

SEC Petition Evaluation Report Petition SEC-00133

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Subject Expert(s):	Joseph Guido
Site Expert(s):	N/A

Petitioner Administrative Summary			
Petition Under Evaluation			
Petition #	Petition Type	Petition A Receipt Date	DOE/AWE Facility Name
SEC-00133	83.14	November 18, 2008	Mallinckrodt Chemical Co., Destrehan Street Plant

NIOSH-Proposed Class Definition
All employees of DOE, its predecessor agencies, and their contractors and subcontractors who worked in the Uranium Division at the Mallinckrodt Chemical Co., Destrehan Street Plant in St. Louis, Missouri, from January 1, 1958 to December 31, 1958, for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees included in the SEC.

Related Petition Summary Information			
SEC Petition Tracking #(s)	Petition Type	DOE/AWE Facility Name	Petition Status
SEC-00012	83.13	Mallinckrodt Chemical Co., Destrehan Street Plant	SEC-00012-1 Added to SEC SEC-00012-2 Added to SEC

Related Evaluation Report Information	
Report Title	DOE/AWE Facility Name
SEC Petition Evaluation Report SEC-00012-2	Mallinckrodt Chemical Co., Destrehan Street Plant

ORAU Lead Technical Evaluator: Joseph Guido	ORAU Review Completed By: Michael Kubiak
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Peer Review Completed By:	[Signature on file] _____ <i>LaVon Rutherford</i>	12/01/2008 _____ <i>Date</i>
SEC Petition Evaluation Reviewed By:	[Signature on file] _____ <i>J. W. Neton</i>	12/01/2008 _____ <i>Date</i>
SEC Evaluation Approved By:	[Signature on file] _____ <i>Larry Elliott</i>	12/01/2008 _____ <i>Date</i>

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Evaluation Report Summary: SEC-00133, Mallinckrodt Chemical Co., Destrehan Street Plant

This evaluation report by the National Institute for Occupational Safety and Health (NIOSH) addresses a class of employees proposed for addition to the Special Exposure Cohort (SEC) per the *Energy Employees Occupational Illness Compensation Program Act of 2000*, as amended, 42 U.S.C. § 7384 *et seq.* (EEOICPA) and 42 C.F.R. pt. 83, *Procedures for Designating Classes of Employees as Members of the Special Exposure Cohort Under the Energy Employees Occupational Illness Compensation Program Act of 2000*.

NIOSH-Proposed Class Definition

All employees of the Department of Energy (DOE), its predecessor agencies, and their contractors and subcontractors who worked in the Uranium Division at the Mallinckrodt Chemical Co., Destrehan Street Plant in St. Louis, Missouri from January 1, 1958 to December 31, 1958, for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees included in the SEC.

Feasibility of Dose Reconstruction Findings

NIOSH lacks sufficient information, which includes specific monitoring data, sufficient air monitoring information, and sufficient process and radiological source information, to allow it to estimate with sufficient accuracy the potential internal exposures to uranium progeny present in pitchblende raffinate (e.g., thorium-230, protactinium-231, and actinium-227) to which the proposed class may have been subjected.

NIOSH finds that it likely is feasible to reconstruct both individual external dose and occupational medical dose for Mallinckrodt Chemical Co., Destrehan Street Plant workers with sufficient accuracy.

- Throughout 1958, the Mallinckrodt Chemical Co., Destrehan Street Plant continued to handle residues from the processing of uranium ore, known to contain equilibrium activities of radionuclides present in the natural uranium decay series. After uranium was extracted from the pitchblende ore, residues known as raffinate were generated. The uranium progeny in the pitchblende raffinate (e.g., thorium-230, protactinium-231, and actinium-227) were known to be present in substantial disequilibrium. The collection and storage of the raffinate at the Destrehan Street Plant continued to represent a significant potential source term for internal exposure through December 31, 1958.
- There is no individual bioassay monitoring or other monitoring information that can be used to quantify internal exposures to thorium-230, protactinium-231, and actinium-227 for raffinate workers specifically at the Mallinckrodt Chemical Co., Destrehan Street Plant for the period January 1, 1958 through December 31, 1958.
- The specific air sample data that exist for the Mallinckrodt Chemical Co., Destrehan Street Plant are insufficient to establish the internal doses from inhalation of thorium-230, protactinium-231, and actinium-227 with sufficient accuracy for the period from January 1, 1958 through December

31, 1958. This is because 1) the air sample data found at the Mallinckrodt Chemical Co., Destrehan Street Plant do not provide radionuclide-specific information for the site; and 2) very few data are available to characterize the degree of disequilibrium in the raffinate source term at the Mallinckrodt Chemical Co., Destrehan Street Plant.

