SEC Petition Evaluation Report
Petition SEC-00082

Report Rev # 0 Report Submittal Date 3-26-2007

Subject Expert(s):	Christopher J. Miles, Michael S. Kubiak
Site Expert(s):	N/A

Petitioner Administrative Summary			
Petition Under Evaluation			
Petition #	Petition Type	Petition A Receipt Date	DOE/AWE Facility Name
SEC-00082	83.14	January 22, 2007	W. R. Grace (Tennessee)

Proposed Class Definition

The NIOSH-proposed class includes all AWE employees who were monitored, or should have been monitored, for potential exposure to thorium while working in any of the 100 series buildings or Buildings 220, 230, 233, 234, 301, or 310 at the W. R. Grace site at Erwin, Tennessee, for a number of work days aggregating at least 250 work days from January 1, 1958 through December 31, 1970, 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			

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

ORAU Lead Technical Evaluator: Christopher J. Miles	**ORAU Review Completed By:** Michael Kubiak

Peer Review Completed By:	[Signature on file] *Tom Tomes*	3/27/2007 *Date*
SEC Petition Evaluation Reviewed By:	[Signature on file] *Jim Neton*	3/28/2007 *Date*
SEC Evaluation Approved By:	[Signature on file] *Larry Elliott*	3/29/2007 *Date*

This page intentionally left blank

Evaluation Report Summary: SEC-00082, W. R. Grace

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

The NIOSH-proposed class includes all AWE employees who were monitored, or should have been monitored, for potential exposure to thorium while working in any of the 100 series buildings or Buildings 220, 203, 233, 234, 301, or 310 at the W. R. Grace site at Erwin, Tennessee, for a number of work days aggregating at least 250 work days from January 1, 1958 through December 31, 1970, 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

Per EEOICPA and 42 C.F.R. § 83.14(b), NIOSH has established that it does not have sufficient information to complete dose reconstructions for individual members of the class with sufficient accuracy. NIOSH lacks thorium-specific dosimetric data, making reconstruction of internal thorium doses infeasible.

Health Endangerment Determination

The NIOSH evaluation did not identify evidence supplied by the petitioners or from other sources 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 thorium. 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.

This page intentionally left blank

Table of Contents

This page intentionally left blank

SEC Petition Evaluation Report for SEC-00082

1.0 Purpose and Scope

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: Christopher J. Miles, CHP; Quantaflux, LLC. 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.

This report evaluates the feasibility of reconstructing doses for employees who worked at specific facilities 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 on both 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 the Department of Health and Human Services to 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

[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.

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 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 were monitored, or should have been monitored, for potential exposure to thorium while working in any of the 100 series buildings or Buildings 220, 230, 233, 234, 301, or 310 at the W. R. Grace site at Erwin, Tennessee, for a number of work days aggregating at least 250 work days from January 1, 1958 through December 31, 1970, or in combination with work days within the parameters established for one or more other classes of employees in the SEC. During this time period, employees at this facility worked with processes involving various forms of uranium and thorium. Beginning in 1966, employees also worked with processes involving plutonium.

The evaluation responds to Petition SEC-00082, 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 Shift Foreman at W. R. Grace from 1962 to 1976. 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 W. R. Grace from January 1, 1958 through December 31, 1970 and the information available to NIOSH to characterize particular processes and radioactive source materials. Using available sources, NIOSH has attempted to gather process and source descriptions, information regarding the identity and quantities of radionuclides of concern, and information describing processes through which the radiation exposures of concern may have occurred and the physical environment in which they may have occurred. The information included within this evaluation report is meant only to be a summary of the available information.

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

4.1 Operations Description

The Davison Chemical Company, a division of W. R. Grace, began processing radioactive materials in the late 1950s at the site of the current Nuclear Fuels Services (NFS) facility near Erwin, Tennessee. The principal operation at the site has been converting highly enriched uranium (HEU) and low-enriched uranium (LEU) from UF_6 to a form that could be used to manufacture nuclear fuel. Thorium, depleted uranium (DU), U-233, and plutonium have also been processed at the facility.

