SEC Petition Evaluation Report
Petition SEC-00075

Report Rev # _0___ Report Submittal Date _____05/09/2007____

Subject Expert(s):	Tim Adler and Mike Mahathy
Site Expert(s):	NA

Petition Administrative Summary			
Petition Under Evaluation			
Petition #	Petition Type	Petition B Qualification Date	DOE/AWE Facility Name
SEC-00075	83.13	January 30, 2007	Ames Laboratory

Petitioner Class Definition
Sheet metal workers, physical plant maintenance and associated support staff (includes all maintenance shop personnel of Ames Laboratory), and supervisory staff who may have been exposed to the maintenance and renovation activities of the thorium production areas in Wilhelm Hall (a.k.a. the Metallurgy Building or "Old" Metallurgy Building) at the Ames Laboratory, for the time period from January 1, 1955 through December 31, 1970.

NIOSH Proposed Class Definition
Sheet metal workers, physical plant maintenance and associated support staff (includes all maintenance shop personnel of Ames Laboratory), and supervisory staff who were monitored, or should have been monitored for potential internal radiation exposures associated with the maintenance and renovation activities of the thorium production areas in Wilhelm Hall (a.k.a. the Metallurgy Building or "Old" Metallurgy Building) at the Ames Laboratory, for the time period from January 1, 1955 through December 31, 1970 and who were employed for a number of work days aggregating at least 250 work days, either solely under this employment or in combination with work days within the parameters (excluding aggregate work day parameters) established for other classes of employees included in the SEC.

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

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

ORAU Lead Technical Evaluator: Tim Adler	**ORAU Review Completed By:** Dan Stempfley

Peer Review Completed By:	[Signature of file] *Lavon Rutherford*	5/10/2007 *Date*
SEC Petition Evaluation Reviewed By:	[Signature on file] *J. W. Neton*	5/11/2007 *Date*
SEC Evaluation Approved By:	[Signature on file] *Dave Sundin for Larry Elliott*	5/14/2007 *Date*

This page intentionally left blank

Evaluation Report Summary: SEC-00075, Ames 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*.

Petitioner-Requested Class Definition

Petition SEC-00075, qualified on January 30, 2007, requested that NIOSH consider the following class: *Sheet metal workers, physical plant maintenance and associated support staff (includes all maintenance shop personnel of Ames Laboratory), and supervisory staff that may have been exposed to the maintenance and renovation activities of the thorium production areas in Wilhelm Hall (a.k.a. the Metallurgy Building or "Old" Metallurgy Building) at the Ames Laboratory, for the time period from January 1, 1955 through December 31, 1970.*

NIOSH-Proposed Class Definition

Based on its research, NIOSH accepted the petitioner-requested class to define a single class of employees for which NIOSH cannot estimate radiation doses with sufficient accuracy. The NIOSH-proposed class includes sheet metal workers, physical plant maintenance and associated support staff (includes all maintenance shop personnel of Ames Laboratory), and supervisory staff who were monitored, or should have been monitored for potential internal radiation exposures associated with the maintenance and renovation activities of the thorium production areas in Wilhelm Hall (a.k.a. the Metallurgy Building or "Old" Metallurgy Building) at the Ames Laboratory, for the time period from January 1, 1955 through December 31, 1970 and who were employed for a number of work days aggregating at least 250 work days, either solely under this employment or in combination with work days within the parameters (excluding aggregate work day parameters) established for other classes of employees included in the SEC. The class was accepted because data and documentation available to NIOSH show that the renovation and demolition activities described in the petition took place with little Health Physics or Industrial Hygiene oversight, presented radiological exposure potential, and the workers involved were not monitored.

Feasibility of Dose Reconstruction

Per EEOICPA and 42 C.F.R. § 83.13(c)(1), NIOSH has established that it does not have access to sufficient information to: (1) estimate the maximum radiation dose incurred by any member of the class; or (2) estimate radiation doses more precisely than a maximum dose estimate. Information available from the site profile and additional resources is not sufficient to document or estimate the maximum internal and external potential exposure to members of the proposed class under plausible circumstances during the specified period.

Health Endangerment Determination

Per EEOICPA and 42 C.F.R. § 83.13(c)(3), a health endangerment determination is required because NIOSH has determined that it does not have sufficient information to estimate dose for the members of the proposed class.

NIOSH did not identify any evidence supplied by the petitioners or from other resources that would establish that the proposed class was exposed to radiation during a discrete incident likely to have involved exceptionally high-level exposures. However, evidence indicates that some workers in the proposed class may have accumulated substantial chronic exposures through episodic intakes of radionuclides, combined with external exposures to gamma, beta, and alpha radiation. Consequently, NIOSH has determined that health was endangered for those workers covered by this evaluation who were employed for at least 250 aggregated work days either solely under their employment or in combination with work days within the parameters established for other SEC classes (excluding aggregate work day requirements).

Table of Contents

Tables

SEC Petition Evaluation Report for SEC-00075

ATTRIBUTION AND ANNOTATION: Except where noted (by footnote), all conclusions drawn from the data presented in this evaluation were made by the ORAU Team Lead Technical Evaluator: Tim Adler, Oak Ridge Associated Universities. These conclusions were peer-reviewed by the individuals listed on the cover page. The rationale 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 sheet metal workers, physical plant maintenance and associated support staff (includes all maintenance shop personnel of Ames Laboratory), and supervisory staff that may have been exposed to the maintenance and renovation activities of the thorium production areas in Wilhelm Hall (a.k.a. the Metallurgy Building or "Old" Metallurgy Building) at the Ames Laboratory, for the time period from January 1, 1955 through December 31, 1970. It provides information and analyses 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. This report also does not contain the final determination as to whether the proposed class will be added to the SEC (see Section 2.0).

This evaluation was conducted in accordance with the requirements of EEOICPA, 42 C.F.R. pt. 83, and the guidance contained in the Office of Compensation Analysis and Support's (OCAS) *Internal Procedures for the Evaluation of Special Exposure Cohort Petitions*, OCAS-PR-004.

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 (HHS) 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 class of employees through NIOSH dose reconstructions.[1]

42 C.F.R. § 83.13(c)(1) states: *Radiation doses can be estimated with sufficient accuracy if NIOSH has established that it has access to sufficient information to estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred in plausible circumstances by any member of the class, or if NIOSH has established that it has access to sufficient information to estimate the radiation doses of members of the class more precisely than an estimate of the maximum radiation dose.*

[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.

Under 42 C.F.R. § 83.13(c)(3), if it is not feasible to estimate with sufficient accuracy radiation doses for members of the class, NIOSH must also then determine whether or not there is a reasonable likelihood that such radiation doses may have endangered the health of members of the class. The regulation requires 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 at least 250 aggregated work days within the parameters established for the class or in combination with work days within the parameters established for other SEC classes (excluding aggregate work day requirements).

