SEC Petition Evaluation Report
Petition SEC-00067

Report Rev # 0 Report Submittal Date 11/10/06

Subject Expert(s):	Cindy Bloom
Site Expert(s):	

Petitioner Administrative Summary			
Petition Under Evaluation			
Petition #	Petition Type	Petition A Receipt Date	DOE/AWE Facility Name
SEC-00067	83.14	September 6, 2006	Allied Chemical Corporation Plant

Proposed Class Definition
All AWE employees who were monitored, or should have been monitored, for exposure to ionizing radiation while working at the Allied Chemical Corporation Plant in Metropolis, Illinois, for a number of work days aggregating at least 250 work days from January 1, 1959 through December 31, 1976 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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Evaluation Report Summary: SEC-00067, Allied Chemical Corporation 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

The NIOSH-proposed class includes all Atomic Weapons Employer (AWE) employees who were monitored, or should have been monitored, for exposure to ionizing radiation while working at the Allied Chemical Corporation Plant in Metropolis, Illinois, for a number of work days aggregating at least 250 work days from January 1, 1959 through December 31, 1976 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 does not have access to sufficient personal monitoring data or workplace monitoring data to adequately determine the potential intake of non-uranium radionuclides; therefore, NIOSH does not have sufficient information to estimate with sufficient accuracy the internal radiation doses of the class of employees covered by this SEC evaluation.

With the data currently available to NIOSH, it appears to be feasible to reconstruct with sufficient accuracy external doses, as well as internal doses from uranium, for those Allied Chemical Corporation Plant workers who were monitored for uranium for the covered period from January 1, 1959 through December 31, 1976.

Health Endangerment Determination

The NIOSH evaluation did not identify evidence from the petitioners or from other sources that would establish the class was exposed to radiation during a discrete incident likely to have involved exceptionally high-level exposures. However, the evidence reviewed in this evaluation indicates that some workers in the class may have accumulated chronic radiation exposures through unmonitored intakes of non-uranium radionuclides. Therefore, the regulation [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-00067

1.0 Purpose and Scope

This report evaluates the feasibility of reconstructing doses for employees who worked at the Allied Chemical Corporation Plant (Allied) in Metropolis, Illinois, from January 1, 1959 through December 31, 1976. 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 provide 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 (see Section 2.0). 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 on 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 to the Advisory Board on Radiation and Worker Health (Board). The Board will consider the NIOSH evaluation report, together with the petition, comments of the petitioner(s) and such other information as the Board considers appropriate, to make recommendations to the Secretary of HHS on whether or not to add one or more classes of employees to the SEC. Once NIOSH has received and considered the advice of the Board, the Director of NIOSH will propose a decision on behalf of HHS. The Secretary of HHS will make the final decision, taking into account the NIOSH evaluation, the advice

[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 www.cdc.gov/niosh/ocas.

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

This NIOSH report summarizes the methods and findings of the NIOSH SEC evaluation for all AWE employees who worked at Allied for the period from January 1, 1959 through December 31, 1976 for a number of days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days of employment occurring within the parameters established for other classes of employees included in the SEC. During this period, employees at this facility were involved in converting uranium ore concentrates to UF_6 feed material for the gaseous diffusion enrichment process.

The evaluation responds to Petition SEC-00067, which was submitted by an EEOICPA claimant who was employed at the facility during this period as an ore preparation assistant and operator, a fluorination assistant and operator, a green salt (UF_6) operator, a distillation operator, a yard operator, and an F_2 products cylinder handler. This EEOICPA claimant's dose reconstruction could not be completed by NIOSH because of a lack of sufficient dosimetry-related information about non-uranium radionuclide components of the feed material and/or waste streams as a potential source of internal radiological exposure (i.e., lead-210, polonium-210, radium-226, actinium-227, thorium-228, thorium-230, thorium-232, and protactinium-231).[3] The NIOSH determination that it is unable to complete a dose reconstruction for a 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 Allied Chemical from January 1959 to December 1976, and the information available to NIOSH to characterize particular processes and radioactive source materials. From available sources NIOSH has gathered process and source descriptions, information regarding the identity and quantities of radionuclides of concern, and information describing the 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 Allied Chemical Corporation Plant Description

