SEC Petition Evaluation Report
Petition SEC-00079

Report Rev #: (0) Report Submittal Date: 4/13/2007

Subject Expert(s):	James Mahathy
Site Expert(s):	N/A

Petitioner Administrative Summary			
Petition Under Evaluation			
Petition #	Petition Type	Petition A Receipt Date	DOE/AWE Facility Name
SEC-00079	83.14	November 28, 2006	Dow Chemical Company (Madison Site)

Proposed Class Definition
All AWE employees who were monitored, or should have been monitored, for exposure to thorium radionuclides while working at the Dow Chemical Company site in Madison, Illinois, for a number of work days aggregating at least 250 work days from January 1, 1957 through December 31, 1960 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	

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SEC Evaluation Approved By:	[Signature on file] *Larry Elliott*	4/13/2007 Date

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Evaluation Report Summary: SEC-00079, Dow Madison

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 Atomic Weapons Employer (AWE) employees who were monitored, or should have been monitored, for exposure to thorium radionuclides while working at the Dow Chemical Company site in Madison, Illinois, for a number of work days aggregating at least 250 work days from January 1, 1957 through December 31, 1960 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 sufficient personal and workplace monitoring data to adequately determine the potential intake of thorium radionuclides, making reconstruction of internal thorium doses infeasible.

Health Endangerment Determination

NIOSH's evaluation did not identify evidence from 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 exposure. However, the evidence reviewed in this evaluation suggests that some workers in the class may have accumulated chronic radiation exposures through intakes of thorium. Consequently, in accordance with 42 C.F.R. § 83.13(c)(3)(ii), NIOSH has determined that health may have been endangered for those workers covered by this evaluation who were employed for a number of work days aggregating at least 250 work days within the parameters established for this class or in combination with work days within the parameters established for one or more other classes of employees in the SEC.

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SEC Petition Evaluation Report for SEC-00079

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: James Mahathy; Oak Ridge Associated Universities. 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 Special Exposure Cohort (SEC).

This report does not make any determinations concerning the feasibility of dose reconstruction that necessarily apply to any individual energy employee who might require a dose reconstruction from NIOSH, with the exception of the employee whose dose reconstruction could not be completed, and whose claim consequently led to this petition evaluation. The finding in this report is not the final determination as to whether 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 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 regarding 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 (HHS) to add a class of employees to the SEC. The evaluation is intended to provide a fair, science-based determination of whether or not it is feasible to estimate, with sufficient accuracy, the radiation doses of the proposed class of employees through NIOSH dose reconstructions.[1]

NIOSH is required to document its evaluation in a report, and to do so, relies upon both its own dose reconstruction expertise as well as technical support from its contractor, Oak Ridge Associated Universities (ORAU). Once completed, NIOSH provides the report to both the petitioners and the Advisory Board on Radiation and Worker Health. The Board will consider the NIOSH evaluation report, together with the petition, comments of the petitioner(s) and such other information as the

[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.

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 exposure to thorium radionuclides while working at the Dow Chemical Company site in Madison, Illinois, for a number of work days aggregating at least 250 work days from January 1, 1957 through December 31, 1960 or in combination with work days within the parameters established for one or more other classes of employees in the SEC.

The evaluation responds to Petition SEC-00079, 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 at the facility during the AWE operational period as a painter, laborer, and bricklayer. 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. § 83.12 and 42 C.F.R. § 83.14.

4.0 Radiological Operations Relevant to the Proposed Class

The following subsections summarize the radiological operations at the Dow Chemical Company site in Madison, Illinois, (Dow Madison) from January 1, 1957 through December 31, 1960 and the information available to NIOSH to characterize particular processes and radioactive source materials. Using available sources, NIOSH has attempted to gather process and source descriptions, information regarding the identity and quantities of radionuclides of concern, and information describing processes through which the radiation exposures of concern may have occurred and the physical environment in which they may have occurred. The information included within this evaluation report is meant only to be a summary of the available information.