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 petitioner(s) and to the Advisory Board on Radiation and Worker Health (Board). The Board will consider the NIOSH evaluation report, together with the petition, petitioner(s) comments, and other information the Board considers appropriate, in order 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 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 decision process, petitioners may seek a review of certain types of final decisions issued by the Secretary of HHS.[2]

3.0 Petitioner-Requested Class/Basis

Petition SEC-00075, qualified on January 30, 2007, requested that NIOSH consider the following class for addition to the SEC: *Sheet metal workers, physical plant maintenance and associated support staff (includes all maintenance shop personnel of Ames Laboratory), and supervisory staff that may have been exposed to the maintenance and renovation activities of the thorium production areas in Wilhelm Hall (a.k.a. the Metallurgy Building or "Old" Metallurgy Building) at the Ames Laboratory, for the time period from January 1, 1955 through December 31, 1970.*

The petitioner provided information and affidavit statements in support of the petitioner's belief that accurate dose reconstruction over time is impossible for the Ames Laboratory workers in question. NIOSH deemed the following information and affidavit statements sufficient to qualify SEC-00075 for evaluation:

> An affidavit submitted with the petition states that the sheet metal workers were involved in cutting, dismantling, and renovating exhaust systems, fume hoods, stacks, ceiling tiles, wall boards, and other structural materials in the basement of the Metallurgical Building (Wilhelm Hall). [Thorium research and production had been conducted in the basement of Wilhelm Hall from about 1948 through 1953.] The affidavit states that the majority of the renovation work

[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.

was performed between 1960 and 1966. However, workers performed additional significant renovation and removal activities in other parts of the same building from 1967 through 1970. Additionally, the affidavit suggests that in the course of performing this work, the workers were exposed to potentially high concentrations of thorium dust , were not monitored for radiological exposures, either externally or internally, and the areas they worked in were not consistently overseen by Industrial Hygiene or Health Physics personnel. One affidavit contributor describes being completely covered with dust and "looking like a coal miner" on many days during this period, especially after tearing out ceiling panels. He was not provided respiratory protection. Workers took their breaks at the worksite, smoked cigarettes, and ate lunch in the same area in which they were tearing out the ductwork and equipment.

The information and statements provided by the petitioner qualified the petition for further consideration by NIOSH, the Board, and HHS. The details of the petition basis are addressed in Section 7.4.

4.0 Data Sources Reviewed by NIOSH

NIOSH identified and reviewed numerous data sources to evaluate the feasibility of dose reconstruction for the class of employees proposed for this petition. This included determining the availability of information on personal monitoring, area monitoring, industrial processes, and radiation source materials. The following subsections summarize the data sources identified and reviewed by NIOSH.

4.1 Site Profile

A Site Profile provides specific information concerning the documentation of historical practices at the specified site. Dose reconstructors can use the Site Profile to evaluate internal and external dosimetry data for monitored and unmonitored workers, and to supplement, or substitute for, individual monitoring data. A Site Profile consists of an Introduction and five Technical Basis Documents (TBDs) that provide process history information, information on personal and area monitoring, radiation source descriptions, and references to primary documents relevant to the radiological operations at the site. The Site Profile for a small site may consist of a single document, as is the case with the Site Profile for Ames Laboratory. As part of NIOSH's evaluation detailed herein, it examined the following Draft Site Profile for insights into Ames Laboratory operations or related topics/operations at other sites:

- *Draft Site Profile for Ames Laboratory*, ORAUT-TKBS-0055; Rev. 00-B; January 5, 2007; SRDB Ref ID: Not currently available in the SRDB—draft document

4.2 ORAU Technical Information Bulletins (OTIBs)

An ORAU Technical Information Bulletin (OTIB) is a general working document that provides guidance for preparing dose reconstructions at particular sites or categories of sites. NIOSH reviewed the following OTIBs as part of its evaluation:

- *OTIB: Estimating the Maximum Plausible Dose to Workers at Atomic Weapons Employer Facilities,* ORAUT-OTIB-00004*;* December 6, 2006; SRDB Ref ID: 29949

- *OTIB: Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures*; ORAUT-OTIB-0006; December 21, 2005; SRDB Ref ID: 20220

- *OTIB: Interpretation of Dosimetry Data for Assignment of Shallow Dose,* ORAUT-OTIB-0017; October 11, 2005; SRDB Ref ID: 19434

- *OTIB: Use of Coworker Dosimetry Data for External Dose Assignment*, ORAUT-OTIB-0020; October 7, 2005; SRDB Ref ID: 19440

4.3 Facility Employees and Experts

In addition to the Computer Assisted Telephone Interview (CATI) performed with the primary petitioner, NIOSH interviewed six Ames Laboratory employees (current and former employees). Interviewee selection was based on document references as well as the primary petitioner's and other interviewees' recommendations. The additional employees interviewed included:

- *Personal Communication with a Health Physicist/Security Officer who started work at Ames in 1970*; Telephone Interview by Tim Adler; March 9, 2007; SECIS Ref ID: 12342

- *Personal Communication with an Industrial Hygienist who started work at Ames in 1991*; Telephone Interview by Tim Adler; March 9, 2007; SECIS Ref ID: 12343

- *Personal Communication with a Radiation Safety Officer who started work at Ames in 2005*; Telephone Interview by Tim Adler; March 9, 2007; SECIS Ref ID: 12345

- *Personal Communication with a Manager of Facilities Services who started work at Ames in 1975*; Telephone Interview by Tim Adler; March 9, 2007; SECIS Ref ID: 12344

- *Personal Communication with a Health Physicist/Industrial Hygienist who worked at Ames from 1963 through 1993*; Telephone Interview by Tim Adler; March 9, 2007; SECIS Ref ID: 12347

- *Personal Communication with a Health Physicist who worked at Ames from 1992 through 2000*; Telephone Interview by Tim Adler; March 9, 2007; SECIS Ref ID: 12341

Information obtained from the employee interviews contributed to NIOSH's understanding of the activities and practices described within the SEC-00075 affidavit. After determining employment history, interview discussions were generally focused on obtaining details and timelines of renovation and remediation-type work performed in Wilhelm Hall from 1955 through the early 1990s, the hazards associated with the various work performed, and associated Industrial Hygiene and Health Physics coverage.

4.4 Previous Dose Reconstructions

NIOSH reviewed its NIOSH OCAS Claims Tracking System (NOCTS) to locate EEOICPA-related dose reconstructions that might provide information relevant to the petition evaluation. Table 4-1 summarizes the results of this review for the period of January 1, 1955 through December 31, 1970. (NOCTS data available as of April 16, 2007)

Table 4-1: No. of Ames Laboratory Claims Submitted Under the Dose Reconstruction Rule
(January 1, 1955 through December 31, 1970)

Description	Totals
Total number of claims submitted for energy employees who meet the proposed class definition criteria	8
Number of dose reconstructions completed for energy employees who were employed during the years identified in the proposed class definition	0
Number of claims for which internal dosimetry records were obtained for the identified years in the proposed class definition	0
Number of claims for which external dosimetry records were obtained for the identified years in the proposed class definition	0

Claim files were reviewed to determine the job titles and work locations. Eight former workers fit the class definition and appear to have been involved in the ventilation upgrade of Wilhelm Hall. The job titles of these employees include sheet metal worker, painter, electrician, welder, plumber, and HVAC mechanic. These job titles fit within the requested class definition. NIOSH reviewed the data available for each of these claimants to determine if personal monitoring data were available. A limited amount of external monitoring data or evidence of participation in the external dosimetry program were found for some claimants. However, no external data were applicable to the 1954 through 1970 proposed-class timeframe. In addition, no internal monitoring data were located for these claimants for the covered period. NIOSH has not completed a dose reconstruction for any of these claimants.

4.5 NIOSH Site Research Database

NIOSH also examined its Site Research Database to locate documents supporting the evaluation of the proposed class. Three hundred and eighteen documents in this database were identified as pertaining to Ames Laboratory. These documents were evaluated for their relevance to this petition. The documents include historical background on the site and processes, external monitoring data, and some bioassay data.

