30, 1946.

As outlined in Section 4.4, documentation available to NIOSH does not sufficiently indicate any definite boundaries between radiological and non-radiological areas. NIOSH has no documentation to confirm that all radioactive materials were restricted to identified areas or that contamination was

adequately controlled. NIOSH recommends that the proposed class definition include all buildings and areas of the Metallurgical Laboratory during the specified time period.

As outlined in Section 4.5, NIOSH has found no documentation associating job titles and/or job assignments with specific radiological operations or conditions. Without such information, NIOSH is unable to define the proposed SEC class based on worker job descriptions. NIOSH therefore recommends that the class include all workers at the Metallurgical Laboratory during the specified period.

7.0 Summary of Feasibility Findings for Petition SEC-00135

This report evaluates the feasibility for completing dose reconstructions for employees at the Metallurgical Laboratory from August 13, 1942 through June 30, 1946. NIOSH determined that members of this class may have received radiation exposures from reactor operations, and the handling of plutonium, fission products, uranium, radium, and uranium progeny in unknown states of disequilibrium with uranium. NIOSH lacks sufficient information, which includes specific biological monitoring data, sufficient air monitoring information, or sufficient process and radiological source information, that would allow it to estimate the potential internal and external exposures to which the proposed class may have been exposed. However, adequate reconstruction of medical dose for Metallurgical Laboratory workers is likely to be feasible.

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.

Although NIOSH found that it is not possible to completely reconstruct radiation doses for the proposed class, NIOSH intends to use any available internal and external 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 Metallurgical Laboratory, but not qualifying for inclusion in the SEC, may be performed using these data as appropriate.

8.0 Evaluation of Health Endangerment for Petition SEC-00135

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-00135

The evaluation defines a single class of employees for which NIOSH cannot estimate radiation doses with sufficient accuracy. This class includes all AWE employees who worked at the Metallurgical Laboratory in Chicago, Illinois, from August 13, 1942 through June 30, 1946, 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 SEC.

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 the Metallurgical Laboratory for whom dose reconstruction may not be feasible.

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11.0 References

42 C.F.R. pt. 81, *Guidelines for Determining the Probability of Causation Under the Energy Employees Occupational Illness Compensation Program Act of 2000*; Final Rule, Federal Register/Vol. 67, No. 85/Thursday, p 22,296; May 2, 2002; SRDB Ref ID: 19391

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

ORAUT-OTIB-0006, *Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures*, Rev. 3 PC-1, R. L. Kathern, V. E. Shockley; December 21, 2005; SRDB Ref ID: 20220

Air, 1946, *Air Sample Records (New Chemistry Laboratory)*, various dates, 1946; SRDB Ref ID: 16801

Buildings, 1980, *University of Chicago Buildings Used by the Manhattan Engineer District*, The Aerospace Corporation; September 16, 1980; SRDB Ref ID: 9989

Chemistry, 1946, *New Chemistry Weekly Report, July 27 through August 3, 1946*; from G. F. Steel to J. E. Rose; SRDB Ref ID: 16772

Chronology, 1944, *Chronology of the Metallurgical Project*, Metallurgical Laboratory; September 14, 1944; SRDB Ref ID: 13388

Decontamination, 1983, *Proposed Decontamination of Three Buildings at the University of Chicago Contaminated as a Result of Previous MED/AEC Activities*; Action Description Memorandum; U.S. Department of Energy; Oak Ridge Operations; December, 1983; SRDB Ref ID: 15335

DOE, 2008, U.S. Department of Energy, Office of Health, Safety, and Security, Energy Employees Occupational Illness Compensation Program; Find facilities List:
<http://www.hss.energy.gov/healthsafety/fwsp/advocacy/faclist/findfacility.cfm>

DOL, 2008, memo on *Time Periods of Operation of Metallurgical Laboratory and Argonne National Laboratory - East*, R. P. Leiton, U.S. Department of Labor; Division of Energy Employees Occupational Illness Compensation; November 13, 2008; SRDB Ref ID 54446

Final Reactor Design, 2008, *Final Reactor Design and X-10; Met Lab and Oak Ridge (Clinton) (1942-1943)*, USDOE Office of History and Heritage Resources,
http://www.cfo.doe.gov/me70/manhattan/final_reactor_x-10.htm; SRDB Ref ID: 43014

Mears, 1945, *Results of Breath Analyses*, memos from H. J. Mears, R. Tybout, and R. A. Warren to Chicago Area Engineer; various dates, 1945; SRDB Ref ID: 4715

Monthly, 1943, *Health, Radiation, and Protection Report for the Month Ending June 7, 1943*, Dr. R. S. Stone; 1943; SRDB Ref ID: 40754