Specific tasks performed at the facility included processing of ThO_2 mixed with U-233 to make light-water breeder reactor fuel for the Shippingport Reactor, and fabricating plutonium and DU mixed oxide (MOX) fuel for the South-West Experimental Fast Oxide Reactor (SEFOR). These operations, along with all other AEC weapons-related operations, ceased in 1970. Other operations involved scrap recovery of uranium and other nuclear fuel material and cleaning empty cylinders used to transport low-enriched UF_6.

UF_6 was received at the W. R. Grace facility in solid form in cylinders. To convert it to uranium metal, the UF_6 first had to be vaporized and then reduced to UF_4. Vaporization was accomplished by heating the UF_6 cylinders in an electric oven. The UF_6 vapor was piped into a reactor unit, where it was reduced with hydrogen to form solid UF_4 powder. This powder dropped into a collection hopper, where it was metered into safe-diameter product cans. The UF_4 was further reduced to uranium metal by heating it under vacuum with a reducing agent, such as magnesium metal. After cooling, the uranium metal derby was broken and separated from the slag. Uranium remaining in the slag was recovered in the scrap recovery operations described below. The uranium derbies were broken into smaller pieces on a large hydraulic press. The derbies were often re-melted and cast into various shapes or alloyed with other metals. Melting was done in a large vacuum induction furnace.

Recovery operations involved grinding, pulverizing, sawing, chopping, oxidizing, and blending uranium-containing scrap material. Dissolver tanks using a nitric acid solution were then employed. For uranium of less than 2% enrichment, a 500-gallon tank was used; batch sizes were limited to 220 lbs. of UO_2. For all higher enrichments, a 20-gallon tank was used with each batch containing less than 400 grams of U-235. Although there is no evidence of thorium recovery operations, the uranium-containing scrap material sometimes contained thorium [e.g., urania-thoria scrap generated by the Elk River Reactor pellet fabrication (Dubinski, 1961)].

Fuel consisting of uranium oxide mixed with thorium oxide and/or zirconium oxide (MOX) was also produced at the W. R. Grace facility. According to the Site Profile, *An Exposure Matrix for W. R. Grace and Company in Erwin, Tennessee*, this process involved eleven steps (ORAUT-TKBS-0043, Section 2.1.4):

1. Receiving and Storage: The material arrived as uranyl nitrate solution containing approximately 150 g/L U-233.

2. Concentration: The uranyl nitrate solution was concentrated by evaporation.

3. Precipitation: A precipitating agent such as NH_4OH was introduced.

4. Drying and Grinding: The precipitate was dried and ground to a fine powder.

5. Calcination to UO_2: The fine uranium powder was calcined to UO_2 in a muffle furnace in a hydrogen atmosphere

6. Blending: The UO_2 was blended to homogeneity.

7. Diluent Addition and Blending: Diluents of ThO_2 and/or ZrO_2 were weighed out and blended with the UO_2.

8. Binder Addition: A binder was mixed with the oxide blend, the wet mixture granulated and dried, and the granules broken up by screening.

9. Lubricant Addition and Pressing: A lubricant was blended with the granules and the oxides were compacted into pellets on a 40-ton press.

10. Binder Removal and Sintering: The resultant pellets were loaded into trays and heated to drive off the binder, and then sintered in a muffle furnace in a hydrogen atmosphere.

11. Physical Measurement and Grinding: The pellets were inspected and ground to size specifications (as needed), cleaned with water, and dried.

Documentation showing the process steps for PuO_2-containing MOX is unavailable. However, based on similar operations at other Department of Energy (DOE) sites, it is likely that the steps for producing plutonium-containing MOX would have been similar to those for thorium-containing MOX described above (ORAUT-TKBS-0043, Section 2.1.5).

4.2 Radiation Exposure Potential from Operations

The potential for external radiation dose existed at all locations where radioactive materials were handled or stored. Based on the site operations outlined in Section 4.1, sources of exposure included beta, photon, and neutron radiation emitted from materials containing uranium, thorium, and plutonium.