4.6 Documentation and/or Affidavits Provided by Petitioners

In qualifying and evaluating the petition, NIOSH reviewed the following documents submitted by the petitioners:

- *Multi-document Transmittal that Contains a Form, General Correspondence, and an Affidavit;* October 23, 2006; SECIS Ref ID: 10380

- *Various Emails from [Name Redacted]*, Ames Laboratory SEC petition versus Dose Reconstruction questions to DOL and NIOSH/OCAS; October 3, 2006; SECIS Ref ID: 10553

- *Various Emails between [Name Redacted] and OCAS Concerning Ames Laboratory and the Sheet Metal Worker Exposures During Renovation of Wilhelm Hall in the 1960s*; November 13, 2006; SECIS Ref ID: 10555

- *Email from [Name Redacted] to NIOSH Transmitting Comments on 1952 and 1953 Urine and Air Sampling Data from an Ames Laboratory Health Physicist*; February 2, 2007; SECIS Ref ID: 10974

- *Ames Lab SEC Addendum and Risk from Residual Contamination*, Email from [Name Redacted] to NIOSH; February 2, 2007; SECIS Ref ID: 10967

5.0 Radiological Operations Relevant to the Proposed Class

The following subsections provide a brief background of the role Ames Laboratory played in the production of strategic nuclear materials for the Manhattan Project. Additionally, information available to NIOSH describing particular processes and radioactive source materials used for thorium production work conducted in Wilhelm Hall is provided in Subsection 5.2. Though the thorium production work started in Wilhelm Hall in 1949 and ended in 1953—prior to the start of the proposed class time frame—that production work served as the primary source of the contamination in the building and was principally responsible for the radiological sources the proposed class was exposed to during the renovation and remediation work they performed from 1955 through 1970. Surveys performed in the 1980s and 1990s have confirmed that the primary contaminant in Wilhelm Hall is thorium-232 (Hokel, 1998). As such, the thorium production work is the dominating radiological operation responsible for exposures incurred by the proposed class and the focus of this evaluation.

Other smaller scale work involving radionuclides also occurred in Wilhelm Hall. Some bench scale alloy research work was performed involving uranium-238, but the amount of uranium involved and residual contamination left behind was very small and "almost insignificant" compared to the thorium activities (Hokel, 1998). Similarly, a small scale research effort using plutonium was conducted in a glove box in a single laboratory within Wilhelm Hall to study the behavior of plutonium in molten metal systems. There is no indication of research involving sufficient plutonium quantities such that residual exposure of plutonium would be significant (ORAUT-TKBS-0055, Section 5.2) and there is also no evidence of a spread of residual plutonium contamination from that glove box to the other parts of the building (Hokel, 1998).

From all available sources, NIOSH has attempted to gather process and source descriptions, information regarding the identity and quantities of each radionuclide of concern, and information describing both processes through which radiation exposures may have occurred and the physical environment in which they may have occurred. The information included within this evaluation report is a summary of the limited data that NIOSH was able to locate.

5.1 Ames Laboratory Plant and Process Descriptions

The Ames Laboratory site consists of a number of buildings at Iowa State University (ISU) in Ames, Iowa. The precursor to the Ames Laboratory was the Ames Project, which was established in 1942 in a contract between the Metallurgical Laboratory at the University of Chicago and Iowa State College (ISC-10). Ames Laboratory was established by the AEC in May 1947 (ORAUT-TKBS-0055).[3]

The Ames Project/Laboratory played a key role in the production of strategic nuclear materials for the Manhattan Project and the AEC. Early in 1942, at the beginning of the Manhattan Project, the most pressing problem was the preparation of large amounts of pure uranium metal and casting uranium metal into the necessary shapes for use in the development of fuels for nuclear reactors (ORAUT-TKBS-0055).[4] Iowa State College faculty members in the Chemistry Department with expertise in rare earth metallurgy were called on to develop a method to purify uranium and reduce the cost of production (ORAUT-TKBS-0055).[5] By November 1942, successful methods were developed and approximately one-third of the uranium used in the Chicago pile was supplied by the Ames Project (ORAUT-TKBS-0055).[6] The Ames Project was asked to turn its process over to industry by 1945. Between mid-1942 and August 1945, more than 1,000 tons of pure uranium metal was supplied to the Manhattan Project (ORAUT-TKBS-0055).[7]

Following bombardment experimentation in 1942, thorium was considered to be a potential alternative source of fuel for nuclear reactors (ISC-10). Once this need for thorium metal was recognized, the Ames Project began developing methods for purifying thorium in 1943. By late 1944, a large-scale process for thorium metal production was developed. Prior to a turnover of thorium production to industry in April 1953, more than 65 tons of pure thorium metal and thorium compounds were produced by the Ames Laboratory (ORAUT-TKBS-0055).[8]
In addition to the early uranium and thorium metal production operations, personnel at Ames Laboratory handled a number of other radionuclides and operated an 80-MeV synchrotron, a 5-MW research reactor, and several radiation-generating machines.

[3] The summary provided in the Draft Site Profile for Ames Laboratory was based on the following primary source document: Karsjen, 2003.

[4] The summary provided in the Draft Site Profile for Ames Laboratory was based on the following primary source document: Ames, 1960.

[5] The summary provided in the Draft Site Profile for Ames Laboratory was based on the following primary source document: Ames, 1960.

[6] The summary provided in the Draft Site Profile for Ames Laboratory was based on the following primary source document: Karsjen, 2003.

[7] The summary provided in the Draft Site Profile for Ames Laboratory was based on the following primary source document: Ames, 1960.

[8] The summary provided in the Draft Site Profile for Ames Laboratory was based on the following primary source document: Ames, 1960.

5.2 Ames Laboratory Operations at Wilhelm Hall

The largest quantity of metal produced at Ames after uranium production declined was thorium. Thorium production had been initiated at the "Little Ankeny" facility as early as 1943. Production and research activities continued at Little Ankeny until 1949, when they were moved to the newly completed "Metallurgy Building," which was built by DOE for research at Ames Laboratory. The Metallurgy Building was later renamed Harley Wilhelm Hall.

Purified thorium was produced at Wilhelm Hall using a five-stage process:

1. Solution and precipitation
2. Calcination and hydrofluorination
3. Metal reduction
4. Thorium metal casting
5. Machining

During the solution and precipitation stage, thorium received as nitrate in drums was weighed and dissolved in dilute nitric acid and oxalic acid. The precipitated thorium oxalate was crushed in an Eimco press to increase the surface area and was then filtered. The damp thorium oxalate was then placed into 30-gallon drums and sealed (Hokel, 1998).

Calcination and hydrofluorination was initiated by transferring the thorium oxalate to trays for drying. The dried thorium oxalate was then weighed and calcined in an electric muffle furnace at 1,100 ^{0}F. After cooling, the thorium oxalate was then dumped into a loading hood, weighed, and placed into reactors for hydrofluorination to thorium tetrafluoride. The thorium tetrafluoride was then cooled and packaged into five gallon containers (Hokel, 1998).

The metal reduction, casting, and machining stages started with crushing the thorium tetrafluoride and mixing the resultant fine powder with calcium metal. Calcium reduction to a "thorium biscuit" was accomplished by adding a mixture of zinc chloride, calcium fluoride, and thorium tetrafluoride to a dolomite-lined refractory "bomb" (beryllium crucible), which was then gas fired. The reaction was initiated with an electrically heated fuse wire and resulted in liquid thorium metal. The densest metal would collect on the bottom of the refractory bomb, which was then allowed to cool into biscuits, which were then unloaded from the bomb and conveyed manually into the thorium casting area. A graphite heater was used to recast the thorium metal (biscuit) to obtain the appropriate shape. By two successive vacuum furnace castings, the impure thorium biscuits were dezinced and terminally purified into thorium billets. Machining operations were then performed on each of the billets to secure the desired parameters. These operations included sawing, turning, milling, and cropping. Production of thorium continued in Wilhelm Hall until 1953. The combination of production, processing, and handling of fine-powdered forms of thorium and beryllium; poor contamination control practices; and poor building ventilation all contributed to contamination of the building (Hokel, 1998).

Since the cessation of thorium activities, several major renovation and remediation projects have contributed to an overall reduction in the amount and extent of contamination in Wilhelm Hall. As early as 1954, Ames Laboratory initiated decontamination work. Work performed by members of the proposed class included painting and sealing spots of contamination, removing and replacing

ventilation duct work, removing and disposing of laboratory hoods and other contaminated equipment, removing contaminated floor and ceiling tiles, moving basement walls, filling contaminated floor pits, converting lab space into office space, dismantling machine shops, and removing the roof and contaminated equipment that was on the roof (Personal Communication, 2007e).