Plutonium, 1945, *Health Protection Activities at the Plutonium Project*, Dr. R. S. Stone, Metallurgical Project; November 2, 1945; SRDB Ref ID: 7693

Reports, 1943, Assorted Correspondence and Reports for 1943; various authors and dates; SRDB Ref ID: 44735

Resurvey, 1977, *Formerly Utilized MED/AEC Sites Remedial Action Program Radiological Survey of Kent Chemical Laboratory University of Chicago*, Chicago Illinois, ANL MED/AEC Resurvey Group, September 7-13, 1977; SRDB Ref ID: 16487

Samples, 1943, *Number of Samples and Significance and Spectrochemical Analysis Report*, University of Chicago; January 14, 1943, SRDB Ref ID: 30763

Summary, 1951, *Summary Report of the Accomplishments of the Plutonium Project Under the Sponsorship of the University of Chicago During the Decade 1942-1951*, attachment to a letter from N. Hilberry (Deputy Director of Argonne National Laboratory) to W. B. Harrell (University of Chicago); September 17, 1951; SRDB Ref ID: 9987

Wynveen, 1977, *Radiological Survey of the New Chemistry Lab and Annex, The West Stands, and Ricketts Lab, University of Chicago, Chicago Illinois*, R. A. Wynveen, W. H. Smith, C. B. Mayes; Argonne National Laboratory; MED/AEC Resurvey Group; August 2, 1977; SRDB Ref ID: 17477

Attachment 1: Data Capture Synopses

Table A1-1: Data Capture Synopsis for the Metallurgical Laboratory			
Data Capture Information	Data Captured Description	Completed	Uploaded
<p>Primary Site/Company Name: Metallurgical Laboratory, Chicago, IL BE 1942-1946; AWE:1942-1952; Res. Rad. 1953-1981; 1984-1986; DOE:1982-1983;1987 (remediation)</p> <p>Other Site Names: Eckhardt Hall (+ West Stands, New Chem. Lab and Annex, Ryerson Physical Lab, Kent Chem. Lab)</p>	None, the Metallurgical Laboratory no longer exists as an operating entity.	N/A	0
State Contacted: Illinois Emergency Management Agency	Greenpeace report on residual contamination in the Palos Park Preserve and an Illinois Department of Nuclear Safety radiological verification of conditions in the park.	06/06/2008	2
DOE Legacy Management - MoundView (Fernald Holdings, includes Fernald Legal Database)	Laboratory reports.	08/26/2004	3
Comprehensive Epidemiologic Data Resource (CEDR)	No relevant data identified.	04/04/2008	0
Cincinnati Public Library	Optical instrumentation used in plutonium research and the personal history of a Met Lab researcher.	02/26/2008	2
CDC Interlibrary Loan	Glenn T. Seaborg's plutonium research journals.	05/15/2008	1
DOE Argonne National Laboratory	Lab notebooks with methods and results, lists of personnel, public relations material, security and accountability reports, infrastructure proposals, beryllium transfers and reports, laboratory progress reports, instrument development, various conference reports, graphite pile physics, pile cooling experimental results and proposals, meeting minutes, correspondence, incident investigations and reports, health and safety manuals, animal experiments, and exposure reduction proposals.	04/04/2008	209
DOE Germantown	General and FUSRAP regarding the site and unclassified portions of the Manhattan District history.	03/11/2008	6

Table A1-1: Data Capture Synopsis for the Metallurgical Laboratory

Data Capture Information	Data Captured Description	Completed	Uploaded
DOE Hanford Declassified Document Retrieval System (DDRS)	Trip reports, laboratory progress reports, and a discussion of radiation tolerance levels.	04/04/2008	28
DOE Legacy Management Considered Sites	Long-term surveillance and maintenance plans and a site description.	01/31/2008	5
DOE Oak Ridge National Laboratory (ORNL)	Laboratory progress report, neutron tolerance values, the test plan for evaluating various films for dosimetry, and a discussion of plutonium separation techniques.	08/31/2004	4
DOE OpenNet	Human radiation experimentation reports, a description of the health protection program, health, radiation, and protection division reports, and a summary of health division activities.	01/31/2008	28
DOE OSTI	Human radiation studies.	06/08/2007	1
DOE OSTI Energy Citations	The Seaborg diaries of plutonium work, blood changes in employees following the first year of employment, and radiological issues at the chemical plant.	07/09/2008	6
DOE OSTI Information Bridge	A site history, FUSRAP surveys, a report on the toxicity of uranium, laboratory test and progress reports.	03/11/2008	27
Google	Histories of human radiation studies, public health assessments of the Palos Park Preserve, histories and descriptions of the Chicago Pile, detector development, and personnel biographies and histories.	03/11/2008	53
NARA Atlanta	Health hazards of polonium and plutonium, radon breath analyses, descriptions of the site, chronology of research projects, metal production operations, records of material transfers, uranium billet testing, and analytical reports.	06/19/2008	34
NARA Kansas City	FUSRAP surveys of Met Lab facilities, decontamination plans, and project management plans.	06/24/2005	10
National Academies Press (NAP)	No relevant data identified.	04/04/2008	0
National Nuclear Security Administration (NNSA) - Nevada Site Office	No relevant data identified.	01/31/2008	0
NRC Agencywide Document Access and Management (ADAMS)	No relevant data identified.	01/31/2008	0
U.S. NRC	No relevant data identified.	01/31/2008	0