After World War II, uranium in the form of concentrates and high-grade ores was refined by companies like Allied Chemical to produce feed material for gaseous diffusion uranium enrichment for the U.S. government. The K-25 gaseous diffusion plant in Oak Ridge, Tennessee, was expanded between 1946 and 1954, and gaseous diffusion plants were built at Paducah, KY and Piketon, OH in

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

[3] The term "non-uranium radionuclides" will be used throughout this document to collectively designate lead-210, polonium-210, radium-226, actinium-227, thorium-228, thorium-230, thorium-232, and protactinium-231.

the early and mid-1950s. The Allied Chemical Corporation Plant near Metropolis, Illinois, converted uranium ore concentrates to UF_6 for feed for the Paducah Gaseous Diffusion Plant. The concentrates contained approximately 70-75% uranium and various impurities, depending on the mill circuit and the original concentrations of ore impurities (Perkins, 1982). These concentrates were converted, using the fluoride volatility process, into gaseous UF_6. This product was then sent to an enrichment facility to increase the concentration of the desirable uranium-235 isotope.

The Allied plant, located at 101 Columbia Road in Massac County, Illinois, was originally contracted in 1959 to process 5,000 tons of U_3O_8 per year. By 1982, the plant's throughput capacity had been increased to 14,000 tons of uranium per year and the facility had processed over 100,000 tons of uranium. The UF_6 production facility used a "dry" conversion process (versus a "wet" chemical solvent extraction process [Perkins, 1982]). The plant operated under an Atomic Energy Commission (AEC) contract through June 30, 1964 when it was temporarily closed; it resumed operations in February 1968. The facility is now owned by Honeywell, and still provides UF_6 to gaseous diffusion plants for use in the commercial sector. The facility currently operates under a Nuclear Regulatory Commission (NRC) license.

Allied was an Atomic Weapons Employer for the period 1959 through 1976, and was also known both as General Chemical Division and as Allied Signal Metropolis Plant.

4.2 Allied Functional Areas

Allied Chemical operations included the following functional areas:

- Receiving and Sampling: Ore concentrates were received and sampled for uranium assay and moisture content.

- Pre-treatment: Incoming uranium concentrates containing sodium, and the uranium concentrates produced by the uranium recovery activities, were pre-treated to remove sodium and potassium impurities. Pre-treatment was necessary because sodium formed a compound that caused caking and sintering in the fluorination fluid beds.

- Ore Preparation: As a first step, incoming ore and recovered uranium were dried. The materials were then blended, agglomerated, crushed, and sized before being sent to the reduction circuit.

- Reduction: The U_3O_8 was fed into the reductor vessel where it was mixed with N_2, H_2 and additional nitrogen to form a fluidized bed and then reduced to UO_2.

- Hydrofluorination: The UO_2 from the reduction process was reacted with HF to form UF_4.

- Fluorination: The UF_4 from the hydrofluorination process was fed into fluid bed reactors where, by introducing fluorine (F_2), the UF_4 was converted into gaseous UF_6. The gaseous UF_6 from the column was condensed in two cold traps operated in series. The UF_6 was transferred to UF_6 shipping cylinders by melting the UF_6 and allowing the material to drain into the cylinders. (Perkins, 1982)

- Uranium Recovery and Reprocessing: Uranium was recovered from waste material through calcining (drying) the various uranium-containing sludges derived throughout the process, grinding the material into a fine powder, leaching the material using a sodium carbonate solution to solubilize the uranium, and precipitating the uranium from the solution using NaOH.

- Cylinder Wash: Uranium was recovered from cylinders containing residual UF_6 and uranium daughters that were returned to Allied from the enrichment facilities.