5.3 Radiological Exposure Sources from Renovation/Remediation at Wilhelm Hall

The thorium metal production operations resulted in alpha, beta and gamma radiation exposures to workers in Wilhelm Hall (NIOSH 2006b). The greatest source of contamination in the building resulted from surface, airborne, and re-suspended dust particles contaminated with thorium and its progeny. During the production operations, thorium surface contamination and airborne dust resulted from inadequately controlled processes of preparing and drying the fine powder and mixing and loading the powder charge in the reduction crucibles. In addition to settling on various surfaces within the general production areas, contamination was pulled (by design) into exhaust ductwork that was later removed by members of the proposed class (Hokel, 1998).

Operations involved with the renovation and remediation of thorium contamination in Wilhelm Hall would have resulted in alpha, beta, and gamma radiation exposures to workers in the proposed class. Exposures would have resulted from a combination of workers being in close proximity to contamination and the resuspension of contaminated particles that had settled inside ventilation ducts, exhaust hoods, fans, and on building surfaces (e.g. ceiling tiles, walls) that the workers were renovating. The significance of emissions from thorium depends on the state of equilibrium with the thorium-232 parent (which is a factor of the time elapsed since the thorium process feed material was separated) (OCAS, 2006). As time passed, thorium approached secular equilibrium. As a result, photon exposure rates would also have increased with the in-growth of radium-228. Photon exposure rates as high as 22 mR/hr were reported for a thorium storage area, suggesting that this raw material for the thorium production process was not newly separated (Klevin, 1952).

5.3.1 Alpha Particle Emissions

Thorium-232 decays into radium-228, emitting two primary alpha particles of 3.95 MeV (24%) and 4.01 MeV (76%). The decay series contains several other progeny, most of which decay by alpha particle emission, but each has a half-life of less than 12 hours.

5.3.2 Beta Radiation Fields

As with the alpha emitters, the majority of the beta exposure could have resulted from exposure to natural thorium and its progeny which is considered to have been in secular equilibrium (Klevin, 1952). Assuming secular equilibrium, the beta-emitting radionuclides, energies and percentages are shown in Table 5-1.

Table 5-1: Major Beta Energies and Intensities for Thorium at Wilhelm Hall		
Radionuclide	**Energy (MeV)**	**Intensity (%)**
Radium-228 (Mesothorium I)	0.0389	100%
Actinium-228 (Mesothorium II)	0.983 1.014 1.115 1.17 1.74 2.08	7% 6.6% 3.4% 32% 12% 8%
Lead-212	0.158 0.334 0.573	5.2% 85.1% 9.9%
Bismuth-212	1.59 2.246	8% 48.4%
Thallium-208	1.28 1.52 1.80	25% 21% 50%

5.3.3 Neutron Exposures

Neutron emissions were not a potential source of exposure for members of the proposed class. The contamination the proposed class encountered during the renovation and remediation of Wilhelm Hall resulted from thorium production activities. Thorium-232 (and its progeny) does not produce neutron emissions.

5.3.4 Photon Exposures

Nine of the radionuclides in the natural thorium series decay by photon emissions. Actinium-228 is one of the daughter products of thorium decay and emits a hard gamma ray. The overall photon energy ranges are: <30 keV - 0%; 30-250 keV - 16%; and >250 keV - 84%.

5.3.5 Incidents and Fires

There were frequent small explosions and fires associated with the uranium and thorium production operations; there were as many as six small fires in a single day (ORAUT-TKBS-0055).[9] These fires contributed to work-area contamination and potential airborne radioactive material exposures. No records were found to indicate that air sampling or contamination control was associated with these fires. Aside from increasing levels of residual contamination, direct exposures associated with these production-era events predate the time frame being evaluated for the proposed class of workers.

6.0 Summary of Available Monitoring Data for the Proposed Class

NIOSH reviewed the sources described in Section 4.0 for internal and external monitoring data representative of the proposed class under evaluation. Included in NIOSH's review were searches for

[9] The summary provided in the Draft Site Profile for Ames Laboratory was based on the following primary source document: Payne 1992.

personal monitoring data (e.g., film badges, TLDs, bioassays) and area monitoring data. NIOSH also attempted to gather air monitoring data that would represent conditions encountered during renovation and remediation activities that immediately followed the thorium production era in Wilhelm Hall. While data have been obtained for other areas, processes, and employees working within Wilhelm Hall, no data (internal, external, or air) have been identified that was collected from members of the proposed SEC class or their immediate work environments.

6.1 Ames Laboratory Internal Monitoring Data

A review of all documents and data available to NIOSH identified some bioassay data for the period from January 1, 1942 through December 31, 2005. Only limited *in vitro* bioassay data have been found for the years 1942 through 1945, and some thorium bioassay data, which resulted from an AEC study, have been identified for the years and 1952 through 1953. NIOSH has located tritium bioassay data for the period of 1965 through 1981. The tritium data identified were for employees who worked at the Ames Laboratory Research Reactor facility.

NIOSH has identified ninety bioassay (urine) samples that were collected in March 1952 and analyzed for thorium by AEC (AEC, Various Samples). NIOSH has also identified approximately 70 bioassay (urine) samples collected and analyzed for thorium by AEC in 1953 (AEC, Various Samples). NIOSH has not identified any thorium bioassay samples or results after 1953. As stated above, no internal monitoring data collected from members of the proposed SEC class or applicable for use in dose reconstruction for members of the proposed class have been identified.

6.2 Ames Laboratory External Monitoring Data

Ames Laboratory staff received regular film badge service in 1953. External dosimetry use at Ames Laboratory appears to have targeted professional level staff employees that had a known potential for occupational exposure to radiation. Workers with job titles such as security patrolman, craftsman, janitor, secretary, or clerk (who did not work routinely in radiological areas) were probably not monitored (ORAUT-TKBS-0055, Section 6.3.1). Workers with job titles such as scientist, chemist, metallurgist, engineer, technician, or machinist (who were more likely to incur known higher exposures) were generally monitored for external exposures (ORAUT-TKBS-0055, Section 6.3.1). NIOSH has examined available external records and has determined that none of the workers in the proposed class were monitored for external radiation exposure during the 1955 through 1970 time frame.

Details regarding the various analyses used and the associated minimum detectable activities are presented in the Draft Site Profile for Ames Laboratory. Table 6-1 provides a brief summary of the external dosimetry program pertinent to this evaluation. Table 6-2 provides a summary of the external dosimetry records available to NIOSH for Ames employee external dose reconstruction.