Table A1-1: Data Capture Synopsis for the Metallurgical Laboratory			
Data Capture Information	Data Captured Description	Completed	Uploaded
Washington State University (U.S. Transuranium and Uranium Registries)	List of USTUR registrants.	04/04/2008	1
Washington University Libraries - St. Louis	The chemistry of uranium halides, the basic chemistry and metallurgy of plutonium, and the observed thermal deformation of the graphite pile.	04/27/2007	5
Unknown	FUSRAP surveys of Met Lab facilities, decontamination reports, the FUSRAP Remedial Action Plan, and an AEC advisory committee meeting agenda.	06/23/2003	17
TOTAL			442

Table A1-2: Database Searches for the Metallurgical Laboratory			
Database/Source	Keywords / Phrases	Hits	Uploaded
Legacy Management Considered Sites http://csd.lm.doe.gov/ COMPLETED 01/31/2008	Site A/Plot M	14	5
	Illinois-Chicago North		
	Chicago North Site		
DOE OpenNet http://www.osti.gov/opennet/advancedsearch.jsp COMPLETED 01/31/2008	Title contains National Guard Armory	71	28
	Title contains Chicago North Site		
	Title contains Certification Docket		
	Document Number contains ANL and date between 1942-1945		
	Document Number contains AEC and date between 1942-1945		
	Document Number contains AEC		
	Document Number contains MUC and date between 1942-1945		
	Document Number contains MUC		
	Full text contains "Atomic" and date between 1/1/1942-12/31/1942		
	Full text contains "Atomic" and date between 1/1/1943-12/31/1943		
	Full text contains "Atomic" and date between 1/1/1944-12/31/1944		
	Full text contains "Atomic" and date between 1/1/1945-12/31/1945		
	Title contains "Photographic Film" and date between 1942-1950		
	Title contains "Film Dosimeter" and date between 1942-1950		
	Full text Contains (Radiation Survey Data Metallurgical Laboratory) Title Contains (Metallurgical)		
Authors Contains (Stone) Title Contains ("Metallurgical" and "Health")			

Table A1-2: Database Searches for the Metallurgical Laboratory			
Database/Source	Keywords / Phrases	Hits	Uploaded
NNSA - Nevada Site Office www.nv.doe.gov/main/search.htm COMPLETED 01/31/2008	Title contains National Guard Armory	0	0
	Title contains Chicago North Site		
	Title contains Certification Docket		
	"Metallurgical Laboratory"		
NRC ADAMS Reading Room http://www.nrc.gov/reading-rm/adams/web-based.html COMPLETED 01/31/2008	Title contains National Guard Armory	8	0
	Title contains Chicago North Site		
	Title contains Certification Docket		
	Title contains Metallurgical Laboratory		
	Title Contains "Met Lab"		
	Title Contains "University of Chicago"		
DOE OSTI Information Bridge http://www.osti.gov/bridge/advancedsearch.jsp COMPLETED 03/11/2008	Title contains National Guard Armory	316	27
	Title contains Chicago North Site		
	Title contains Certification Docket		
	"Metallurgical Laboratory" and "Dosimetry" in title		
	"Metallurgical Laboratory" and "Radiation" in title		
	"Metallurgical Laboratory" and "Chicago" in title		
	"Metallurgical Laboratory" in title		
	Met Lab in title		
	Manhattan Project in title		
	Chicago Pile in title		
	Manhattan Project in Subject		
	Manhattan Engineering District in Subject		
	Manhattan Engineering District in Title		
	CP-1 in Title		
	University of Chicago in any field and dates between 1940-1950		
Environmental Review Site A in title			
Title contains "Site A" and "Plot M"			