4.1 Operations Description

Dow Madison supplied the Atomic Energy Commission (AEC) with both materials and services from January 1, 1957 through December 31, 1960. Information is limited regarding the processes involving radiological operations at Dow Madison. Dow Madison services for the AEC included: the gamma-phase extrusion of uranium metal (the gamma [γ]-phase of a material refers to a solid solution with a face-centered crystal lattice and randomly distributed different species of atoms); and the straightening of uranium rods for Mallinckrodt Chemical Works. The primary purposes of the

[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.

uranium extrusion services were to improve the process and assist the AEC with selection of tools and supplies used in the process at Mallinckrodt (FUSRAP, 2001).
Dow Madison also commercially fabricated and manufactured magnesium metal alloys. By 1956, Dow Madison had started commercially producing magnesium alloys containing thorium (Affidavits, 2006; Farer, 1998; ORNL/TM-11552). These alloys were known as HK-31, HK-61, HM-21, and AZ-31.

Thorium alloys produced at Dow Madison were used in airplane and space rocket assemblies (Dow, 1957). Indications are that thorium work at Dow Madison also involved the removal of commercial thorium from various alloys (Affidavits, 2006). According to information provided from interviews of former Dow Madison workers, thorium bars were processed to make alloy billets, slabs, rolls of metal, and other metal forms (Affidavits, 2006).

Thorium was received in barrels about three or four-feet high and was stored in the "Casting" area of Building 6. Various processes were conducted with thorium. Using an indirect heating crucible, thorium was melted in the "Pot Room." The melting process required workers to stir the hot mixture. Once melting was completed, thorium that rose to the top of the mixture was poured into hot baskets. The pouring process had to be completed in a timely manner in order to avoid generating oxidation fires that would cause the product to clump. Sludge remaining in the crucibles was collected and eventually stored on a 40-acre area of the Dow Madison site (Farer, 1998).

Interviews with Dow Madison workers indicate that thorium metals were milled. NIOSH has substantiated milling operations (Dow, 1959; AEC, 1960). Milling processes included the weighing, grinding, gouging, sanding, rolling, and packaging of the milled material (Affidavits, 2006; Dow, 1959; AEC, 1960). The quantity of thorium that was received by Dow Madison was documented in an AEC inspection report to be 80 English tons through July 1, 1960 (AEC, 1960).

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 potential external exposures included primarily beta with some photon radiation emitted from materials containing uranium and thorium (AEC, 1960, Radiological Health, 1970).

The primary source of potential internal radiation exposure at the site was from suspension and re-suspension of thorium and uranium and their progenies generated during the manufacturing of alloys, and the buffing, grinding, cutting and welding of thorium (Dow, 1959; AEC, 1960; Radiological Health, 1970) and extrusion and straightening of uranium (Affidavits, 2006; Radiological Health, 1970).

4.3 Time Period Associated with Radiological Operations

Dow Madison supplied the AEC with materials and services from January 1, 1957 through December 31, 1960. On March 15, 1957, Dow signed a contract with Mallinckrodt to conduct research and development on the extrusion of uranium metal and rods (Contract, 1957). This contract requested research and development related to the gamma-phase extrusion of uranium metal. The gamma (γ)-phase of a material does not refer to the radiological characteristics of the material, but, refers to a solid solution with a face-centered crystal lattice and randomly-distributed different species of atoms (Hofman, 1998). NIOSH has obtained information suggesting that two rod-straightening operations were performed on uranium metals at Dow Madison during the AEC operations period (FUSRAP, 2001).

Dow Chemical Company continued to commercially manufacture alloys containing thorium at the Madison site beyond 1960. Dow Chemical sold the Madison facility in 1969 to Consolidated Aluminum, which continued to operate the facility from 1969 through 1986. Later, Spectrulite purchased the plant from Consolidated Aluminum. In 1992, the site was designated as part of the Formerly Utilized Site Remediation Action Program (FUSRAP); however, no remediation work took place under the FUSRAP prior to that program being transferred to the U.S. Army Corps of Engineers in 1997 (ORNL/TM-11552).

The time period associated with Dow Madison radiological operations covered by the EEOICPA is January 1, 1957 through December 31, 1960. Exposures to uranium and commercially-processed thorium[3] are both covered during this operational time period. Based on currently-available information, the exact beginning and ending dates for uranium and thorium processing within the covered period are uncertain. However, it is evident that both commercial thorium and AEC uranium processing occurred during the site's covered period. For the purpose of this evaluation, it is assumed that uranium and thorium operations were conducted during the entire period of AEC-related operations (January 1, 1957 through December 31, 1960); this assumption maximizes the assumed exposure and the extent of the class of employees under consideration.