Figure 4-1 (reprinted from the Allied Site Profile) describes the process of conversion from ore concentrates to uranium hexafluoride (ORAUT-TKBS-0044):

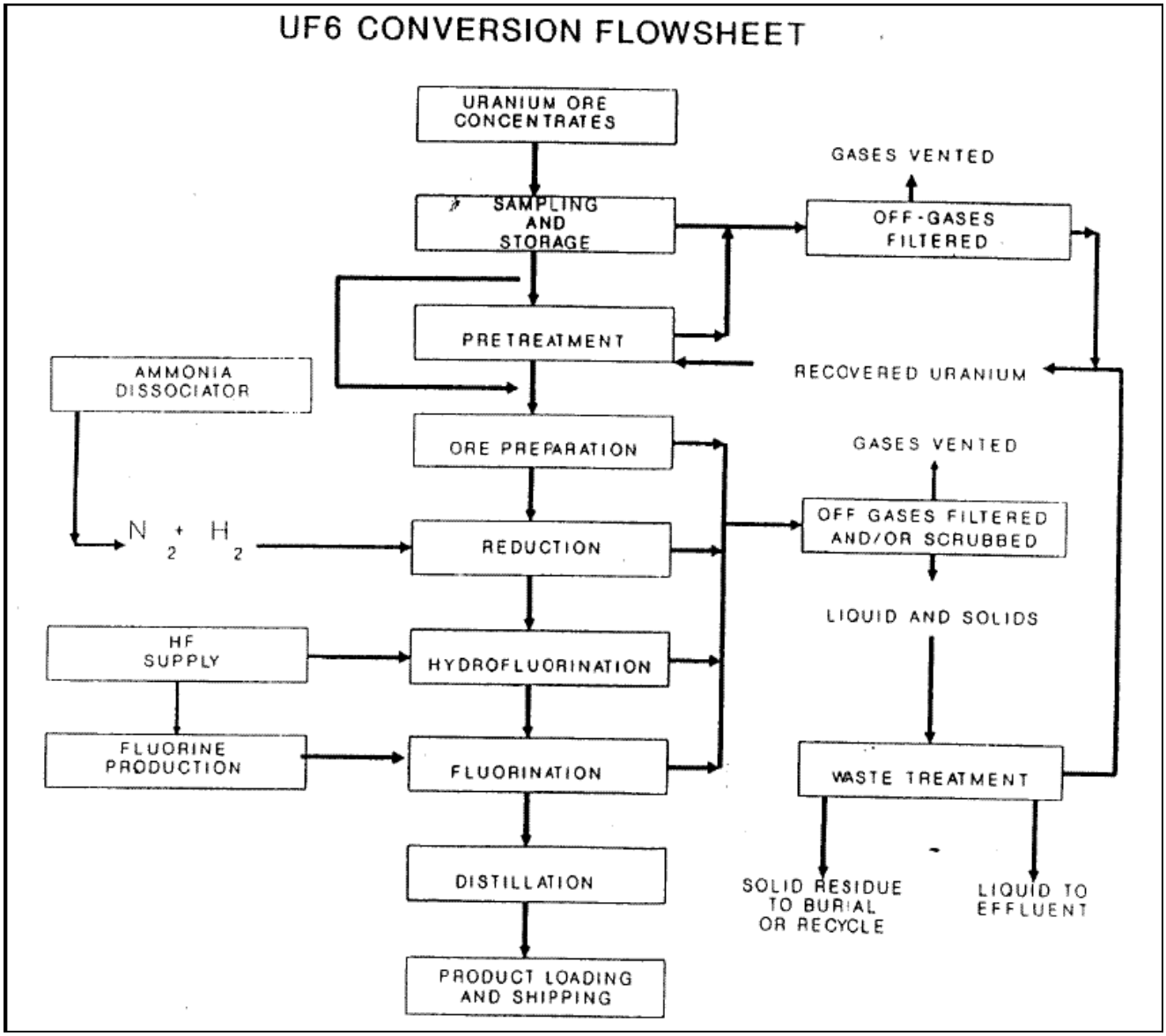

Figure 4-1: Ore to Uranium Hexafluoride Conversion Process

4.3 Radiological Exposures

Potential radiological exposures at Allied resulted from uranium ore, ore concentrates, and non-uranium radionuclide contaminants in the milled uranium ore. The forms of uranium may have included all solubility types: Type F (fast dissolution and high level of absorption to blood); Type M (intermediate rate of dissolution and level of absorption to blood); and Type S (slow dissolution rate and low level of absorption to blood). Additional radiological exposure resulted from the non-uranium contaminants assumed to have arrived with the ore concentrate. The source term activity ratios of the contaminants relative to uranium are not sufficiently understood to allow a plausible bounding estimate of the radiological exposure the contaminants contributed. The exposure scenario is further complicated by the concentration of non-uranium radionuclides (in unknown ratios) by the processes. Such concentration would have been maximal in the fluorination bed ash and other waste streams.

The feed preparation, reduction, hydrofluorination, and fluorination circuits were all located in the Feed Materials Building. Other locations having significant potential for radiological exposures were the ore sampling building, the ore storage pads, all waste handling or storage facilities, and the laboratory building.

4.3.1 External Exposures

External exposures to Allied personnel were monitored using film badges until April 1976, with results for photon and beta exposures reported. Potential photon exposures were primarily in the 30 to 250 keV energy range; potential electron exposures were above 15 keV. There was some potential for neutron exposure from alpha particle collision reactions, with neutron energies in the 0.1 to 2 MeV range.

Processing uranium concentrates results in a concentration of non-uranium radionuclides in the by-products, with the associated beta and gamma radiation fields contributing to potential external dose.