Table A1-2: Database Searches for the Metallurgical Laboratory			
Database/Source	Keywords / Phrases	Hits	Uploaded
	Title contains Ricketts Laboratory		
	Chemistry Laboratory and Annex		
	Title contains Ryerson Physical Laboratory		
	Title contains Eckhart Hall		
	Title contains Kent Chemical Laboratory		
	Title contains Jones Chemical Laboratory		
	Identified Numbers contain "CH"		
	Identified Numbers contain "MUC"		
	Title contains "Metallurgical Project"		
	All fields contains "Metallurgical Project"		
Google http://www.google.com COMPLETED 03/11/2008	Americium "Metallurgical laboratory" Chicago Monitoring	475,977	53
	Oralloy Health monitoring		
	"Early dosimetry"		
	"Atomic Energy Commission" "Worker Health" Chicago		
	"Airborne Measurements of Radioactivity"		
	"Measurements of Radioactivity" Metallurgical		
	"Measurement of Radioactivity" Metallurgical		
	"Monitoring of Radioactivity" Metallurgical		
	"Sampling of Radioactivity" Metallurgical		
	Air Sampling "Atomic Energy Commission" Metallurgical		
	"film badge dosimeter" Metallurgical		
	"Bioassay Sampling" Metallurgical		
	"Gas Proportional Counting" Metallurgical		
	"Liquid Scintillation Counting" Metallurgical Chicago		
	"In Vivo Counting of Radioactive"		
	"In Vivo Counting of Radiation"		
	"In Vivo Counting of Nuclides"		
	"In Vivo Counting of Radionuclides"		
	"In Vivo Counting " Metallurgical		
	"In Vitro Counting of Radioactive"		
	"In Vitro Counting of Radiation"		

Table A1-2: Database Searches for the Metallurgical Laboratory

Database/Source	Keywords / Phrases	Hits	Uploaded
	"In Vitro Counting of Nuclides"		
	"In Vitro Counting of Radionuclides"		
	"In Vivo Counting " Metallurgical		
	"Beryllium Vendor" Metallurgical		
	"Beryllium Exposure" Metallurgical "Atomic Energy"		
	"Atomic Energy" "University of Chicago" " Worker Health" (reviewed 1st 100)		
	Uranium "Met Lab" (reviewed 1st 100)		
	U-235 "Met Lab" (reviewed 1st 100)		
	"Metallurgical Laboratory" postum		
	"Metallurgical Laboratory" tuballoy		
	"Metallurgical Laboratory" uranyl nitrate hexahydrate OR UNH		
	"Metallurgical Laboratory" columnation		
	"Metallurgical Laboratory" denitration OR denitration pot		
	"Metallurgical Laboratory" Ether-Water Project		
	"Metallurgical Laboratory" "F machine"		
	"Metallurgical Laboratory" femptocurie		
	"Metallurgical Laboratory" fluoroscopy		
	"Metallurgical Laboratory" "Formerly Utilized Sites Remedial Action Program" OR FUSRAP		
	"Metallurgical Laboratory" "gas proportional"		
	"Metallurgical Laboratory" hydrofluorination		
	"Metallurgical Laboratory" "isotopic enrichment"		
	"Metallurgical Laboratory" "JS Project"		
	"Metallurgical Laboratory" log "log sheet" OR "log book"		
	"Metallurgical Laboratory" "low enriched uranium" OR "Metallurgical Laboratory" LEU		
	"Metallurgical Laboratory" millicurie		
	"Metallurgical Laboratory" "mixed fission product" OR MFP		
	"Metallurgical Laboratory" "nasal wipe"		

Table A1-2: Database Searches for the Metallurgical Laboratory

Database/Source	Keywords / Phrases	Hits	Uploaded
	"Metallurgical Laboratory" "nose wipe"		
	"Metallurgical Laboratory" "nuclear track emulsion" OR "type A NTA"		
	"Metallurgical Laboratory" "occupational radiation exposure"		
	"Metallurgical Laboratory" "ore concentrate"		
	"Metallurgical Laboratory" "PC Project"		
	"Metallurgical Laboratory" nanocurie		
	"Metallurgical Laboratory" "liquid scintillation"		
	"Metallurgical Laboratory" "uranium tetrafluoride"		
	"Metallurgical Laboratory" "uranium trioxide"		
	"Metallurgical Laboratory" "phosphate research"		
	"Metallurgical Laboratory" picocurie		
	"Metallurgical Laboratory" radeco		
	"Metallurgical Laboratory" "Radiological Survey Data Sheet" OR RSDS		
	"Metallurgical Laboratory" raffinate		
	"Metallurgical Laboratory" "retention schedules"		
	"Metallurgical Laboratory" "Tiger Team"		
	"Metallurgical Laboratory" "tolerance dose"		
	"Metallurgical Laboratory" urinalysis		
	"Metallurgical Laboratory" "whole body count" OR WBC		
	"Metallurgical Laboratory" "feed material"		
	"Metallurgical Laboratory" oralloy		
	"Metallurgical Laboratory" "uranium dioxide"		
	"Metallurgical Laboratory" "uranium hexafluoride"		
	"Metallurgical Laboratory" accident		
	"Metallurgical Laboratory" "air filter"		
	"Metallurgical Laboratory" alpha		
	"Metallurgical Laboratory" bioassay OR bio-assay		
	"Metallurgical Laboratory" breath OR breathing zone OR BZ		
	"Metallurgical Laboratory" calibration		