- Records from the Mallinckrodt Chemical Co., Destrehan Street Plant indicate that during 1958, employees may have rotated through a number of different jobs. The changes in work assignments make it difficult to distinguish the raffinate-exposed workers from the workers who never worked with raffinate.
- Pursuant to 42 C.F.R. § 83.13(c)(1), NIOSH determined that there is insufficient information to either: (1) estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred under plausible circumstances by any member of the class; or (2) estimate the radiation doses of members of the class more precisely than a maximum dose estimate.
- Although NIOSH found that it is not possible to completely reconstruct radiation doses for Mallinckrodt Chemical Co., Destrehan Street Plant employees, NIOSH intends to use any available internal and external monitoring data that may be available for an individual claim (and can be interpreted using existing NIOSH dose reconstruction processes or procedures). Further, NIOSH has determined that occupational medical dose for all workers can be reconstructed. Therefore, dose reconstructions for individuals with non-presumptive cancers or fewer than 250 days employment in the class period may be performed using these data as appropriate.

Health Endangerment Determination

The NIOSH evaluation did not identify any evidence supplied by the petitioners or from other resources that would establish that the class was exposed to radiation during a discrete incident likely to have involved exceptionally high-level exposures, such as nuclear criticality incidents or other events involving similarly high levels of exposures. However, the evidence reviewed in this evaluation indicates that some workers in the class may have accumulated chronic radiation exposures through intakes of uranium and uranium progeny and from direct exposure to radioactive materials. Therefore, 42 C.F.R. § 83.13(c)(3)(ii) requires NIOSH to specify that health may have been endangered for those workers covered by this evaluation who were employed for a number of work days aggregating at least 250 work days within the parameters established for this class or in combination with work days within the parameters established for one or more other classes of employees in the SEC.

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SEC Petition Evaluation Report for SEC-00133

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: Joseph Guido, MJW Corporation, Inc. These conclusions were peer-reviewed by the individuals listed on the cover page. The rationales for all conclusions in this document are explained in the associated text.

1.0 Purpose and Scope

This report evaluates the feasibility of reconstructing doses for employees who worked at Mallinckrodt Chemical Co., Destrehan Street Plant in 1958. It provides information and analysis germane to considering a petition for adding a class of employees to the Congressionally-created SEC.

This report does not make any determinations concerning the feasibility of dose reconstruction that necessarily apply to any individual energy employee who might require a dose reconstruction from NIOSH, with the exception of the employee whose dose reconstruction could not be completed, and whose claim consequently led to this petition evaluation. The finding in this report is not the final determination as to whether or not the proposed class will be added to the SEC. This report will be considered by the Advisory Board on Radiation and Worker Health (the Board) and by the Secretary of Health and Human Services (HHS). The Secretary of HHS will make final decisions concerning whether or not to add one or more classes to the SEC in response to the petition addressed by this report.

This evaluation, in which NIOSH provides its findings both on the feasibility of estimating radiation doses of members of this class with sufficient accuracy and on health endangerment, was conducted in accordance with the requirements of EEOICPA and 42 C.F.R. § 83.14.

2.0 Introduction

Both EEOICPA and 42 C.F.R. pt. 83 require NIOSH to evaluate qualified petitions requesting that the Department of Health and Human Services add a class of employees to the SEC. The evaluation is intended to provide a fair, science-based determination of whether it is feasible to estimate, with sufficient accuracy, the radiation doses of the proposed class of employees through NIOSH dose reconstructions.¹

NIOSH is required to document its evaluation in a report, and to do so, relies upon both its own dose reconstruction expertise as well as technical support from its contractor, Oak Ridge Associated Universities (ORAU). Once completed, NIOSH provides the report to both the petitioners and the Advisory Board on Radiation and Worker Health. The Board will consider the NIOSH evaluation report, together with the petition, comments of the petitioner(s) and such other information as the Board considers appropriate, to make recommendations to the Secretary of HHS on whether or not to add one or more classes of employees to the SEC. Once NIOSH has received and considered the

¹ NIOSH dose reconstructions under EEOICPA are performed using the methods promulgated under 42 C.F.R. pt. 82 and the detailed implementation guidelines available at <http://www.cdc.gov/niosh/ocas>.