The primary sources of internal radiation exposure at the site were uranium and thorium dust produced during the handling of the source material and during preparation of nuclear fuels (ORAUT-TKBS-0043, Section 3.0). Beginning in 1966, there was also the potential for internal dose from plutonium-containing dust.

4.3 Time Period Associated with Radiological Operations

The *Report to Joint Committee on Atomic Energy Congress of the United States* by the United States General Accounting Office, dated September 14, 1967, states:

> *AEC authorized the Davidson Chemical Division of W. R. Grace & Company (Grace) to receive and process special nuclear material under license number SNM-124. Grace received its first material as an AEC licensee by lease agreement in March 1958 and its first nuclear material as an AEC contractor in May 1959.* (GAO, 1967)

The Site Profile indicates that processing of radioactive materials at W. R. Grace began in late 1957. This conclusion was made based on exposure monitoring data for existing claimants in the latter part of 1957 and is consistent with information provided at a U.S. Congressional hearing (Congress, 1986) and historical timeline provided on the NFS Web site (http://www.nuclearfuelservices.com).

Based on currently-available information, the exact date that uranium or thorium processing began at W. R. Grace is uncertain. It is evident, however, that both thorium and uranium processing began very early in the site's history of radiological operations. For the purpose of this evaluation, it is assumed that uranium and thorium operations were conducted during the entire period of AEC-related operations; this assumption maximizes the assumed exposure time and favors claimants. Work with uranium metals and compounds has been on-going at the site since processing began in the late 1950s and continues to the present day under NFS. Thorium operations began in 1957 and ended in 1970 Congress, 1986). Plutonium operations at W. R. Grace began in 1966. All AEC weapons-related work (including work with plutonium) ended in 1970.

4.4 Site Locations Associated with Radiological Operations

According to the Site Profile, the following radiological materials were received, stored, or processed in the specified buildings (ORAUT-TKBS-0043, Table 2-1):

- Uranium in various forms: 100, 105, 110, 110C, 110D, 110E, 111, 120, 130, 131, 132, 133, 135, 220, 230, 233, 234, 234B, 234C, 300, 301, 302, 303, 304, 310, and 330.

- Thorium: 110C, 110D, 111, 130, 234B, 234C, and 310.

- Plutonium: 234A, 234B, 234C, 110C, and 110D.

Following preparation of the Site Profile, via e-mail correspondence (NFS, Jun06) and a telephone interview (NFS, Aug06), NFS management suggested that all 100 series buildings may have processed thorium and that Building 301 was also used for thorium operations. In addition, a Health and Safety bulletin (Grace, 1962) indicates air concentrations of 50% MAC for thorium in Building 233 in 1962. For the purpose of this evaluation, it is assumed that all 100 series buildings and Buildings 220, 230, 233, 234, 301, and 310 were potentially affected by thorium operations. Considering all sources of information currently available to NIOSH, there is no evidence suggesting that any other buildings at the W. R. Grace site in Tennessee were affected by thorium operations.

4.5 Job Descriptions Affected by Radiological Operations

No documentation is currently available that associates job titles and/or job assignments with specific radiological operations. Without information that associates work locations with worker job descriptions, it is impractical to narrow down the job descriptions for those who may have been potentially exposed to radioactive materials. Therefore, it is not possible to determine that any specific work group was not potentially exposed to radioactive materials or possible subsequent contamination.

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 personal air monitoring data or breathing zone air monitoring data are used to estimate the potential internal exposure. If personal monitoring and breathing zone air monitoring data 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. 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 Guide,* and OCAS-IG-002, *Internal Dose Reconstruction Implementation Guide*. These documents are available at: http://www.cdc.gov/niosh/ocas/ocasdose.html.