Table A1-2: Database Searches for the Metallurgical Laboratory

Database/Source	Keywords / Phrases	Hits	Uploaded
	"Metallurgical Laboratory" contamination		
	"Metallurgical Laboratory" curie		
	"Metallurgical Laboratory" derby OR regulus		
	"Metallurgical Laboratory" dose		
	"Metallurgical Laboratory" dosimeter -NIOSH		
	"Metallurgical Laboratory" dosimetric -NIOSH		
	"Metallurgical Laboratory" dosimetry -NIOSH		
	"Metallurgical Laboratory" electron -NIOSH		
	"Metallurgical Laboratory" environment Chicago -NIOSH		
	"Metallurgical Laboratory" exposure OR "exposure investigation" OR "radiation exposure" -NIOSH		
	"Metallurgical Laboratory" external -NIOSH		
	"Metallurgical Laboratory" fecal -NIOSH		
	"Metallurgical Laboratory" film -NIOSH		
	"Metallurgical Laboratory" fission -NIOSH		
	"Metallurgical Laboratory" "gamma-ray" -NIOSH		
	"Metallurgical Laboratory" "gaseous diffusion" -NIOSH		
	"Metallurgical Laboratory" health "health instrument" OR "health physics" OR H.I. OR HI OR HP -NIOSH		
	"Metallurgical Laboratory" "highly enriched uranium" OR HEU -NIOSH		
	"Metallurgical Laboratory" "in vitro" -NIOSH		
	"Metallurgical Laboratory" "in vivo" -NIOSH		
	"Metallurgical Laboratory" incident -NIOSH		
	"Metallurgical Laboratory" ingestion -NIOSH		
	"Metallurgical Laboratory" inhalation -NIOSH		
	"Metallurgical Laboratory" internal -NIOSH		
	"Metallurgical Laboratory" investigation -NIOSH		
	"Metallurgical Laboratory" isotope -NIOSH		
	"Metallurgical Laboratory" isotopic -NIOSH		
	"Metallurgical Laboratory" Landauer -NIOSH		

Table A1-2: Database Searches for the Metallurgical Laboratory

Database/Source	Keywords / Phrases	Hits	Uploaded
	"Metallurgical Laboratory" "maximum permissible concentration" OR "MPC" -NIOSH		
	"Metallurgical Laboratory" metallurgy -NIOSH		
	"Metallurgical Laboratory" microcurie -NIOSH		
	"Metallurgical Laboratory" monitor OR "air monitoring" -NIOSH		
	"Metallurgical Laboratory" neutron -NIOSH		
	"Metallurgical Laboratory" nuclear OR "Chicago-Nuclear" OR "nuclear fuels" -NIOSH		
	"Metallurgical Laboratory" occurrence -NIOSH		
	"Metallurgical Laboratory" permit OR "radiation work permit" OR "safe work permit" OR "special work permit" OR RWP OR SWP -NIOSH		
	"Metallurgical Laboratory" photon -NIOSH		
	"Metallurgical Laboratory" pitchblende -NIOSH		
	"Metallurgical Laboratory" "pocket ion chamber" OR PIC -NIOSH		
	"Metallurgical Laboratory" problem -NIOSH		
	"Metallurgical Laboratory" procedure -NIOSH		
	"Metallurgical Laboratory" radiation -NIOSH		
	"Metallurgical Laboratory" radioactive -NIOSH		
	"Metallurgical Laboratory" radioactivity -NIOSH		
	"Metallurgical Laboratory" radiograph -NIOSH		
	"Metallurgical Laboratory" radiological -NIOSH		
	"Metallurgical Laboratory" radionuclide -NIOSH		
	"Metallurgical Laboratory" reactor -NIOSH		
	"Metallurgical Laboratory" respiratory -NIOSH		
	"Metallurgical Laboratory" roentgen -NIOSH		
	"Metallurgical Laboratory" sample OR "air sample" OR "dust sample" OR "general area air sample" -NIOSH		