advice of the Board, the Director of NIOSH will propose a decision on behalf of HHS. The Secretary of HHS will make the final decision, taking into account the NIOSH evaluation, the advice of the Board, and the proposed decision issued by NIOSH. As part of this final decision process, the petitioner(s) may seek a review of certain types of final decisions issued by the Secretary of HHS.²

3.0 NIOSH-Proposed Class Definition and Petition Basis

The NIOSH-proposed class includes all employees of DOE, its predecessor agencies, and their contractors and subcontractors who worked in the Uranium Division at the Mallinckrodt Chemical Co., Destrehan Street Plant in St. Louis, Missouri, from January 1, 1958 to December 31, 1958, for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees included in the SEC. During this period, employees at this facility handled residues from the processing of uranium ore involving exposures to uranium and uranium progeny.

The evaluation responds to Petition SEC-00133, 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 clerk/typist from 1957 through 1960. 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).

The proposed class is based on the NIOSH determination that the radiological conditions in 1958 at the Destrehan Street Plant are indistinguishable from the conditions that existed in 1957. On October 14, 2005, HHS designated a class of Mallinckrodt Chemical Co. employees for addition to the SEC (HHS, 2005). The designation became effective on November 13, 2005, and included the class of employees who worked in the Uranium Division from 1949 to 1957. The HHS findings relating to the period from 1949 through 1957 are summarized below:

- Between 1949 and 1957, the Mallinckrodt facility processed large quantities of pitchblende ore, known to contain equilibrium activities of radionuclides present in the natural uranium decay series. After uranium was extracted from the pitchblende ore, more than 100,000 tons of residues, known as raffinate, were generated. The uranium progeny in the pitchblende raffinate (e.g., thorium-230, protactinium-231, and actinium-227) were known to be present in substantial disequilibrium. The collection and storage of the raffinate at the Destrehan Street facility of Mallinckrodt Chemical Works represent a significant potential source term for internal exposure (HHS, 2005).
- There is not individual bioassay monitoring or other monitoring information that can be used to quantify internal exposures to thorium-230, protactinium-231, and actinium-227 for raffinate workers specifically at the Destrehan Street facility of the Mallinckrodt Chemical Works for the period 1949 through 1957 (HHS, 2005).

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

- The specific air sample data that exist for the Destrehan Street facility of Mallinckrodt Chemical Works are insufficient to establish the internal doses from inhalation of thorium-230, protactinium-231, and actinium-227 at the site with sufficient accuracy for the period from 1949 through 1957. This is because 1) the air sample data found at the Destrehan Street facility of Mallinckrodt Chemical Works do not provide radionuclide-specific information for the site; and 2) very little data are available to characterize the degree of disequilibrium in the raffinate source term at the Destrehan Street facility of Mallinckrodt Chemical Works (HHS, 2005).
- Records from the Destrehan Street facility of Mallinckrodt Chemical Works indicate that during the time frame 1949-1957, employees may have rotated through a number of different jobs. The changes in work assignments make it difficult to distinguish the raffinate-exposed workers from the workers who never worked with raffinate (HHS, 2005).

4.0 Radiological Operations Relevant to the Proposed Class

The following subsections summarize the radiological operations at the Mallinckrodt Chemical Co., Destrehan Street Plant from January 1, 1958 to December 31, 1958 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

A detailed description of process operations at the Mallinckrodt Chemical Co., Destrehan Street Plant can be found in the NIOSH Site Profile document *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* (ORAUT-TKBS-0005). The Mallinckrodt Chemical Co., Destrehan Street Plant refined uranium under contract to the United States Government from 1942 to 1958. While site activities continued until 1962, sometime in 1957 or 1958, all uranium refining operations ceased and the work moved from the Destrehan Street Plant to Fernald and Weldon Spring (USACE, 2003; Cooperstein, 1981). All Mallinckrodt Plant 6 work, which at that time included processing steps through uranium oxide production, was transferred to Weldon Spring in March 1957 (Eisenbud, 1975). Some Mallinckrodt Plant 7 production operations continued through July 1958 (possibly to exhaust the store of orange oxide that had already been produced at the Destrehan Plant) before they were transferred to Weldon Spring (Mason, 1959). Mallinckrodt documents support the conclusion that the Mallinckrodt Chemical Co., Destrehan Street Plant was put on standby in 1958 (Mallinckrodt, 1994). Therefore, NIOSH concludes that the radiological conditions upon which the 1949 to 1957 SEC class is based continued into 1958.