4.4 Site Locations Associated with Radiological Operations

Although limited, the data available to NIOSH indicates that the following radiological materials were received, stored, or processed in the specified buildings:

- Uranium: Extrusion was performed in the metal extrusion department located in Building 6. Uranium materials were also handled and transferred to Building 4 and to and from the Warehouse (ORNL/TM-11552).

- Thorium: The material was received in barrels and stored in the "Casting" area of Building 6. Various processes were conducted with thorium, including melting and pouring in the "Pot Room" (Affidavits, 2006; AEC, 1960). Sludge remaining in the crucibles was collected and eventually stored on a 40-acre area of the Dow Madison site (Farer, 1998).

[3] See the Note under Section 6.0 for an explanation of EEOICPA rules regarding the reconstruction of exposures to commercially-processed thorium during a site's AWE operational period vs. a residual radiation period.

NIOSH has identified limited information stating that thorium metal was stored in a roped-off area, but thorium pieces and slag were stored around the areas where thorium was processed (AEC, 1960). NIOSH has no further documentation regarding site-wide transport or storage practices for radioactive materials at Dow Madison, other than the knowledge that thorium was stored in a 40-acre on-site area. Although NIOSH does have access to the air monitoring and dose rate data (Dow, 1959; AEC, 1960) and site survey data (ORNL/TM-11552), these data are not sufficient to determine whether some areas of the Dow Madison site did not have the potential for exposure to thorium. Because it is not possible to determine if employees working in specific locations were not potentially exposed to thorium, all areas of the Dow Madison site are included in the proposed SEC class definition.

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 known worker job descriptions with specific work locations, it is impractical to narrow down listed job descriptions to only those workers with potential exposures to thorium radionuclides. Therefore, it is not possible to determine that any specific work group was not potentially exposed to thorium, and not possible to use job descriptions to define the proposed class.

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 data are unavailable, the air monitoring data from breathing zone and general area monitoring are used to estimate the potential internal exposure. If personal monitoring and breathing zone area monitoring are unavailable, internal exposures can sometimes be estimated using more general area monitoring, process information, and information characterizing and quantifying the source term.

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

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

NIOSH searched available DOE data to find source term, workplace monitoring, and personnel monitoring information pertaining to the DOW Chemical Company site in Madison, Illinois. NIOSH also searched U.S. Nuclear Regulatory Commission (NRC) repositories to locate site-related license information or monitoring data. NIOSH has obtained documentation that describes the processes used to manufacture alloys containing thorium at Dow Madison (AEC, 1960). NIOSH has also obtained documentation of the thorium source term received at the Dow Madison site through July 1, 1960 and has obtained air monitoring and dose rate measurements (Silverstein, 1957; Dow, 1959; AEC, 1960).

5.1 Internal Personnel Monitoring Data

NIOSH has not located any bioassay data or site records indicating that Dow Madison site employees were monitored for internal exposure to radioactive materials, either by *in vivo* or *in vitro* analysis. Worker input indicates that site employees were not monitored for internal exposure to radioactive materials.

5.2 External Personnel Monitoring Data

NIOSH has not located any external personnel monitoring data or records that indicate Dow Madison site employees were monitored for external exposure to radioactive materials, either by film badge or direct reading dosimeter. Worker input indicates that site employees were not monitored or were only sporadically monitored for external radiation exposure.

5.3 Workplace Monitoring Data

While the Dow-Mallinckrodt contract referenced in Section 4.3 indicates that Mallinckrodt was to perform air monitoring for uranium during contract operations, NIOSH's search of Mallinckrodt records did not reveal any air monitoring results for uranium for Dow Madison. NIOSH has obtained some documents detailing air monitoring results for thorium airborne contamination collected during a single sampling campaign. Ten sample results are available for mechanical operations on thorium-bearing alloys. Of these ten, three are associated with rotary filing, while a single sample is associated with surface grinding, open-wheel grinding, buffing, sawing, drumming powder, the mill slab ovens area, and the rolling slabs area. Approximately ten air sample results are available from various locations at the alloy production area. Air sample results are variously reported as long-lived alpha activity, long-lived beta activity, short-lived alpha activity, radon daughter activity, and thorium mass, but rarely is more than one of these values reported for a single sample (Silverstein, 1957; Dow, 1959; AEC, 1960). NIOSH has also identified dose rate measurements taken in areas where commercial thorium operations were conducted. Approximately five dose rate measurements are available from 1957, and seven are available from 1960. The 1960 measurements have both open window (beta plus gamma) and closed window (gamma) values. One of the 1957 measurements is identified as beta plus gamma, but the others are not specified. Most of the 1957 results are presented as ranges rather than as single values (Silverstein, 1957; AEC, 1960).