Table A1-2: Database Searches for the Metallurgical Laboratory

Database/Source	Keywords / Phrases	Hits	Uploaded
	"Metallurgical Laboratory" "sampling OR "air sampling" OR "dust sampling" OR "general area air sampling" -NIOSH		
	"Metallurgical Laboratory" "solvent extraction" -NIOSH		
	"Metallurgical Laboratory" source OR "sealed source" -NIOSH		
	"Metallurgical Laboratory" spectra -NIOSH		
	"Metallurgical Laboratory" spectrograph -NIOSH		
	"Metallurgical Laboratory" spectroscopy -NIOSH		
	"Metallurgical Laboratory" spectrum -NIOSH		
	"Metallurgical Laboratory" standard OR "operating standard" OR "processing standard" -NIOSH		
	"Metallurgical Laboratory" survey OR "building survey" OR "routine survey" OR "special survey" -NIOSH		
	"Metallurgical Laboratory" "technical basis" -NIOSH		
	"Metallurgical Laboratory" "thermal diffusion" -NIOSH		
	"Metallurgical Laboratory" "thermoluminescent dosimeter" OR TLD -NIOSH		
	"Metallurgical Laboratory" urine -NIOSH		
	"Metallurgical Laboratory" "working level" OR WL -NIOSH		
	"Metallurgical Laboratory" "X-ray" OR "X ray" OR Xray -NIOSH		
	"Met Lab" "University of Chicago"		
	"Met Lab" "University of Chicago" postum		
	"Met Lab" "University of Chicago" tuballoy		
	"Met Lab" "University of Chicago" uranyl nitrate hexahydrate OR UNH		
	"Met Lab" "University of Chicago" K-65		
	"Met Lab" "University of Chicago" "sump cake"		
	"Met Lab" "University of Chicago" "air count"		
	"Met Lab" "University of Chicago" "air dust"		
	"Met Lab" "University of Chicago" "belgian congo ore"		

Table A1-2: Database Searches for the Metallurgical Laboratory

Database/Source	Keywords / Phrases	Hits	Uploaded
	"Met Lab" "University of Chicago" "airborne test"		
	"Met Lab" "University of Chicago" columnation		
	"Met Lab" "University of Chicago" denitration OR denitration pot		
	"Met Lab" "University of Chicago" Ether-Water Project		
	"Met Lab" "University of Chicago" "F machine"		
	"Met Lab" "University of Chicago" femptocurie		
	"Met Lab" "University of Chicago" fluoroscopy		
	"Met Lab" "University of Chicago" "Formerly Utilized Sites Remedial Action Program" OR FUSRAP		
	"Met Lab" "University of Chicago" "gas proportional"		
	"Met Lab" "University of Chicago" hydrofluorination		
	"Met Lab" "University of Chicago" "isotopic enrichment"		
	"Met Lab" "University of Chicago" "JS Project"		
	"Met Lab" "University of Chicago" log "log sheet" OR "log book"		
	"Met Lab" "University of Chicago" "low enriched uranium" OR "Met Lab" "University of Chicago" LEU		
	"Met Lab" "University of Chicago" millicurie		
	"Met Lab" "University of Chicago" "mixed fission product" OR MFP		
	"Met Lab" "University of Chicago" "nasal wipe"		
	"Met Lab" "University of Chicago" "nose wipe"		
	"Met Lab" "University of Chicago" "nuclear track emulsion" OR "type A NTA"		
	"Met Lab" "University of Chicago" "occupational radiation exposure"		
	"Met Lab" "University of Chicago" "ore concentrate"		
	"Met Lab" "University of Chicago" "PC Project"		
	"Met Lab" "University of Chicago" nanocurie		
	"Met Lab" "University of Chicago" "liquid scintillation"		
	"Met Lab" "University of Chicago" "uranium tetrafluoride"		

Table A1-2: Database Searches for the Metallurgical Laboratory

Database/Source	Keywords / Phrases	Hits	Uploaded
	"Met Lab" "University of Chicago" "uranium trioxide"		
	"Met Lab" "University of Chicago" "phosphate research"		
	"Met Lab" "University of Chicago" picocurie		
	"Met Lab" "University of Chicago" radeco		
	"Met Lab" "University of Chicago" "Radiological Survey Data Sheet" OR RSDS		
	"Met Lab" "University of Chicago" raffinade		
	"Met Lab" "University of Chicago" "retention schedules"		
	"Met Lab" "University of Chicago" "Tiger Team"		
	"Met Lab" "University of Chicago" "tolerance dose"		
	"Met Lab" "University of Chicago" urinalysis		
	"Met Lab" "University of Chicago" "whole body count" OR WBC		
	"Met Lab" "University of Chicago" "feed material"		
	"Met Lab" "University of Chicago" oralloy		
	"Met Lab" "University of Chicago" "uranium dioxide"		
	"Met Lab" "University of Chicago" "uranium hexafluoride"		
	"Met Lab" "University of Chicago" accident -NIOSH		
	"Met Lab" "University of Chicago" "air filter"		
	"Met Lab" "University of Chicago" alpha -NIOSH		
	"Met Lab" "University of Chicago" bioassay OR bio-assay		
	"Met Lab" "University of Chicago" breath OR breathing zone OR BZ		
	"Met Lab" "University of Chicago" calibration		
	"Met Lab" "University of Chicago" contamination		
	"Met Lab" "University of Chicago" curie		
	"Met Lab" "University of Chicago" derby OR regulus		
	"Met Lab" "University of Chicago" dose		
	"Met Lab" "University of Chicago" dosimeter -NIOSH		
	"Met Lab" "University of Chicago" dosimetric -NIOSH		
	"Met Lab" "University of Chicago" dosimetry -NIOSH		