4.2 Radiation Exposure Potential from Operations

The potential for external and internal radiation dose existed at the Mallinckrodt Chemical Co., Destrehan Street Plant. Based on the site operations outlined in Section 4.1, Mallinckrodt Chemical Co., Destrehan Street Plant sources of exposure in 1958 included uranium and uranium progeny. Similar to the sources of exposure during the previously designated SEC period from 1949 through 1957, the 1958 exposures potentially included uranium progeny present in pitchblende raffinate (e.g., thorium-230, protactinium-231, and actinium-227), known to be present in substantial disequilibrium. Specific exposure conditions during the period from 1949 through 1957 are discussed in the NIOSH SEC Petition Evaluation Reports for SEC-00012 (SEC-00012-1 and SEC-00012-2) and ORAUT-TKBS-0005.

4.3 Time Period Associated with Radiological Operations

Per the DOE Office of Health, Safety and Security, the time period associated with DOE operations at the Mallinckrodt Chemical Co., Destrehan Street Plant is from 1942 through 1962 (DOE, 2008). HHS has previously designated SEC classes for employment at the Destrehan Street Plant during the periods 1942 through 1948, and 1949 through 1957. Based on the site operations and exposure conditions outlined in Sections 4.1 and 4.2, NIOSH has concluded that similar operations and exposure conditions continued into 1958. NIOSH has found no substantive difference in site operations, personnel and workplace monitoring, source term, or available site characterization data between 1958 and the previously designated SEC period from 1949 through 1957. After uranium refining operations ended in 1958, plant operations consisted of decontamination and decommissioning activities (ORAUT-TKBS-0005). Because NIOSH is unable to determine (using available documentation) exactly when in 1958 uranium operations were completed at the Destrehan Street Plant, NIOSH has assigned a date of December 31, 1958 for the cessation of uranium refining operations.

4.4 Site Locations Associated with Radiological Operations

The radiological conditions and work processes conducted throughout the Mallinckrodt Chemical Co., Destrehan Street Plant in 1958, and during earlier periods, are discussed in the NIOSH SEC Petition Evaluation Reports for SEC-00012 (SEC-00012-1 and SEC-00012-2) and in ORAUT-TKBS-0005. The current SEC class for Uranium Division workers employed during the period from 1949 through 1957 is not administered based on site work locations. Based on the site operations and exposure conditions outlined in Sections 4.1 and 4.2 of this report, NIOSH has found no substantive difference in site operations, personnel and workplace monitoring, source term, or available site characterization data between 1958 and the previously designated SEC period from 1949 through 1957. As with the earlier 1949 through 1957 SEC period, NIOSH does not have sufficient information for 1958 regarding the receipt, transport, or storage of uranium raffinate onsite to enable NIOSH to limit any 1958 SEC class based on work location within the Mallinckrodt Chemical Co., Destrehan Street Plant.

4.5 Job Descriptions Affected by Radiological Operations

On October 14, 2005, HHS designated a class of Mallinckrodt Chemical Co. employees for addition to the SEC (HHS, 2005). This class included “*DOE employees or DOE contractor or subcontractor*

employees who worked in the Uranium Division at the Destrehan Street facility of Mallinckrodt Chemical Works from 1949 to 1957 ...”

HHS based the class description on findings that records from the Destrehan Street facility of Mallinckrodt Chemical Works indicate that during the 1949 through 1957 timeframe, employees may have rotated through a number of different jobs; these changes in work assignments made it difficult to distinguish the raffinate-exposed workers from the workers who never worked with raffinate (HHS, 2005).

Based on the site operations and exposure conditions outlined in Sections 4.1 and 4.2 of the report, NIOSH has concluded that handling of residues from processing of uranium ore continued into 1958. NIOSH has found no substantive difference in site operations, personnel and workplace monitoring, source term, or available site characterization data between 1958 and the previously designated SEC period from 1949 through 1957. As with the earlier 1949 through 1957 SEC period, NIOSH does not have sufficient information for 1958 to distinguish the raffinate-exposed workers from the workers who never worked with raffinate. Therefore, NIOSH is unable to limit any 1958 SEC class more specifically than the class description designated by HHS for the existing 1949 through 1957 SEC class (HHS, 2005).