NIOSH has obtained Dow Madison site survey data measured in 1989 by the Oak Ridge National Laboratory (ORNL/TM-11552). This reference contains surface contamination data and direct exposure results.

5.4 Radiological Source Term Data

NIOSH has found AEC documentation stating that Mallinckrodt contracted Dow Madison to perform up to twelve experiments using up to twenty billets of uranium spanning twenty-eight work hours (Contract, 1957). Indications are that Mallinckrodt transported the billets to the Dow Madison facility along with their own press, and transported the extruded metal and scrap back to the Mallinckrodt facility (Contract, 1957). The Mallinckrodt subcontract stated that subsequent production extrusion work would be performed at another site to be determined by the AEC pending

the outcome of the Dow Madison tests (Contract, 1957). The above information leads NIOSH to believe that the Dow extrusion work was performed with up to 240 billets (also referred to as ingots and rods by Mallinckrodt). Billets were approximately 18 inches long by 6 inches in diameter and weighed up to 125 pounds (Fleishman, 1967; ORAUT-TKBS-0005).

NIOSH has found documentation stating that Dow Madison performed two uranium rod-straightening campaigns for Mallinckrodt Chemical Works. Mallinckrodt retained accountability for the uranium throughout the operations and was responsible for removing unused uranium and for clean-up of facilities following operations (FUSRAP, 2001). The first straightening campaign ended on December 21, 1959, and the second on January 25, 1960 (FUSRAP, 2001). NIOSH has not identified information documenting the actual periods of performance or quantities of uranium metal involved in these straightening operations.

NIOSH has found AEC documentation stating that the thorium source term at the Madison magnesium foundry from onset of operations through July 1, 1960 was 80 English tons. Most of that quantity (64 tons or 80 percent) was received from Canadian suppliers in the form of pellets. Thirteen tons of scrap containing thorium was received from Consolidated Edison and three tons of master (aluminum) alloy containing 25 to 40 percent thorium was received from Canadian entities (AEC, 1960).

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 10.0). 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.

NOTE: For dose reconstructions under EEOICPA, all sources of radiation exposure must be considered in the assessment of dose received during AWE operational periods. However, exposures due to non-AEC radioactive materials are not included in the assessment of dose received during an AWE residual radiation period if they can be distinguished from exposures resulting from AEC residual contamination[4]. Therefore, reconstruction of Dow Madison site dose received from non-AEC thorium activities is required for the AWE operational period of 1957 through 1960, but the non-AEC thorium exposures received during the site's residual radiation period (January 1, 1961 through December 31, 1998) are not included in the assessment of site dose. During the Dow Madison residual radiation period, only the dose due to residual contamination from AEC-related uranium is required to be assessed.

6.1 Feasibility of Estimating Internal Exposures

As stated in Section 5.1, no personnel bioassay monitoring results have been identified for thorium. Some thorium air monitoring results have been identified as well as information on thorium source quantities handled at Dow Madison through July 1, 1960 (Dow, 1957; Dow, 1959; AEC, 1960). While the air monitoring data and source term information are suitable to define work processes, these data are not adequate to reconstruct with sufficient accuracy potential doses received from exposure to thorium. In general, only one sample result is available for a sampling location, representing a single sampling campaign during the covered period. NIOSH does not have enough documentation to ensure that all conditions that could affect exposure levels were similar to those represented by the available air monitoring data. In addition, there are descriptions of radiological activities, such as size reduction of sludge that contains up to 50% thorium, for which no air samples are available. As a result, it is not feasible to reconstruct with sufficient accuracy the internal doses that may have resulted from potential exposure to thorium isotopes associated with commercial operations during Dow Madison's AWE operational period from January 1, 1957 through December 31, 1960.

NIOSH has access to sufficient information to estimate the maximum radiation dose that could have been incurred from exposure to uranium. Potential internal doses received from exposure to uranium during AEC-related uranium metal operations can be reconstructed using assumptions and methods such as those provided in the NIOSH guidance document, *Estimating the Maximum Plausible Dose to Workers at Atomic Weapons Employer Facilities* (ORAUT-OTIB-0004). Survey results of uranium dust contamination obtained during a 1989 site survey at Dow Madison are consistent with the guidance criteria used in that publication and demonstrate that Dow Madison performed work with uranium metals. Potential internal doses received from inhalation and/or ingestion of re-suspended uranium during the residual contamination period can be reconstructed, as indicated by the model dose reconstructions covering the period January 1, 1957 through December 31, 1998.