Personal monitoring data are available through DOE for monitored individuals who worked at the W. R. Grace site from the latter part of 1957 through the present time. Data capture efforts for this site have included formal requests to the current operator (NFS), the State of Tennessee Division of Radiological Health, and the Office of State and Tribal Programs of the U. S. Nuclear Regulatory Commission (NRC). Information was also received from NFS via e-mail exchanges (NFS, Jun06) and by telephone interview (NFS, Aug06). A Worker Outreach meeting was held on July 21, 2005 with members of the United Steelworkers of America Local 5-3677 in Erwin, Tennessee. The transcript of this meeting is available at: http://www.cdc.gov/niosh/ocas/pdfs/tbd/outreach/wo072105.pdf. In addition, documents with information specific to the W. R. Grace site have been acquired through Internet searches and from data capture visits to the DOE Germantown Office, the National Archive and Records Administration in Atlanta, and other AEC sites (e.g., Fernald). All site-specific documents identified from these combined efforts are available on the ORAU Team Site Research Database (SRDB) or the Special Exposure Cohort Information System (SECIS).

5.1 Internal Personnel Monitoring Data

Beginning in 1964, urine bioassay data for uranium are available for monitored workers at the site. Of the 57 claimants in NIOSH's claimant database at the time of this report, 41 have uranium *in vitro* results and 33 have *in vivo* results. These data include over 2300 uranium *in vitro* results and over 700 *in vivo* results. *In vitro* results are in units of dpm/L; *in vivo* results are in units of µg of uranium or nCi. Urine bioassay data for plutonium are available for monitored workers during the time period of plutonium operations (beginning in 1966). *In vivo* counting at W.R. Grace began in 1970. Internal monitoring data for thorium exposures are not available until the late 1980s, after the cessation of AEC operations.

5.2 External Personnel Monitoring Data

Personal monitoring data for external radiation exposures at the site are available for monitored employees from the beginning of AEC operations in 1958. Of the 57 claimants in NIOSH's claimant database at this time, 52 have external personal monitoring data. In the early years at W. R. Grace, film badge dosimetry was provided by Nuclear Chicago. Beginning January 1, 1961, film badges were provided and processed by R. S. Landauer, Jr. & Company. Film dosimeters were replaced by TLDs in 1989. These data include whole-body and shallow dose estimates. Some extremity monitoring data are also available from wrist and finger-ring dosimeters. Neutron dosimetry data are not available.

5.3 Workplace Monitoring Data

There are two AEC reports containing uranium air monitoring data from samples collected in 1959 and 1961 (HASL-75, 1959; HASL-61-9, 1961). These data are presented in the Site Profile, Tables 3-3 through 3-8 (ORAUT-TKBS-0043). Although it is clear, based on Health and Safety bulletins, that other routine workplace air and surface contamination monitoring was performed at the site, those data are generally unavailable. NIOSH has been unable to locate workplace monitoring data that are specific to thorium or plutonium.

5.4 Radiological Source Term Data

The aforementioned *Report to Joint Committee on Atomic Energy Congress of the United States* by the United States General Accounting Office, dated September 14, 1967, also states:

> *NFS has received substantial quantities of special nuclear material under lease, contract, and supply agreement. The NFS records showed that, from start-up to October 31, 1966, the material received by NFS, excluding non-Section 53 material for contracts then active, included 29,838 kilograms of U-235.* (GAO, 1967)

Section 2.1.2 of the Site Profile (ORAUT-TKBS-0043) describes scrap recovery operations involving batch sizes limited to 220 pounds of UO_2 if less than 2% enrichment; otherwise, batch sizes were limited to less than 400 grams of U-235. Section 2.1.4 of the Site Profile describes a typical shipment of uranyl nitrate solution as containing approximately 7 kg of U-233, with a U-233 concentration of 150 g/L. Section 3.3 of the Site Profile describes production of MOX fuel containing 99% by weight

$^{232/228}ThO_2$ with a breakdown of 50% Th-232 activity and 50% Th-228 activity. Due to criticality concerns, only 4 kg of this material could be processed at a time. MOX fuel containing a plutonium mixture of 12% by weight PuO_2 is also described in Section 3.4 of the Site Profile.

NIOSH has been unable to locate documentation providing a comprehensive summary of the total quantities of uranium, thorium, or plutonium stored or used at the site.