The fluorination bed ash was known to contain short-lived uranium progeny radionuclides. Because these impurities accumulate, the ash had to be withdrawn, drummed, and stored long enough to allow the uranium daughters thorium-234 and protactinium-234m to decay. This work potentially resulted in elevated beta and gamma radiation fields contributing to higher extremity doses for individuals handling the fluorination ash or decontaminating equipment used to contain or transport the bed ash (ORAUT-TKBS-0044).

4.3.2 Internal Exposures

The primary internal radiation exposure hazard at the Allied plant was radiological dust produced from processing uranium concentrates (ORAUT-TKBS-0044). During the operational period considered by this evaluation, the drums of uranium concentrates received for processing were weighed and sampled using a falling stream method. The ore preparation cycle physically blended, agglomerated, crushed, and sized the feed material. Both of these cycles potentially generated airborne dust that could have been inhaled or ingested.

The Allied facilities used engineering controls and ventilation equipment as the primary method to reduce employee or environmental radiation/radioactivity exposure. When unconfined material was to be handled, ventilation controls were relied on to reduce exposure. Building exhaust points were monitored to determine workroom air activity and environmental uranium loss.

Allied considered the following job categories to involve work in areas with significant internal exposure potential from un-encapsulated uranium processing (Bioassay, 1986):

- Ore preparation operators and assistants
- UF_4 operators and assistants
- Fluorination operators and assistants
- Distillation operators and assistants
- Decontamination employees
- Shift breakers and relief operators working in the Feed Materials process area
- Sampling plant employees
- Mechanics in the Feed Materials buildings and Sampling Plant
- Production and maintenance foremen and shift supervisors in the Feed Materials building
- Health physics technicians assigned to the Feed Materials building or Sampling Plant
- Electricians
- Instrument personnel
- Laboratory technicians

NIOSH has compiled and published a more complete summary of the information available to it regarding the exposures at Allied. This information is summarized in the Allied Site Profile document, ORAUT-TKBS-0044, and is available online from http://www.cdc.gov/niosh/ocas.