Table 6-1: Ames Laboratory Dosimeter Program

Dosimeter Type	Dosimeter Provider	Period of Use	Exchange Frequency[a]	MRD (mrem)[b]			MDL (mrem)[c]		
				Skin	β/γ deep	Neutron	Skin	Deep	Neutron
β/γ film	Ames Laboratory In-house System	January 1954–February 1957	Bi-weekly	25	25	NA	40	40	NA
		Mar 1957–December 1961		10	10	NA	40	40	NA
β/γ/NTA film	BNL[d]	April 1954–June 1957	Bi-weekly	15	15	10	40	40	(e)
β/γ/NTA film	NCA[f]	July 1957–June 1963	Bi-weekly	10	10	10	40	40	(e)
β/γ/NTA film	Atomic Film Badge Corporation	July 1963–March 1965	Monthly	10	10	10	40	40	(e)
Pocket Chambers	Ames Laboratory	April–June 1965	Daily	NA	5	NA	NA	5	NA
β/γ/NTA film	Health Physics Services, Inc.	July 1965–October 1979	Monthly	10	5	28	40	40	(e)

Notes:
[a] The exchange frequency was established from dosimetry reports
[b] Based on minimum doses recorded on dosimetry reports
[c] Estimated MDL typical of film dosimeter capabilities (Wilson, 1960; Wilson, 1987; NIOSH, 1993; NRC, 1989; Wilson, 1990)
[d] Brookhaven National Laboratory
[e] For years during which NTA film was used (between 1954 and 1979), the adjusted neutron dose is calculated using a correction factor of 2
[f] Nucleonic Corporation of America

Table 6-2 Available External Dosimetry Records (Doses in mrem continued on page 19)

	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Total number of dosimeters issued	709	709	709	709	709	709	709	303	303	303	501	237	271	269	277	277
Number of positive gamma results	25	34	157	181	195	180	180	27	50	102	166	64	75	71	93	65
Highest gamma dose	357	170	995	1006	1528	1246	1729	267	370	404	523	828	1323	2640	3478	4950
Number of positive beta results	51	30	12	0	0	1	0	13	8	2	26	29	49	33	32	13
Highest beta dose	1300	405	350	0	0	65	0	199	180	45	325	1750	1289	1164	913	600
Number of positive neutron results	39	34	46	55	57	94	109	1	32	38	237	162	204	204	207	158

Table 6-2 Available External Dosimetry Records (Doses in mrem continued on page 19)																
	1955	**1956**	**1957**	**1958**	**1959**	**1960**	**1961**	**1962**	**1963**	**1964**	**1965**	**1966**	**1967**	**1968**	**1969**	**1970**
Highest neutron dose	260	170	210	340	370	380	300	5	31	55	364	476	294	574	1512	784

Data referenced in Table 6-2 are available for use by NIOSH. However, some employee identifiers are missing for certain years. A co-workers study performed by NIOSH to address this issue is discussed in Subsection 7.3.1.

6.3 Ames Laboratory Air Sampling Data

NIOSH has not located any documentation indicating that Ames Laboratory conducted a routine air sampling program for uranium, plutonium, or thorium during the operation of Ames Laboratory. However, NIOSH has found some air sampling data. Twenty-two general area air dust (uranium) samples were collected as part of a special study performed in May, June, and July of 1943 by the Army Corp of Engineers (Friedell, 1943; Iowa State University, 1943). The purpose of the sampling was not identified in the documentation associated with the sampling results. Additionally, approximately 700 general air sample results for thorium were collected in an AEC study performed in March 1952 (Klevin, 1952); approximately 270 breathing zone air samples were also collected during this same study. Air sampling data from Wilhelm Hall, performed by Iowa State University in February 1953, were also identified (Hokel, 1998).

The 1952 and 1953 AEC studies focused on contaminant concentrations associated with the thorium production process and potential exposures to workers involved with that process. The data are not viewed as representative of airborne contaminant concentrations that members of the proposed class were potentially exposed to while performing their renovation and remediation work. NIOSH has not located any air monitoring data (general process or breathing zone) that were collected during, or representative of, the renovation and remediation work performed by the proposed class.

7.0 Feasibility of Dose Reconstruction for the Proposed Class

The feasibility determination for the proposed class of employees covered by this evaluation report is governed by both EEOICPA and 42 C.F.R. § 83.13(c)(1). Under that Act and rule, NIOSH must establish whether or not it has access to sufficient information either to 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 to estimate the radiation doses to members of the class more precisely than a maximum dose estimate. If NIOSH has access to sufficient information for either case, NIOSH would then determine that it was feasible to conduct dose reconstructions.

In determining feasibility, NIOSH begins by evaluating whether current or completed NIOSH dose reconstructions demonstrate the feasibility of estimating with sufficient accuracy the potential radiation exposures of the class (discussed in Section 4.4 of this report). If the conclusion is one of infeasibility, NIOSH systematically evaluates the sufficiency of different types of monitoring data,

process and source or source term data, which together or individually might assure that NIOSH can estimate either the maximum doses that members of the class might have incurred, or more precise quantities that reflect the variability of exposures experienced by groups or individual members of the class as summarized in Section 7.5. This approach is discussed in OCAS's SEC Petition Evaluation Internal Procedures which are available at http://www.cdc.gov/niosh/ocas. The next four major subsections of this Evaluation Report examine:

- the sufficiency and reliability of the available data (Section 7.1)
- the feasibility of reconstructing internal radiation doses (Section 7.2)
- the feasibility of reconstructing external radiation doses (Section 7.3)
- the bases for petition SEC-00075 as submitted by the petitioner (Section 7.4)

7.1 Pedigree of Ames Laboratory Data

This subsection answers questions that need to be asked before performing a feasibility evaluation. An analysis of data pedigree addresses the background, history, and origin of the data. It requires considering data collection, management, and related dosimetry methodologies and any changes from the relevant period to the present; primary versus secondary data sources and whether they match; and whether data are internally consistent. All these issues form the bedrock of the researcher's confidence and later conclusions about the data's quality, credibility, reliability, representativeness, and sufficiency for determining the feasibility of dose reconstruction. The feasibility evaluation presupposes that data pedigree issues have been settled.

In the case of this evaluation, NIOSH has found that internal, source, and air monitoring data are insufficient for estimating internal radiation doses with sufficient accuracy for members of the proposed class. Additionally, external monitoring data collected directly from members of the proposed class are unavailable. This lack of primary data and the inability to reconstruct internal doses with sufficient accuracy for the proposed class members eliminates the need and/or possibility of presenting a detailed analysis of data pedigree in this evaluation report.

The data available to NIOSH to perform internal and external dose reconstructions for Ames workers who were employed from 1955 forward, but who would not be considered members of this proposed class, is discussed in the Draft Site Profile for Ames Laboratory. The Draft Site Profile includes discussions regarding the history of source, internal, external, and air monitoring data available to NIOSH. The records obtained for the Draft Site Profile are "original" records; they have never been transcribed to summary sheets or transferred to another data repository such as an electronic database. As a result, data consistency checks amongst varying repositories are not required.

Although external monitoring data are unavailable for the proposed class, NIOSH does believe that external monitoring data available for Ames employees that are not included in the proposed class can be used to estimate the maximum radiation dose and (bound) external exposures that could have been incurred under plausible circumstances by any member of the proposed class. A brief summary of the history and use of this data are therefore presented in Subsection 7.3 of this document.

7.2 Internal Radiation Doses at Ames Laboratory

Information obtained from employee interviews, reviewed data sources, and the SEC-0075 petition affidavit indicates a potential for internal exposure hazard to members of the proposed class. The principal source and pathway for internal radiation doses would have resulted from inhalation and ingestion of thorium and its progeny during renovation and remediation activities conducted in Wilhelm Hall. The presence of the source materials resulted from thorium production and research that occurred within the building from 1949 through 1953.

Though renovation and remediation work within Wilhelm Hall has been occurring intermittently for decades, the work performed during the proposed class time frame (1955 through 1970) likely presented the highest exposure potentials. Information obtained from employee interviews and the SEC-00075 affidavit indicate that the majority of renovation and remediation work was first performed during the 1955 through 1970 timeframe and that the workers involved in the work received very little oversight from Health Physics or Industrial Hygiene personnel and were not monitored for thorium intakes, nor were they supplied with effective respiratory protection equipment (Personal Communication, 2007e). However, former employees did state that while Industrial Hygiene and Health Physics involvement with the renovation and remediation activities was minimal prior to 1970, later work was appropriately overseen (Personal Communication, 2007a; Personal Communication, 2007e). Employees familiar with the work occurring after 1970 stated that Industrial Hygiene and Health Physics personnel assessed potential hazards prior to initiation of each planned task and personal protection was appropriately prescribed and implemented. Also, two employees indicated that internal monitoring data available for Wilhelm Hall renovation workers are minimal, even after 1970, because sample collection was generally determined to be unnecessary given the Industrial Hygiene and Health Physics measured exposure potentials associated with the tasks and because of the conservative personal protection equipment that was being prescribed (Personal Communication, 2007d; Personal Communication, 2007e).