6.2 Feasibility of Estimating External Exposures

This evaluation responds to a petition based on NIOSH determining that internal radiation exposures to thorium could not be reconstructed for a dose reconstruction referred to NIOSH by the Department of Labor (DOL). Based on the research that NIOSH conducted for this evaluation, NIOSH concludes that the maximum external doses that could have been incurred due to uranium metal operations during the AWE operational period at the Dow Madison site can be reconstructed using guidance such

[4] See 42 U.S.C. 7384 n (c)(4)(b)

as that provided in the NIOSH document, *Estimating the Maximum Plausible Dose to Workers at Atomic Weapons Employer Facilities* (ORAUT-OTIB-0004). External doses received due to residual contamination associated with previous AEC uranium metal operations at Dow Madison can be reconstructed, as indicated by the model dose reconstructions covering the period January 1, 1957 through December 31, 1998.

NIOSH considers adequate reconstruction of medical dose for Dow Madison workers feasible by applying pertinent claimant-favorable assumptions and protocols specified in the complex-wide technical information bulletin titled, *Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures* (ORAUT-OTIB-0006).

7.0 Summary of Feasibility Findings for Petition SEC-00079

This report evaluates the feasibility for estimating the dose, with sufficient accuracy, for all AWE employees who worked at the Dow Chemical Company site in Madison, Illinois, from January 1, 1957 through December 31, 1960. NIOSH determined that it lacks sufficient thorium bioassay, thorium source term, and thorium workplace monitoring data to allow adequate reconstruction of the radiation doses resulting from internal thorium exposures received by members of this class of employees. Consequently, NIOSH finds that it is not feasible to estimate with sufficient accuracy the total radiation dose received by members of this class of employees.

With the data currently available to NIOSH, it is feasible to reconstruct with sufficient accuracy the external and internal doses resulting from exposure to uranium metal during the Dow Madison AWE operational period (January 1, 1957 through December 31, 1960), and during the residual radiation period (January 1, 1961 through December 31, 1998). NIOSH also considers the reconstruction of medical dose for Dow Madison workers to be feasible.

NIOSH has documented herein that it cannot complete the dose reconstructions related to this petition where doses resulted from exposure to thorium-containing materials. The basis of this finding is specified in this report, which demonstrates that NIOSH does not have access to sufficient information to estimate with sufficient accuracy 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 at the Dow Chemical Company site in Madison, Illinois, may have received unmonitored internal and external radiological exposures from thorium radionuclides at the plant. NIOSH lacks sufficient information, which includes sufficient personnel and workplace monitoring data and radiological source term information, to allow NIOSH to estimate the potential total internal thorium exposures to which the proposed class may have been exposed.

8.0 Evaluation of Health Endangerment for Petition SEC-00079

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.

The petitioner did not provide, and NIOSH has not obtained, any information to indicate that members of the class were 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 unmonitored exposure to thorium radionuclides. The facility processed substantial quantities of thorium during its operational period while it was conducting work for the AEC. Consequently, NIOSH is specifying 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.

9.0 NIOSH-Proposed Class for Petition SEC-00079

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 exposure to thorium radionuclides while working at the Dow Chemical Company site in Madison, Illinois, for a number of work days aggregating at least 250 work days from January 1, 1957 through December 31, 1960 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 basis for concern that there is likely to be a second similar class of employees at the Dow Chemical Company site in Madison, Illinois, for whom dose reconstruction may not be feasible.

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 22296; 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 *et seq*., *Energy Employees Occupational Illness Compensation Program Act of 2000*; as amended; OCAS website

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-3 (draft), Oak Ridge Associated Universities; 2007; SRDB Ref ID: To be assigned

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

ORAUT-TKBS-0005, *Basis for Development of an Exposure Matrix for the Mallinckrodt Chemical Company St. Louis Downtown Site and the St Louis Airport Site, St. Louis, Missouri, Period of Operation: 1942–1958*; Rev. 01; March 10, 2005; SRDB Ref ID: 19783

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