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 external exposures to the cancer site. Personal monitoring data from film badges or thermoluminescent dosimeters (TLDs) comprise 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.

5.1 Allied Internal Monitoring Data

Individual uranium urinalysis data are available from as early as December 1958. Urinalysis was done in-house and was routine at Allied. Indications are that most employees, including administrative staff and contract workers, participated in the *in vitro* bioassay program.

Allied's 1982 NRC License Renewal Application describes whole-body-counting bioassay performed to determine the lung deposition of insoluble natural uranium (Site Procedures, 1985). The earliest *in vivo* data available to NIOSH are dated December 1978, after the Allied Chemical covered period. Because any soluble material will clear from the lung compartment, these post-AEC *in vivo* data are only useful qualitatively to assure that calculated intakes based on earlier urinalysis results do not over-predict observed lung activity.

NIOSH has reviewed the available claimant data, and for the 74 Allied Chemical claim files with monitoring data, NIOSH currently has 17,949 urinalysis results and 623 *in vivo* results, none of which are non-uranium radionuclide sampling results. An Allied Chemical site policy and procedure document supports NIOSH's finding that non-uranium analysis was not performed (Bioassay, 1986). The policy document only addresses possible employee exposures to the uranium component of the uranium ore concentrates, UF_4, UO_2, UF_6, or UO_2F_2. Determination of internal exposures specific to non-uranium radionuclides, including thorium-230, thorium-232, thorium-238, radium-226, lead-210, protactinium-231, and actinium-227 did not occur within the AWE operational period (ending December 31, 1976).

5.2 Allied External Monitoring Data

The earliest available Allied external dosimetry results are dated January 1, 1959 (ORAUT-TKBS-0044). External whole body dosimetry results are available for all 74 claims examined by NIOSH, and there are indications that external monitoring data are likely available for Allied workers for the entire AWE operational period (January 1959 through December 1976).

Beginning in 1969, external dosimetry services using film badges were provided by R. S. Landauer, Jr. and Company. Prior to the Landauer records, external monitoring data are handwritten and do not include information identifying the company providing the service or the method of measurement. In mid-1976, Eberline Instrument Company began to provide TLD services to Allied Chemical (ORAUT-TKBS-0044). Landauer documentation indicates that the Landauer dosimetry reported exposures in millirem ranging from 30 KeV to 20 MeV for photons, 1.5 MeV and above for betas, and 1-10 MeV for neutrons. Any photon exposures below 10 millirem, hard beta exposures below 40 millirem, fast neutron exposures below 20 millirem, or thermal neutron exposures below 10 millirem were recorded as "M" for minimum quantity measurable. (Landauer, 1970)

Personnel working in areas where potential neutron exposure could occur were issued film badges sensitive to beta, gamma, and neutron radiation. Otherwise, personnel were issued film badges sensitive to only beta and gamma radiation. Available Allied records show that the typical badge exchange frequency was monthly.

NIOSH has found no documented Allied Chemical requirement for occupationally-required medical X-ray examinations. More than half of the claimant interviews documented by NIOSH indicate that chest X-ray examinations were routine and a significant number of such interviews indicate the frequency was annual.

5.3 Allied Workplace Monitoring Data

Summaries of results are available for daily stationary breathing zone samples collected in various uranium work areas since 1985 (ORAUT-TKBS-0044). Also as of 1985, surface-removable contamination measurements were performed routinely in selected areas, but were only counted for alpha radioactivity. These surveys appear to have been used primarily to direct clean-up efforts; only limited summaries of these data are available at this time. NIOSH has no documentation that suggests non-uranium materials were specifically identified, or monitored for, by air sampling. The limited air sampling data available for review during the development of the Site Profile indicate that concentrations were trending downward over time. The airborne concentrations were reported in units of micro-curies of uranium per milliliter (uCi/ml), but it appears there was no chemical processing of the sample filters. Indications are that the results were actually based on gross alpha counting, and therefore, would include long-lived non-uranium alpha emitters; however, NIOSH has located no documentation that would allow sufficiently accurate estimation of non-uranium activity levels (ORAUT-TKBS-0044).