As indicated above and in Section 6.0, there is no internal monitoring data available that were collected from members of the SEC-00075 proposed class. Internal monitoring data would allow reconstruction of an individual claimant's internal dose. Also, there is neither air monitoring data nor survey data that are known to accurately represent the conditions encountered during the specific tasks performed by members of the proposed class. Data and methods are available for reconstructing internal doses for Ames workers employed from 1955 forward who would not be members of the proposed class (ORAUT-TKBS-0055, Section 5.0), but NIOSH judges these data to be insufficient for bounding exposures associated with the work performed by the proposed class, due to the unique exposure conditions of the proposed class.

7.2.1 Process-Related Internal Doses at Ames Laboratory

Members of the proposed class are considered to have worked in the renovation and remediation operations at Wilhelm-Hall in a full time capacity. These workers were potentially exposed to varying high levels of surface and airborne contamination of thorium and its progeny. They were not monitored for internal intakes of thorium and were not supplied with effective respiratory protection equipment (Hokel, 1998; Personal Communication, 2007e).

7.2.2 Ambient Environmental Internal Radiation Doses at Ames Laboratory

The Draft Site Profile for Ames Laboratory describes the rationale, historical background, and data for reconstructing ambient environmental internal doses for unmonitored personnel while outside operational facilities on the Site. As discussed in the Draft Site Profile for Ames Laboratory, these environmental intakes may be assigned to Ames Laboratory claimants for the applicable periods as defined for each Ames Laboratory location.

7.2.3 Internal Dose Reconstruction Feasibility Conclusion

Occupational internal radiation doses received by the members of the proposed class cannot be reconstructed with sufficient accuracy due to the lack of applicable bioassay data, air monitoring data, and source term information. While secular equilibrium can reasonably be assumed, NIOSH does not have sufficient information to quantify the amount of thorium and progeny that was present in the contaminated areas of Wilhelm Hall that were later renovated by members of the proposed class. In addition, NIOSH cannot reasonably assume particle sizes or airborne concentrations that were encountered in the contaminated areas of Wilhelm Hall.

NIOSH believes internal doses for other employees of Wilhelm Hall—who are not members of the proposed class—can be reconstructed. Beginning in 1984 and continuing through the 1990s, the entire building, including the rooms, air ducts, hallways, stairwells, transformer rooms, etc., was surveyed to determine locations of residual contamination (Hokel, 1998). Data from these surveys representing the highest concentrations of removable contamination found in generally accessible areas have been incorporated into exposure models which can be used to bound potential doses for workers not in the proposed class. Details of the applicable data and assumptions used are provided in the Draft Site Profile for Ames Laboratory.

7.3 External Radiation Doses at Ames Laboratory

The principal source of external radiation doses for members of the proposed class resulted from beta and photon emissions from the decay of natural thorium and its progeny (ORAUT-TKBS-0055). A thorough review of the collected external dosimetry data and claim files in the NOCTS database indicates that workers in the proposed class were not monitored for external radiation, or their monitoring data have been lost or misidentified. None of the eight claimants who meet the proposed class requirements have external monitoring data for the 1955 through 1970 timeframe being evaluated.

7.3.1 Process-Related External Radiation Doses at Ames Laboratory

While process-related external dosimetry data are not available for members of the proposed class, monitoring data does exist for other Ames Laboratory employees that are not covered under the proposed class. Workers with job titles such as scientist, chemist, metallurgist, engineer, technician, or machinist (who were more likely to incur known higher exposures) were typically monitored for external exposures (ORAUT-TKBS-0055, Section 6.3.1). Radiation sources and activities that monitored workers were predominantly exposed to included the uranium and thorium production processes. Smaller numbers of workers were exposed to sources that included electron accelerators, electron beam welding, beta-ray spectrometers, X-ray and neutron diffraction spectrometers,

plutonium chemistry, and a research reactor. NIOSH believes that external monitoring data obtained from workers associated with the aforementioned activities can be used to bound external exposures to members of the proposed class.

Since 1953, process and research-related external exposures have been monitored with film badges and thermoluminescent dosimeters for employees not covered under the proposed class. Although the records available to NIOSH are essentially complete (ORAUT-TKBS-0055, Section 6.0), from 1965 through 1981 many individual names were not recorded with their individual dosimeter readings. As a result, NIOSH is unable to clearly associate many records with individual workers.

A co-worker data study has been performed to permit dose reconstruction for individuals for which external monitoring data were unavailable or incomplete. The co-worker data study for Ames Laboratory includes all available dosimetry records from 1952 through 1981 (ORAUT-TKBS-0055). All dose results were analyzed, including zeros and blank values, to determine the 50th- and 95th-percentile doses for each year for beta, gamma, and neutron exposures (McCartney, 2006). If any part of a worker's dosimetry record was missing (or unidentified as is the case with members of the proposed class), the 95th-percentile dose from the co-worker data would be applied in the years for which records are missing (ORAUT-OTIB-0020). Details of the co-worker study and its application can be found in the Draft Site Profile for Ames Laboratory.

7.3.2 Ambient Environmental External Radiation Doses at Ames Laboratory

The Draft Site Profile for Ames Laboratory describes the rationale, historical background, and data for reconstructing ambient environmental external doses for unmonitored personnel who were outside operational facilities on the Site. External dose from radioactive materials outside the body may be determined from immersion in a cloud of inert gases, deposition of particles on the skin, or adjacent operational facilities. As discussed in the Draft Site Profile, these environmental doses may be assigned to Ames Laboratory claimants for the applicable periods as defined for each Ames Laboratory location.

7.3.3 Ames Laboratory Occupational X-Ray Examinations

Occupational medical examinations were conducted for the staff of Ames Laboratory as prescribed by the Medical Services of the Manhattan Project (Van Horn, 1943; Stone, 1951). Pre-employment examinations included a chest X-ray and urine analysis. Annual physical examinations also included a chest X-ray. X-ray film records from the early and mid-1950s indicated that some workers, likely those working with beryllium, received chest X-rays on a quarterly frequency while other workers might have chest X-rays on an annual or semiannual frequency. In 1957, the frequency of chest X-rays was changed to twice per year for all Ames Laboratory staff members (Van Bemmel, 1957). X-ray film records indicate that the frequency of chest X-rays was changed to annual in 1960 and bi-annual in 1982. The actual dates of chest X-rays for claimants have been reported by Ames Laboratory in response to data requests for each claim. X-ray examinations of Ames Laboratory staff members were conducted at the Iowa State Student Health Center/College Hospital. All X-ray films examined in the archives at Ames Laboratory were 14-inches by 17-inches; there was no evidence of any X-rays being taken with photofluorographic X-ray equipment.

7.3.4 External Dose Reconstruction

As stated in Section, 4.4, no dose reconstructions have been completed for the eight EEOICPA claims for Ames Laboratory that would be relevant to the proposed class.

There is an established protocol for assessing external exposure when performing dose reconstructions (these protocol steps are discussed in the following subsections):

- Photon Dose
- Electron Dose
- Neutron Dose
- Unmonitored Individuals Working in Production Areas
- Medical X-ray

7.3.4.1 Photon Dose

External photon doses can be reconstructed for the period January 1, 1955 through December 31, 1970 by applying co-worker photon dose distributions for workers without monitoring data, or for each monitoring period where results are not provided.

7.3.4.2 Electron Dose

Shallow doses can be reconstructed for the period January 1, 1955 through December 31, 1970 by applying co-worker dose distributions for workers without monitoring data, or for each monitoring period where results are not provided.