5.0 Summary of Available Monitoring Data for the Proposed Class

The primary data used for determining internal exposures are derived from personal monitoring data, such as urinalyses, fecal samples, and whole-body counting results. If these are unavailable, the air monitoring data from breathing zone and general area monitoring are used to estimate the potential internal exposure. If personal monitoring and breathing zone area monitoring are unavailable, internal exposures can sometimes be estimated using more general area monitoring, process information, and information characterizing and quantifying the source term.

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

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

5.1 Data Capture Efforts and Sources Reviewed

In addition to examining its Site Research Database (SRDB) to locate documents supporting its evaluation of the proposed class, NIOSH has reviewed the site-specific information discussed in the NIOSH SEC Petition Evaluation Reports for SEC-00012 (SEC-00012-1 and SEC-00012-2) and ORAUT-TKBS-0005 to locate information relevant to determining the feasibility of dose

reconstruction for the class of employees proposed for this petition. This included a review of information on personnel monitoring, workplace monitoring, and radiological source term data.

5.2 Internal Personnel Monitoring Data

A detailed description of personnel monitoring practices and available internal monitoring data for the Mallinckrodt Chemical Co., Destrehan Street Plant can be found in ORAUT-TKBS-0005. Uranium urinalysis results are generally available for Mallinckrodt Destrehan Street Plant workers during the period from January 1, 1958 through December 31, 1958.

In its designation of a Mallinckrodt SEC class for the period 1949 through 1957, HHS found that there was no individual bioassay monitoring, or other monitoring, information that could be used to quantify internal exposures to thorium-230, protactinium-231, and actinium-227 for raffinate workers specifically at the Destrehan Street facility of Mallinckrodt Chemical Works for the period 1949 through 1957 (HHS, 2005).

Based on a NIOSH review of claimant internal monitoring data available for workers employed in 1958 and the site operations and exposure conditions outlined in Sections 4.1 and 4.2, NIOSH has found no substantive difference in the availability of internal monitoring data between 1958 and the previously designated SEC period from 1949 through 1957.

5.3 External Personnel Monitoring Data

A detailed description of personnel monitoring practices and available external monitoring data for the Mallinckrodt Chemical Co., Destrehan Street Plant can be found in ORAUT-TKBS-0005. External dosimetry results are generally available for Mallinckrodt Chemical Co., Destrehan Street Plant workers during the period from January 1, 1958 through December 31, 1958.

In its designation of a Mallinckrodt SEC class for the period 1949 through 1957, HHS indicated that the available external dose monitoring information was adequate for the reconstruction of individual exposures for the period from 1949 through 1957 (HHS, 2005).

Based on a NIOSH review of the claimant external monitoring data available for workers employed in 1958 and the site operations and exposure conditions outlined in Sections 4.1 and 4.2, NIOSH has found no substantive difference in the availability of external monitoring data between 1958 and the previously designated SEC period from 1949 through 1957.

5.4 Workplace Monitoring Data

A detailed description of workplace monitoring practices and available workplace monitoring data for the Mallinckrodt Chemical Co., Destrehan Street Plant can be found in ORAUT-TKBS-0005. Some records of workplace surface and air monitoring data, including general area air samples and worker dust exposure studies (time-weighted exposures), are available for the period from January 1, 1958 through December 31, 1958.

In its designation of a Mallinckrodt SEC class for the period 1949 through 1957, HHS found that specific air sample data that exist for the Destrehan Street facility were insufficient to establish the

internal doses from inhalation of thorium-230, protactinium-231, and actinium-227 with sufficient accuracy for the period 1949 through 1957. This is because 1) the air sample data found at Destrehan Street facility of Mallinckrodt Chemical Works do not provide radionuclide-specific information for the site; and 2) very few data are available to characterize the degree of disequilibrium in the raffinate source term at the Destrehan Street facility of Mallinckrodt Chemical Works (HHS, 2005).

Based on a NIOSH review of available workplace monitoring data and the site operations and exposure conditions outlined in Sections 4.1 and 4.2, NIOSH has found no substantive difference in the availability of workplace monitoring data between 1958 and the previously designated SEC period from 1949 through 1957.

5.5 Radiological Source Term Data

A detailed description of process operations and available source term data for the Mallinckrodt Chemical Co., Destrehan Street Plant can be found in ORAUT-TKBS-0005. The primary mission at the Mallinckrodt Chemical Co., Destrehan Street Plant was the refining of uranium. Nuclides present at the site during the period from January 1, 1958 through December 31, 1958 included uranium and associated uranium progeny.