Reference materials dated after the covered period indicate that surface contamination measurements were routinely performed in uranium and non-uranium areas and used as a basis for decontamination; however, NIOSH has been unable to locate applicable area survey data (ORAUT-TKBS-0044).

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 completed research to determine 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. NIOSH has further considered defining the extent of the class of employees who are similarly affected, as indicated by the completed research, and hence, as a class of employees, dose reconstruction is similarly not feasible.

In accordance with 42 C.F.R. § 83.14(a), NIOSH also considered whether or not the completed research provides a basis for evaluating an additional class at the facility for whom NIOSH may believe that dose reconstruction is unlikely to be feasible. If NIOSH were to identify such a basis, it would undertake a separate SEC evaluation regarding the additional class. This would allow NIOSH, the Board, and HHS to complete, without delay, their consideration of the class including a claimant for whom NIOSH has already determined a dose reconstruction cannot be completed, and whose only possible remedy under EEOICPA would be through adding 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

Participation in uranium bioassay monitoring programs by Allied employees was widespread from the start of AEC operations and there appears to be sufficient information to assess their uranium intakes and resulting internal dose from uranium. However, as discussed in Section 4.3, the potential for the presence of thorium, radium, and other non-uranium radionuclides existed at Allied in all radiological areas. A review of the available documentation indicates that analysis of *in vitro* bioassay samples for non-uranium radionuclides was not performed at Allied, and that non-uranium *in vitro* bioassay data are unavailable. As discussed in Section 5.1, the available *in vivo* data were all collected after the Allied covered period and cannot be used to bound the total intakes that may have occurred during the AWE operational period. Due to the lack of non-uranium bioassay data, NIOSH concludes that the available bioassay data do not provide the information necessary to adequately assess non-uranium intakes at the Allied facility.

Health physics reports for later years indicate a continuous reduction in air concentrations over time. This apparent reduction in workplace airborne contamination levels is supported by an overall downward trend in bioassay results. These downward trends indicate that the available airborne monitoring results for periods after the Allied covered period are not representative of the airborne levels that would have existed during AEC work, when air monitoring results are unavailable. The currently-available air monitoring data, therefore, are insufficient for bounding the air concentrations during the Allied AEC operational period. NIOSH has not located sufficient Allied operational area air sampling data to support sufficiently accurate dose reconstruction for the covered period.

Specific source term information regarding the chemical forms and/or solubility of the non-uranium radionuclide components of the ore concentrates or of the by-product sludges is not available. The absorption type of these radionuclides is not necessarily related to the absorption type of the associated uranium; therefore, NIOSH has no basis for determining the actual absorption type for the non-uranium radionuclides. In the absence of specific information, attempts were made by NIOSH to apply conservative assumptions regarding absorption type and activity levels of non-uranium radionuclides. Uranium intakes were estimated using available uranium bioassay results. The intake rates for non-uranium radionuclides were then estimated by assuming conservative ratios relative to uranium (ORAUT-TKBS-0044). These conservative exposure models resulted in unreasonably high estimates of non-uranium radiation dose. Attempts by NIOSH to refine the models also failed to result in reasonable estimates of radiation dose, as required by 42 C.F.R. pt. 82.

Some limited documentation is currently available to match radiological workers to specific locations; however, many of these workers were likely assigned to multiple locations. This is confirmed by a 1996 statement in an Allied Chemical/Honeywell current procedures document (Honeywell, 1996):

> "*…Due to the mobility of the workforce, and the large variety of ore concentrate blends processed, it would be an extremely difficult task to track individual exposure for each uranium compound to which employees might be exposed.*"

Using job titles or job descriptions to determine which employees might have been exposed to radioactive materials would not be accurate for internal dose reconstruction given the available data and the documented worker mobility; thus, the proposed class cannot be defined by job title or description.