Table A1-2: Database Searches for the Metallurgical Laboratory

Database/Source	Keywords / Phrases	Hits	Uploaded
	"Met Lab" "University of Chicago" electron -NIOSH		
	"Met Lab" "University of Chicago" environment -NIOSH		
	"Met Lab" "University of Chicago" exposure OR "exposure investigation" OR "radiation exposure" -NIOSH		
	"Met Lab" "University of Chicago" external -NIOSH		
	"Met Lab" "University of Chicago" fecal -NIOSH		
	"Met Lab" "University of Chicago" film -NIOSH		
	"Met Lab" "University of Chicago" fission -NIOSH		
	"Met Lab" "University of Chicago" "gamma-ray" -NIOSH		
	"Met Lab" "University of Chicago" "gaseous diffusion" -NIOSH		
	"Met Lab" "University of Chicago" health "health instrument" OR "health physics" OR H.I. OR HI OR HP -NIOSH		
	"Met Lab" "University of Chicago" "highly enriched uranium" OR HEU -NIOSH		
	"Met Lab" "University of Chicago" "in vitro" -NIOSH		
	"Met Lab" "University of Chicago" "in vivo" -NIOSH		
	"Met Lab" "University of Chicago" incident -NIOSH		
	"Met Lab" "University of Chicago" ingestion -NIOSH		
	"Met Lab" "University of Chicago" inhalation -NIOSH		
	"Met Lab" "University of Chicago" internal -NIOSH		
	"Met Lab" "University of Chicago" investigation -NIOSH		
	"Met Lab" "University of Chicago" isotope -NIOSH		
	"Met Lab" "University of Chicago" isotopic -NIOSH		
	"Met Lab" "University of Chicago" Landauer -NIOSH		
	"Met Lab" "University of Chicago" "maximum permissible concentration" OR "Met Lab" "University of Chicago" "MPC" -NIOSH		
	"Met Lab" "University of Chicago" metallurgy -NIOSH		
	"Met Lab" "University of Chicago" microcurie -NIOSH		

Table A1-2: Database Searches for the Metallurgical Laboratory

Database/Source	Keywords / Phrases	Hits	Uploaded
	"Met Lab" "University of Chicago" monitor OR "Met Lab" "University of Chicago" "air monitoring" -NIOSH		
	"Met Lab" "University of Chicago" neutron -NIOSH		
	"Met Lab" "University of Chicago" nuclear OR "Met Lab" "University of Chicago" "Chicago-Nuclear" OR "Met Lab" "University of Chicago" "nuclear fuels" -NIOSH		
	"Met Lab" "University of Chicago" occurrence -NIOSH		
	"Met Lab" "University of Chicago" permit OR "Met Lab" "University of Chicago" "radiation work permit" OR "Met Lab" "University of Chicago" "safe work permit" OR "Met Lab" "University of Chicago" "special work permit" OR "Met Lab" "University of Chicago" RWP OR "Met Lab" "University of Chicago" SWP -NIOSH		
	"Met Lab" "University of Chicago" photon -NIOSH		
	"Met Lab" "University of Chicago" pitchblende -NIOSH		
	"Met Lab" "University of Chicago" "pocket ion chamber" OR "Met Lab" "University of Chicago" PIC -NIOSH		
	"Met Lab" "University of Chicago" problem -NIOSH		
	"Met Lab" "University of Chicago" procedure -NIOSH		
	"Met Lab" "University of Chicago" radiation -NIOSH		
	"Met Lab" "University of Chicago" radioactive -NIOSH		
	"Met Lab" "University of Chicago" radioactivity -NIOSH		
	"Met Lab" "University of Chicago" radiograph -NIOSH		
	"Met Lab" "University of Chicago" radiological -NIOSH		
	"Met Lab" "University of Chicago" radionuclide -NIOSH		
	"Met Lab" "University of Chicago" reactor -NIOSH		
	"Met Lab" "University of Chicago" respiratory -NIOSH		
	"Met Lab" "University of Chicago" roentgen -NIOSH		
	"Met Lab" "University of Chicago" sample OR "Met Lab" "University of Chicago" "air sample" OR "Met Lab" "University of Chicago" "dust sample" OR "Met Lab" "University of Chicago" "general area air sample" -NIOSH		