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

There is no indication from available documentation that thorium bioassay monitoring was performed for workers at the W. R. Grace, Erwin, Tennessee, facility until the late 1980s, after the cessation of AEC operations. Thorium-specific workplace monitoring data, such as air monitoring or surface contamination monitoring, are also unavailable. NIOSH has been unable to determine through available data the quantity of thorium-containing materials processed at W. R. Grace. It is also not possible to ratio thorium intakes to monitored uranium intakes because research and production activities involving uranium and thorium were largely independent and the relative quantities processed are unknown. NIOSH does not have access to sufficient thorium bioassay monitoring, air monitoring, or source term data to estimate potential internal exposures to thorium during the period

of AEC operations. Consequently, NIOSH finds that it is not feasible to estimate with sufficient accuracy internal exposures to thorium and resulting doses for the class of employees covered by this evaluation.

Information relevant to estimating internal exposure to uranium and plutonium is provided in the W. R. Grace Site Profile (ORAUT-TKBS-0043). Uranium bioassay monitoring at W. R. Grace began in 1964; internal uranium doses beginning in 1964 can likely be reconstructed using these data. While dose reconstruction methods are currently under development for a revision to the Site Profile, NIOSH considers it likely that pre-1964 uranium doses can be reconstructed using claimant-favorable assumptions along with available uranium air monitoring data and bioassay data from the post-1964 time period. Plutonium bioassay monitoring was conducted during the entire period of plutonium operations; NIOSH considers it likely that internal plutonium doses can be reconstructed using these data. NIOSH considers the adequate reconstruction of internal doses resulting from inhalation and/or ingestion of isotopes of uranium and plutonium likely to be feasible.

6.2 Feasibility of Estimating External Exposures

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

However, NIOSH considers the adequate reconstruction of external dose for W. R. Grace workers likely to be feasible because external beta and photon dosimetry data for monitored workers at the W. R. Grace facility are available. Guidance for interpretation of those data is given in the Site Profile (ORAUT-TKBS-0043). This and other guidance also provide methodologies for estimating neutron dose to workers monitored for photons, and for estimating external dose to unmonitored workers. NIOSH considers adequate reconstruction of external dose likely to be feasible for W. R. Grace workers at Erwin, Tennessee, from 1958 through 1970.

NIOSH also considers the adequate reconstruction of medical dose for W. R. Grace workers likely to be feasible by using claimant-favorable assumptions as well as the applicable protocols in the complex-wide Technical Information Bulletin, *Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures* (ORAUT-OTIB-0006). Site-specific information regarding medical dose at W. R. Grace is provided in Section 4.5 of the Site Profile (ORAUT-TKBS-0043).

7.0 Summary of Feasibility Findings for Petition SEC-00082

This report evaluated the feasibility for estimating the dose, with sufficient accuracy, for all AWE employees who may have been exposed to thorium while working at the W. R. Grace site from January 1, 1958 through December 31, 1970. NIOSH determined that it lacks internal dosimetry data necessary to reconstruct the internal exposures to thorium during this time period. Consequently, NIOSH finds that it is not feasible to estimate with sufficient accuracy the radiation doses resulting from internal thorium exposures received by members of this class of employees.

Thorium is assumed to have been processed during the entire period of AEC weapons-related work. There is some discrepancy regarding the exact time period that W. R. Grace began working with nuclear materials at the Tennessee site. One document (GAO, 1967) states that the site received its first material in March 1958; however, NIOSH has personal exposure monitoring data starting in late 1957 (see the discussion in Section 4.3 herein). NIOSH has therefore recommended that the class include the entire time period specified on the DOE Advocacy website (1958 through 1970; interpreted herein as January 1, 1958 through December 31, 1970).

Buildings associated with thorium work included the 100 series buildings and buildings 220, 203, 233, 234, 301, or 310 (see Section 4.4). Since exposure potential within each of these buildings may not have been limited to only specific groups of workers, NIOSH recommends that the class definition include all employees that worked in the specified buildings during the specified time period.

NIOSH has documented in its evaluation that it cannot complete the dose reconstruction related to this petition. The basis of this finding is specified in this report, which 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.