Non-uranium radiological materials were potentially handled or stored in the Feed Materials building, the Sampling Plant, the Sodium Removal and Uranium Recovery facilities, the KOH Muds Washing facility, the Calcining facility, the Pond Mud Calciner Drier, the Laboratory building, the Cylinder Wash building, the storage facilities, and the outdoor drum storage pads. However, documentation of the site activities, especially the storage and transport of radiological materials across the site, is insufficient to limit the exposure scenario to these listed locations. Consequently, the proposed class cannot be defined by work location.

With the data currently available to NIOSH, it is not possible to reconstruct with sufficient accuracy the non-uranium dose, and therefore the total internal dose, that would have resulted during the Allied Chemical Corporation Plant AWE covered period, 1959 through 1976. It appears to be feasible, however, to reconstruct with sufficient accuracy internal doses from uranium for those workers who were monitored for uranium.

6.2 Feasibility of Estimating External Exposures

This evaluation responds to a petition based on NIOSH determining that internal radiation exposures to non-uranium radionuclides could not be reconstructed for a dose reconstruction referred to NIOSH by the Department of Labor. 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 evaluate the feasibility of reconstructing external radiation exposures in this case.

However, based on the research conducted for this evaluation, NIOSH concludes that it is likely able to estimate external exposure to electrons and photons for employees in this class. In addition, it is likely that NIOSH could estimate neutron doses using the document, *Estimation of Neutron Dose Rates from Alpha-Neutron Reactions in Uranium and Thorium Compounds* (ORAUT-OTIB-0024). Available records indicate that Allied workers were monitored for external whole-body exposures. NIOSH considers adequate reconstruction of external dose possible by using individual dosimetry records, claimant-favorable assumptions, and the relevant protocols specified in various complex-wide Technical Information Bulletins (TIBs).

In addition, NIOSH considers adequate reconstruction of medical dose for Allied workers feasible by applying pertinent claimant-favorable assumptions and protocols specified in the complex-wide technical information bulletin ORAUT-OTIB-0006, *Technical Information Bulletin: Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures*.

7.0 Summary of Feasibility Findings for Petition SEC-00067

This report evaluates the feasibility for estimating the dose, with sufficient accuracy, for all AWE employees at Allied Chemical Corporation Plant from January 1, 1959 through December 31, 1976. NIOSH determined that it lacks sufficient bioassay, source term, and workplace monitoring data for non-uranium radionuclides to reconstruct the total potential internal exposures at the facility during this time period. Consequently, NIOSH finds that it is not feasible to estimate with sufficient accuracy the radiation doses resulting from non-uranium internal exposures received by members of this class of employees.

With the data currently available to NIOSH, as presented in the Site Profile (ORAUT-TKBS-0044), it appears feasible to reconstruct with sufficient accuracy the external doses, and the internal doses from uranium for those workers who were monitored for uranium, that would have resulted during the Allied Chemical Corporation Plant AWE operational period (January 1, 1959 through December 31, 1976).

NIOSH has documented herein that it cannot complete the dose reconstructions 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 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 Allied Chemical Corporation Plant may have received unmonitored internal radiological exposures from non-uranium radionuclides at the plant. NIOSH lacks sufficient information, which includes sufficient non-uranium source term and chemical solubility information, that would allow it to estimate the potential total internal exposures to which the proposed class may have been exposed.

8.0 Evaluation of Health Endangerment for Petition SEC-00067

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 unmonitored intakes of non-uranium radionuclides. 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-00067

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 ionizing radiation while working at the Allied Chemical Corporation Plant in Metropolis, Illinois, for a number of work days aggregating at least 250 work days from January 1, 1959 through December 31, 1976 or in combination with work days within the parameters established for one or more other classes of employees in the SEC.

10.0 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

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