In its designation of a Mallinckrodt SEC class for the period 1949 through 1957, HHS found that between 1949 and 1957, the Mallinckrodt facility processed large quantities of pitchblende ore, known to contain equilibrium activities of radionuclides present in the natural uranium decay series. After uranium was extracted from the pitchblende ore, more than 100,000 tons of residues, known as raffinate, were generated. The uranium progeny in the pitchblende raffinate (e.g., thorium-230, protactinium-231, and actinium-227) were known to be present in substantial disequilibrium. The collection and storage of the raffinate at the Destrehan Street facility of Mallinckrodt Chemical Works represented a significant potential source term for internal exposure (HHS, 2005).

Based on a NIOSH review of available source term and workplace radiological data and the site operations and exposure conditions outlined in Sections 4.1 and 4.2 of this report, NIOSH has found no substantive difference in the radiological conditions or availability of source term data between 1958 and the previously designated SEC period from 1949 through 1957.

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 coworkers 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

The proposed class is based on the NIOSH determination that the radiological conditions in 1958 at the Mallinckrodt Chemical Co., Destrehan Street Plant are indistinguishable from the conditions that existed at the end of the HHS-designated SEC class for Mallinckrodt Chemical Co. employees who worked in the Uranium Division from 1949 to 1957. Based on the site operations and exposure conditions outlined in Sections 4.1 and 4.2 of this report, NIOSH has concluded that handling of residues from processing of uranium ore continued into 1958, and that NIOSH has found no substantive difference in site operations, personnel and workplace monitoring, source term, or available site characterization data between 1958 and the previously designated SEC period from 1949 through 1957.

As presented in Section 4.3, after the shutdown of residue handling operations in 1958, plant operations consisted of decontamination and decommissioning activities (ORAUT-TKBS-0005). Because NIOSH is unable to determine (using available documentation) exactly when in 1958 uranium operations were completed at the Destrehan Street Plant, NIOSH has assigned a date of December 31, 1958 for the cessation of uranium refining operations.

Consistent with the HHS findings relative to the SEC-00012 class designated for the period from 1949 through 1957, NIOSH here finds that:

- Throughout 1958, the Mallinckrodt Chemical Co., Destrehan Street Plant continued to handle residues from processing of uranium ore, known to contain equilibrium activities of radionuclides present in the natural uranium decay series. After uranium was extracted from the pitchblende ore, residues known as raffinate were generated. The uranium progeny in the pitchblende raffinate (e.g., thorium-230, protactinium-231, and actinium-227) were known to be present in substantial disequilibrium. The collection and storage of the raffinate at the Destrehan Street Plant continued to represent a significant potential source term for internal exposure through December 31, 1958.
- There is no individual bioassay monitoring, or other monitoring, information that can be used to quantify internal exposures to thorium-230, protactinium-231, and actinium-227 for raffinate workers specifically at the Mallinckrodt Chemical Co., Destrehan Street Plant for the period January 1, 1958 through December 31, 1958.

- The specific air sample data that exist for the Mallinckrodt Chemical Co., Destrehan Street Plant are insufficient to establish the internal doses from inhalation of thorium-230, protactinium-231, and actinium-227 with sufficient accuracy for the period from January 1, 1958 through December 31, 1958. This is because 1) the air sample data found at the Mallinckrodt Chemical Co., Destrehan Street Plant do not provide radionuclide-specific information for the site; and 2) very few data are available to characterize the degree of disequilibrium in the raffinate source term at the Mallinckrodt Chemical Co., Destrehan Street Plant.
- Records from the Mallinckrodt Chemical Co., Destrehan Street Plant indicate that during 1958, employees may have rotated through a number of different jobs. The changes in work assignments make it difficult to distinguish the raffinate-exposed workers from the workers who never worked with raffinate.

NIOSH does not have access to sufficient personnel monitoring, workplace monitoring, or source term data to estimate potential internal exposures to uranium progeny in the pitchblende raffinate (e.g., thorium-230, protactinium-231, and actinium-227) during the period from January 1, 1958 through December 31, 1958. Consequently, NIOSH finds that it is not feasible to estimate, with sufficient accuracy, internal exposures to uranium progeny in the pitchblende raffinate (e.g., thorium-230, protactinium-231, and actinium-227) and resulting doses for the class of employees covered by this evaluation.