7.3.4.3 Neutron Dose

Workers that would be members of the proposed class did not have the potential to receive exposure from neutrons; therefore, neutron dose reconstruction is not required.

7.3.4.4 Unmonitored Individuals Working in Production Areas

External doses can be reconstructed for the period January 1, 1955 through December 31, 1970 by applying co-worker dose distributions for these workers.

7.3.4.5 Medical X-ray

NIOSH considers reconstruction of medical dose for all Ames Laboratory workers feasible by using actual claimant data, by using the X-ray examination frequencies documented in Section 7.3.3, and by using claimant-favorable assumptions and applicable protocols specified in the complex-wide *Technical Information Bulletin: Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures*.

7.3.5 External Dose Reconstruction Feasibility Conclusion

NIOSH considers reconstruction of occupational external radiation doses feasible for the proposed class of Ames Laboratory workers. Such reconstruction can be accomplished using co-worker data

distributions, claimant-favorable assumptions, and applicable protocols specified in various complex-wide Technical Information Bulletins. NIOSH also considers reconstruction of medical X-ray dose feasible.

7.4 Evaluation of Petition Basis for SEC-00075

The petition basis provided in SEC-00075 stated that members of the proposed class incurred unmonitored radiation exposures (through personal or area monitoring) and doses from January 1, 1955 through December 31, 1970.

Personal monitoring, area monitoring, or co-worker monitoring are not always required in order to develop an exposure model for a given facility. However, if these monitoring data are not available, NIOSH must have access to source term information and detailed process information in order to develop a sufficiently accurate exposure model. NIOSH has determined that not only does it not have internal monitoring data for members of the proposed class, it does not have enough source term or process information applicable to the class to develop a sufficiently accurate model for dose reconstruction. Therefore, NIOSH concludes that there is insufficient information to reconstruct internal doses with sufficient accuracy and that the petition basis has been supported.

7.5 Summary of Feasibility Findings for Petition SEC-00075

This report evaluates the feasibility for completing dose reconstructions for employees at the Ames Laboratory from January 1, 1955 through December 31, 1970. NIOSH found that the available monitoring records, process descriptions and source term data available are not sufficient to complete dose reconstructions for the proposed class of employees.

Table 7-1 summarizes the results of the feasibility findings at Ames Laboratory for each exposure source during the time period January 1, 1955 through December 31, 1970.

Table 7-1: Summary of Feasibility Findings for SEC-00075 January 1, 1955-December 31, 1970

Source of Exposure	Reconstruction Feasible	Reconstruction Not Feasible
Internal[1]		X
- Th-232 and progeny		X
- Ambient Environmental	X	
External	X	
- Gamma	X	
- Beta	X	
- Neutron	NA	
- Ambient Environmental	X	
- Occupational Medical X-ray	X	

8.0 Evaluation of Health Endangerment for Petition SEC-00075

The health endangerment determination for the class of employees covered by this evaluation report is governed by both EEOICPA and 42 C.F.R. § 83.13(c)(3). Under these requirements, if it is not

feasible to estimate with sufficient accuracy radiation doses for members of the class, NIOSH must also determine that there is a reasonable likelihood that such radiation doses may have endangered the health of members of the class. Section 83.13 requires 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.

9.0 NIOSH-Proposed Class for Petition SEC-00075

Based on its research, NIOSH accepted the petitioner-requested class to define a single class of employees for which NIOSH cannot estimate radiation doses with sufficient accuracy. The NIOSH-proposed class of sheet metal workers, physical plant maintenance and associated support staff (includes all maintenance shop personnel of Ames Laboratory), and supervisory staff that were monitored, or should have been monitored for potential internal radiation exposures associated with the maintenance and renovation activities of the thorium production areas in Wilhelm Hall (a.k.a. the Metallurgy Building or "Old" Metallurgy Building) at the Ames Laboratory, for the time period from January 1, 1955 through December 31, 1970 and who were employed for a number of work days aggregating at least 250 work days, either solely under this employment or in combination with work days within the parameters (excluding aggregate work day parameters) established for other classes of employees included in the SEC. The class was accepted because information available to NIOSH indicates the potential for internal exposures to thorium and its progeny existed during the proposed period, but insufficient data exist for reconstructing those potential exposures.

NIOSH has carefully reviewed all material sent in by the petitioner, including the specific assertions stated in the petition, and has responded herein (see Section 7.4). NIOSH has also reviewed available technical resources and many other references, including the Site Research Data Base (SRDB), for information relevant to SEC-00075. In addition, NIOSH reviewed its NOCTS dose reconstruction database to identify EEOICPA-related dose reconstructions that might provide information relevant to the petition evaluation.

These actions are based on existing, approved NIOSH processes used in dose reconstruction for claims under EEOICPA. NIOSH's guiding principle in conducting these dose reconstructions is to ensure that the assumptions used are fair, consistent, and well-grounded in the best available science. Simultaneously, uncertainties in the science and data must be handled to the advantage, rather than to the detriment, of the petitioners. When adequate personal dose monitoring information is not available, or is very limited, NIOSH may use the highest reasonably possible radiation dose, based on reliable science, documented experience, and relevant data to determine the feasibility of reconstructing the dose of an SEC petition class. NIOSH contends that it has complied with these standards of performance in determining that it would not be feasible to reconstruct the dose for the class proposed in this petition.

This page intentionally left blank

10.0 References

42 C.F.R. 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. 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. 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

ISC-10, *History of the Ames Project Under the Manhattan District to December 31, 1946;* Iowa State College; December 9, 1947; SRDB Ref ID: 18823

IS-T 2564, *The Ames Project: History of the Ames Laboratory's Contributions to the Historic Manhattan Project, 1942-1946;* Iowa State University; 2003; SRDB Ref ID: 18859

ORAUT-OTIB-0004, Rev. 03, PC-2, *Estimating the Maximum Plausible Dose to Workers at Atomic Weapons Employer Facilities*; Oak Ridge Associated Universities; Oak Ridge, Tennessee; December 6, 2006; SRDB Ref ID: 29949

ORAUT-OTIB-0006, Rev. 03, PC-1, *Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures*; Oak Ridge Associated Universities; Oak Ridge, Tennessee; December 21, 2005; SRDB Ref ID: 20220

ORAUT-OTIB-0017, Rev. 01, *Interpretation of Dosimetry Data for Assignment of Shallow Dose*; Oak Ridge Associated Universities (ORAU); Oak Ridge, Tennessee; October 11, 2005; SRDB Ref ID: 19434

ORAUT-OTIB-0020, Rev. 01, *Use of Coworker Dosimetry Data for External Dose Assignment*; Oak Ridge Associated Universities; Oak Ridge, Tennessee; October 7, 2005; SRDB Ref ID: 19440

ORAUT-TKBS-0055, Rev. 00-B, *Draft Site Profile for Ames Laboratory*; Oak Ridge Associated Universities; Oak Ridge, Tennessee; January 5, 2007; SRDB Ref ID: Not currently available—draft document

Addendum, 2007, *Ames Lab SEC Addendum and Risk from Residual Contamination*, Email from [Name Redacted] to NIOSH; February 2, 2007; SECIS Ref ID: 10967

AEC, Various Samples, *Various Urine, Air Dust and Slag Samples (1952-1953) for Ames Laboratory*; U.S. AEC New York Operations Office Health and Safety Division; 1953; SRDB Ref ID: 8966

Ames, 1960, *Historical Developments of the Ames Laboratory*; Ames Laboratory, U.S. Atomic Energy Commission, Iowa State University; January 25, 1960; SRDB Ref ID: 18832

Atomic, 1963 & 1964, *1963 and 1964 External Dose Records*; Atomic Film Badge Corporation; 1963-1964; SRDB Ref ID: 25914