Table A1-2: Database Searches for the Metallurgical Laboratory

Database/Source	Keywords / Phrases	Hits	Uploaded
	"Met Lab" "University of Chicago" "sampling OR "Met Lab" "University of Chicago" "air sampling" OR "Met Lab" "University of Chicago" "dust sampling" OR "Met Lab" "University of Chicago" "general area air sampling" -NIOSH		
	"Met Lab" "University of Chicago" "solvent extraction" - NIOSH		
	"Met Lab" "University of Chicago" source OR "Met Lab" "University of Chicago" "sealed source" -NIOSH		
	"Met Lab" "University of Chicago" spectra -NIOSH		
	"Met Lab" "University of Chicago" spectrograph -NIOSH		
	"Met Lab" "University of Chicago" spectroscopy -NIOSH		
	"Met Lab" "University of Chicago" spectrum -NIOSH		
	"Met Lab" "University of Chicago" standard OR "Met Lab" "University of Chicago" "operating standard" OR "Met Lab" "University of Chicago" "processing standard" -NIOSH		
	"Met Lab" "University of Chicago" survey OR "Met Lab" "University of Chicago" "building survey" OR "Met Lab" "University of Chicago" "routine survey" OR "Met Lab" "University of Chicago" "special survey" -NIOSH		
	"Met Lab" "University of Chicago" "technical basis" -NIOSH		
	"Met Lab" "University of Chicago" "thermal diffusion" - NIOSH		
	"Met Lab" "University of Chicago" "thermoluminescent dosimeter" OR "Met Lab" "University of Chicago" TLD - NIOSH		
	"Met Lab" "University of Chicago" urine -NIOSH		
	"Met Lab" "University of Chicago" "working level" OR "Met Lab" "University of Chicago" WL -NIOSH		
	"Met Lab" "University of Chicago" "X-ray" OR "Met Lab" "University of Chicago" "X ray" OR "Met Lab" "University of Chicago" Xray -NIOSH		

Table A1-2: Database Searches for the Metallurgical Laboratory			
Database/Source	Keywords / Phrases	Hits	Uploaded
DOE CEDR http://cedr.lbl.gov/ COMPLETED 04/04/2008	"Metallurgical Laboratory" in Title	0	0
	"Met Lab" in Title		
	Metallurgical in Analytical Data File sets		
	Metallurgical in Working Data File Sets		
	Metallurgical in File Structured Documentation		
	Metallurgical in Variable Structured Documentation		
Hanford DDRS http://www2.hanford.gov/declass/ COMPLETED 04/04/2008	Title contains National Guard Armory	548	28
	Title contains Chicago North Site		
	Title contains Certification Docket		
	Metallurgical Laboratory in Title		
	Met Lab in Title		
	Met Lab in Title and Radiation in Keyword		
	Met Lab in Title and Dupont in Company		
	Met Lab in Title and keyword contains Environment		
	Metallurgical Lab Progress Report in Title		
	Chicago in Title		
	MUC in Document Number		
	Author Contains Compton		
	Author Contains Stone		
	Title contains "Met Lab" and Document No contains "DUH"		
	Title contains "Met Lab" and Keyword contains "Medical"		
	Title contains "Met Lab" and Keyword contains "Surveillance"		
	Document Number contains "CH"		
	Document Number starts with "CH"		
	Title contains "Metallurgical Project"		
	Title contains "Radiation Monitoring" and date between 1942-1950		
Company = "MET" and date between 1942-1950			

Table A1-2: Database Searches for the Metallurgical Laboratory			
Database/Source	Keywords / Phrases	Hits	Uploaded
National Academies Press http://www.nap.edu/ COMPLETED 04/04/2008	Metallurgical Laboratory	44	0
	Met Lab		
U.S. Transuranium & Uranium Registries http://www.ustur.wsu.edu/ COMPLETED 04/04/2008	"Metallurgical Laboratory"	10	1
	Metallurgical		
	"Met Lab"		
Energy Citations Database http://www.osti.gov/energycitations/ COMPLETED 07/09/2008	"Metallurgical Laboratory" in any field	426	6
	"University of Chicago Metallurgical Laboratory" in Research Organization Field		

Table A1-3: OSTI Documents Ordered for the Metallurgical Laboratory			
Document Number	Document Title	Requested	Received
CH-1347-A-1897 OSTI ID: 6347630	Tolerance Concentration of Radioactive Gases in Air dated 1/1/1944	10/19/2007	
DOE/NBM-5003498 OSTI ID: 6304965	Biochemical Survey Section Report for the Month of June 1946 dated 1/1/1946	10/19/2007	