Although NIOSH found that it is not possible to completely reconstruct internal radiation doses for the period from January 1, 1958 through December 31, 1958, NIOSH intends to use any available internal monitoring data that may become available for an individual claim (and can be interpreted using existing NIOSH dose reconstruction processes or procedures). Dose reconstructions for individuals employed at the Mallinckrodt Chemical Co., Destrehan Street Plant in 1958, but not qualifying for inclusion in the SEC, may be performed using these data as appropriate.

6.2 Feasibility of Estimating External Exposures

This evaluation responds to a petition based on NIOSH's determination that internal radiation exposures to uranium progeny in the pitchblende raffinate (e.g., thorium-230, protactinium-231, and actinium-227) 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 of workers covered by this report.

Consistent with the HHS findings relative to the SEC-00012 class designated for the period from 1949 through 1957, NIOSH finds that the external dose monitoring information available for 1958 is adequate for the reconstruction of individual external exposures at the Mallinckrodt Chemical Co., Destrehan Street Plant for the period from January 1, 1958 through December 31, 1958. NIOSH has determined that external dose and medical X-ray dose can likely be reconstructed for the period from January 1, 1958 through December 31, 1958 using guidance and methods presented in ORAUT-TKBS-0005.

6.3 Class Parameters Associated with Infeasibility

As outlined in Section 4.3 of this report, NIOSH has concluded that handling of residues from processing of uranium ore continued into 1958. After the shutdown of residue handling operations in 1958, plant operations consisted of decontamination and decommissioning activities (for which dose reconstruction is possible) (ORAUT-TKBS-0005). NIOSH is unable to determine (using available documentation) exactly when in 1958 uranium refining operations were completed at the Mallinckrodt Chemical Co., Destrehan Street Plant (Mason, 1959). NIOSH recommends that the proposed class include all of 1958 and cover the period from January 1, 1958 through December 31, 1958.

As outlined in Section 4.4 of this report (and consistent with the analysis of the previous 1949 through 1957 SEC class documented in the SEC-00012 Evaluation Reports), the available information for 1958 regarding the receipt, transport, or storage of uranium raffinate is insufficient to allow NIOSH to define the proposed class based on work locations within the Mallinckrodt Chemical Co., Destrehan Street Plant. NIOSH recommends that the proposed class definition include all buildings during the specified time period.

As outlined in Section 4.5 of this report, Mallinckrodt Chemical Co., Destrehan Street Plant employees may have rotated through a number of different jobs. NIOSH does not have sufficient information for 1958 to distinguish the raffinate-exposed workers from the workers who never worked with raffinate. Therefore, NIOSH is unable to limit the proposed class more specifically than the class description designated by HHS for the existing 1949 through 1957 SEC class (HHS, 2005). NIOSH recommends that the proposed class include all employees who worked in the Uranium Division at the Mallinckrodt Chemical Co., Destrehan Street Plant during the specified time period.

7.0 Summary of Feasibility Findings for Petition SEC-00133

This report evaluates the feasibility for completing dose reconstructions for employees at the Mallinckrodt Chemical Co., Destrehan Street Plant from January 1, 1958 through December 31, 1958. NIOSH determined that members of this class may have received radiation exposures from uranium and uranium progeny. NIOSH lacks sufficient information, which includes biological monitoring data, sufficient air monitoring information, or sufficient process and radiological source term information, which would allow it to estimate the potential internal thorium-230, protactinium-231, and actinium-227 exposures to which the proposed class may have been exposed.

NIOSH has documented herein that it cannot complete the dose reconstruction related to this petition. The basis of this finding demonstrates that NIOSH does not have access to sufficient information to estimate either the maximum radiation dose incurred by any member of the class or to estimate such radiation doses more precisely than a maximum dose estimate.

NIOSH has determined that external dose and medical X-ray dose can be reconstructed for the period from January 1, 1958 through December 31, 1958, using guidance and methods presented in ORAUT-TKBS-0005.

Although NIOSH found that it is not possible to completely reconstruct radiation doses for the proposed class, NIOSH intends to use any available internal and external monitoring data that may

become available for an individual claim (and can be interpreted using existing NIOSH dose reconstruction processes or procedures). Therefore, dose reconstructions for individuals employed at the Mallinckrodt Chemical Co., Destrehan Street Plant in 1958, but not qualifying for inclusion in the SEC, may be performed using these data as appropriate.