Atomic, 1964, 1*964 External Dose Reports;* Atomic Film Badge Corporation; 1964; SRDB Ref ID: 25916

Atomic, 1965, *1965 External Dose Records*; Atomic Film Badge Corporation and Health Physics Services, Inc.; 1965; SRDB Ref ID: 25919

Author unknown, 1952-1954, *1952 through 1954 External Exposure Results*; Author unknown; 1952-1954; SRDB Ref ID: 18821

Author unknown, 1953, *Weekly Radiation Exposure Results for 1953*; Author unknown; 1953; SRDB Ref ID: 18822

Author unknown, 1962, *1962 Film Badge Record*; Author unknown; 1962; SRDB Ref ID: 25909

Friedell, 1943, *Letter to [Name Redacted]*, *Dust Samples*; Iowa State College; July 13, 1943; SRDB Ref ID: 8960

Elliott, 2006, *Letter Summarizing the Telephone Discussion Regarding the Results of the Special Exposure Cohort Qualification Process*; Larry J. Elliott; December 6, 2006; SECIS Ref ID: 10720

[Name redacted], 2007, Ames Lab SEC Addendum and Risk from Residual Contamination, email from [Name redacted] to NIOSH; [Name redacted]; February 2, 2007; SECIS Ref ID: 10967

Hayes, 1956, *A Summary of Accidents and Incidents Involving Radiation in Atomic Energy Activities*, June 1945 through December 1955; D. F. Hayes; August 1956; SRDB Ref ID: 30143

Hokel, 1998, *An Assessment of the Causes, Mitigation Efforts, and Current Status of ^{232} Th, ^{238} U, and Beryllium Contamination in Wilhelm Hall at Ames Laboratory*; Bruce W. Hokel, James H. Withers, W. Paul Waters, and Kenneth J. Ewing; April 1998; SRDB Ref ID: 18848

ICN, 1996, *1966 Radiation Exposure Reports*; ICN Dosimetry Service; October-December 1996; SRDB Ref ID: 26681

Iowa State University, date unknown, *Publicity Brochure for Ames Laboratory*; Iowa State University: Institute for Atomic Research; Date unknown; SRDB Ref ID: 18856

Iowa State University, 1962-1965, *Individual Film Badge Radiation Reports for 1962-1965*, limited data for 1957-1961 for one employee; Iowa State University; 1962-1965; SRDB Ref ID: 25837

Karsjen, 2003, *The Ames Project: History of the Ames Laboratory's Contributions to the Historic Manhattan Project, 1942-1946*; Steven R. Karsjen; 2003; SRDB Ref ID: 18859

Klevin, 1952, *Ames Research Laboratory Occupational Exposure to Thorium and Beryllium*; Paul B. Klevin, U.S. AEC New York Operations Office Health and Safety Division; July 14, 1952; SRDB Ref ID: 18942

Landauer, 1981& 1982, *1981 and 1982 Personnel Exposure Reports*; Landauer (R. S. Landauer, Jr. & Co.); 1981-1982; SRDB Ref ID: 26628

Landauer, 1985, *1985 Radiation Exposure Reports*; Landauer (R. S. Landauer, Jr. & Co.); 1985; SRDB Ref ID: 26642

Martin, 1952-2005, *Ames Laboratory Dose Records*; J. B. Martin; 1952-2005; SRDB Ref ID: 29229

McCartney, 2006, *Statistical Analysis of Ames Laboratory External Dose Records*; Cincinnati, Ohio; SRDB Ref ID: 30977

Multi-document Transmittal, 2006, *Multi-document Transmittal that Contains a Form, General Correspondence, and an Affidavit;* October 23, 2006; SECIS Ref ID: 10380

[Name Redacted], 2007, *Email from [Name Redacted] to NIOSH Transmitting Comments on 1952 and 1953 Urine and Air Sampling Data from an Ames Laboratory Health Physicist*; February 2, 2007; SECIS Ref ID: 10974

NIOSH, 1993, *NIOSH Research Issues Workshop: Epidemiologic Use of Nondetectable Values in Radiation Exposure Measurements*; National Institute for Occupational Safety and Health (NIOSH); Cincinnati, Ohio; September 9 and 10, 1993; SRDB Ref ID: 13723

NRC, 1989, Film Badge Dosimetry in Atmospheric Nuclear Tests; National Research Council (NRC); 1989; SRDB Ref ID: 1905

OCAS, 2006, *External Dose Reconstruction Implementation Guideline*, Rev. 2; Office of Compensation Analysis and Support (OCAS); August 25, 2006; SRDB Ref ID: 29929

Payne, 1992, *The Ames Project: Administering Classified Research as a Part of the Manhattan Project at Iowa State College, 1942-1945*, PhD dissertation; Carolyn Stilts Payne; 1992; SRDB Ref ID: 18851

Personal Communication, 2007a, *Personal Communication with a Health Physicist/Security Officer who started work at Ames in 1970*; Telephone Interview by Tim Adler; March 9, 2007; SECIS Ref ID: 12342

Personal Communication, 2007b, *Personal Communication with Industrial Hygiene Department who started work at Ames in 1991*; Telephone Interview by Tim Adler; March 9, 2007; SECIS Ref ID: 12343

Personal Communication, 2007c, *Personal Communication with a Radiation Safety Officer who started work at Ames in 2005*; Telephone Interview by Tim Adler; March 9, 2007; SECIS Ref ID: 12345

Personal Communication, 2007d, *Personal Communication with a Manager of Facilities Services who started work at Ames in 1975*; Telephone Interview by Tim Adler; March 9, 2007; SECIS Ref ID: 12344

Personal Communication, 2007e, *Personal Communication with a Health Physicist/Industrial Hygienist who worked at Ames from 1963 through 1993*; Telephone Interview by Tim Adler; March 9, 2007; SECIS Ref ID: 12347

Personal Communication, 2007f, *Personal Communication with a Health Physicist who worked at Ames from 1992 through 2000*; Telephone Interview by Tim Adler; March 9, 2007; SECIS Ref ID: 12341

Siemens, 1995, *Radiation Exposure Report for 1995*; Siemens Medical Systems Inc.; July 1995; SRDB Ref ID: 26679

Stone, 1951, *Industrial Medicine on the Plutonium Project: Survey and Collected Papers*, see chapters by J. E. Wirth; Edited by Robert S. Stone; 1951; SRDB Ref ID: 739

Van Bemmel, 1957, *Memorandum on Occupational Medical Examinations and Chest X-Rays*; P. F. Van Bemmel; September 16, 1957; SRDB Ref ID: 18857

Van Horn, 1943, *Letter Regarding the Medical Monitoring of Workers*; E. L. Van Horn; September 4, 1943; SRDB Ref ID: 8908

Various emails, October 2006, *Various emails from [Name Redacted]*, Ames Laboratory SEC petition versus Dose Reconstruction questions to DOL and NIOSH/OCAS; October 3, 2006; SECIS Ref ID: 10553

Various emails, November 2006, *Various emails between [Name Redacted] and OCAS concerning Ames Laboratory and the sheet metal workers exposures during renovation of Wilhelm Hall in the 1960s*; November 13, 2006; SECIS Ref ID: 10555

Wilson, 1960, *Detection Level of the Film Badge System*; R. H. Wilson; November 28, 1960; SRDB Ref ID: 15403

Wilson, 1987, *Historical Review of Personnel Dosimetry Development and its Use in Radiation Protection Programs at Hanford*; R. H. Wilson; February 1987; SRDB Ref ID: 262

Wilson, 1990, *Description and Evaluation of the Hanford Personnel Dosimeter Program From 1944 Through 1989*; R. H. Wilson, J. J. Fix, W. V. Baumgartner, and L. L. Nichols; September 1990; SRDB Ref ID: 4793