Members of this class may have received radiation exposures from thorium inhalation and ingestion. NIOSH lacks sufficient information, which includes bioassay results, workplace monitoring data, or sufficient process and radiological source information that would allow it to estimate the potential internal exposure to which members of the proposed class may have been exposed. The adequate reconstruction of internal dose due to uranium and plutonium isotopes, external exposures from all radionuclides, and occupational medical doses for this class of workers is considered likely to be feasible.

8.0 Evaluation of Health Endangerment for Petition SEC-00082

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(c) 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 thorium. 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-00082

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 were monitored, or should have been monitored, for potential exposure to thorium while working in any of the 100 series buildings or Buildings 220, 230, 233, 234, 301, or 310 at the W. R. Grace site at Erwin, Tennessee, for a number of work days aggregating at least 250 work days from January 1, 1958 through December 31, 1970, 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. 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 W. R. Grace facility at Erwin, Tennessee for whom dose reconstruction may not be feasible.

This page intentionally left blank

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

HASL-61-9, 1961, *Davison Chemical Company; Erwin, Tennessee; Occupational Exposure to Radioactive Dust*, Health Protection Engineering Division; Health and Safety Laboratory; NYOO; USAEC; August 23, 1961; SRDB Ref ID: 11771 [part of 240000707.pdf]

HASL-75, 1959, *Davison Chemical Company; Nuclear Reactor Materials Plant; Erwin, Tennessee; Occupational Exposure to Radioactive Dust*, Field Services Branch; Environmental Sciences Division; Health and Safety Laboratory; NYOO; USAEC; November 4, 1959; SRDB Ref ID: 11771 [part of 240000707.pdf]

OCAS-IG-001, *External Dose Reconstruction Implementation Guideline;* Rev. 1; Office of Compensation Analysis and Support (OCAS); National Institute for Occupational Safety and Health (NIOSH); August, 2002; SRDB Ref ID: 22401

OCAS-IG-002, *Internal Dose Reconstruction Implementation Guideline;* Rev. 0; Office of Compensation Analysis and Support (OCAS); National Institute for Occupational Safety and Health (NIOSH); August, 2002; SRDB Ref ID: 22402

ORAUT-OTIB-0004, *Estimating the Maximum Plausible Dose to Workers at Atomic Weapons Employer Facilities*; Rev. 03 PC-2; Oak Ridge Associated Universities; February 6, 2006; SRDB Ref ID: 19421

ORAUT-OTIB-0006, *Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures*; Oak Ridge Associated Universities; December 21, 2005; SRDB Ref ID: 19422

ORAUT-TKBS-0043, *An Exposure Matrix for W. R. Grace and Company in Erwin, Tennessee*; Rev. 00, Oak Ridge Associated Universities; February 14, 2006; SRDB Ref ID: 22269

Congress, 1986, *Erwin Nuclear Fuel Services – Hearing before the Subcommittee on Energy Conservation and Power of the Committee on Energy and Commerce House of Representatives, Ninety-ninth Congress, Second Session,* Serial No. 99-178; U.S. Congress; Washington, D.C.; September 18, 1986; SRDB RefID: 18808

Dubinski, 1961, Trip Report: *Visit to Davison Chemical Company on February 7, 1961*; Leo Dubinski, Division of Inspection, Oak Ridge Operations; 1961; SRDB Ref ID: 11732

GAO, 1967, *Review of Accountability Controls Over Special Nuclear Materials; Nuclear Fuel Services, Inc*.; Report to the Joint Committee on Atomic Energy; Congress of the United States; Comptroller General of the United States; September 14, 1967; SRDB Ref ID: 7214

Grace, 1962, *Health & Safety* [Bulletin], G. C. Loud, W. R. Grace Health & Safety; October, 1962; SRDB RefID: 11776

NSF, Jun06, E-mail exchanges between OCAS Health Physicist and Nuclear Fuel Services (NFS) regarding thorium work at W. R. Grace; June 13, 2006: SECIS ID: 128

NSF, Aug06, Telephone conversation between OCAS Health Physicist and Nuclear Fuel Services (NFS) regarding thorium work at W. R. Grace; August 1, 2006: SECIS ID: 131