8.0 Evaluation of Health Endangerment for Petition SEC-00133

The health endangerment determination for the class of employees covered by this evaluation report is governed by EEOICPA and 42 C.F.R. § 83.14(b) and § 83.13(c)(3). Pursuant to these requirements, if it is not feasible to estimate with sufficient accuracy radiation doses for members of the class, NIOSH must determine that there is a reasonable likelihood that such radiation doses may have endangered the health of members of the class. The regulations require NIOSH to assume that any duration of unprotected exposure may have endangered the health of members of a class when it has been established that the class may have been exposed to radiation during a discrete incident likely to have involved levels of exposure similarly high to those occurring during nuclear criticality incidents. If the occurrence of such an exceptionally high-level exposure has not been established, then NIOSH is required to specify that health was endangered for those workers who were employed for a number of work days aggregating at least 250 work days within the parameters established for the class or in combination with work days within the parameters established for one or more other classes of employees in the SEC.

NIOSH has determined that members of the class were not exposed to radiation during a discrete incident likely to have involved levels of exposure similarly high to those occurring during nuclear criticality incidents. However, the evidence reviewed in this evaluation indicates that some workers in the class may have accumulated chronic radiation exposures through intakes of uranium and uranium progeny and from direct exposure to radioactive materials. Consequently, NIOSH is specifying that health was endangered for those workers covered by this evaluation who were employed for a number of work days aggregating at least 250 work days within the parameters established for this class or in combination with work days within the parameters established for one or more other classes of employees in the SEC.

9.0 NIOSH-Proposed Class for Petition SEC-00133

The evaluation defines a single class of employees for which NIOSH cannot estimate radiation doses with sufficient accuracy. This class includes all employees of DOE, its predecessor agencies, and their contractors and subcontractors who worked in the Uranium Division at the Mallinckrodt Chemical Co., Destrehan Street Plant in St. Louis, Missouri, from January 1, 1958 to December 31, 1958, for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees included in the SEC.

10.0 Evaluation of Second Similar Class

In accordance with § 83.14(a), NIOSH may establish a second class of coworkers at the facility, similar to the class defined in Section 9.0, for whom NIOSH believes that dose reconstruction may not be feasible, and for whom additional research and analyses is required. If a second class is identified, it would require additional research and analyses. Such a class would be addressed in a separate SEC evaluation rather than delay consideration of the current claim. At this time, NIOSH has not identified a second similar class of employees at the Mallinckrodt Chemical Co., Destrehan Street Plant 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 22,296; May 2, 2002; SRDB Ref ID: 19391

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

42 C.F.R. pt. 83, *Procedures for Designating Classes of Employees as Members of the Special Exposure Cohort Under the Energy Employees Occupational Illness Compensation Program Act of 2000*; Final Rule; May 28, 2004; SRDB Ref ID: 22001

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

ORAUT-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*, Rev. 02; Oak Ridge Associated Universities (ORAU); June 14, 2007; SRDB Ref ID: 32277

Cooperstein, 1981, *Information on FUSRAP and Surplus Facility Sites in Missouri*, with attached excerpts; Raymond Cooperstein; November 10, 1981; SRDB Ref ID: 14384

DOE, 2008, *DOE Office of Health, Safety and Security*, EEOICPA website; <http://www.hss.energy.gov/healthsafety/fwsp/advocacy/faclist/findfacility.cfm>; last accessed on November 24, 2008

Eisenbud, 1975, *Early Occupational Exposure Experience with Uranium Processing*; Merrill Eisenbud, January 1, 1975; SRDB Ref ID: 10629

HHS, 2005, *HHS Designation of Additional Members of the Special Exposure Cohort-Designating a Class of Employees from the Uranium Division of Mallinckrodt Chemical Works*, Designation letter and attachments; The Secretary of Health and Human Services; October 14, 2005; OSA Ref ID: 102639

Mallinckrodt, 1994, *Columbium-Tantalum Plant Characterization Plan-Mallinckrodt, Inc. St. Louis, Missouri Plant*; Mallinckrodt; January 10, 1994; SRDB Ref ID: 3840

Mason, 1959, *A Summary of Fifteen Years of Experience with Dust Problems in the Refining and Fabrication of Uranium*; Mont G. Mason; September 1959; SRDB Ref ID: 15825

USACE, 2003, *Formerly Utilized Sites Remedial Action Program-St. Louis Downtown Site (SLDS)*, website; <http://www.mvs.usace.army.mil/engr/fusrap/SLDS.htm>; U.S. Army Corps of Engineers, St. Louis District; December 9, 2003; SRDB Ref ID: 12423