# SEC Petition Evaluation Report
# Petition SEC-00098

Report Rev #: 0 Report Submittal Date: May 14, 2008

| | |
|---|---|
| Subject Expert(s): | Lara Hughes |
| Site Expert(s): | None |

| Petitioner Administrative Summary | | | |
|---|---|---|---|
| **Petition Under Evaluation** | | | |
| Petition # | Petition Type | Petition A Receipt Date | DOE/AWE Facility Name |
| SEC-00098 | 83.14 | September 20, 2007 | Y-12 Plant |

**Proposed Class Definition**

Employees of the Department of Energy (DOE), its predecessor agencies, and DOE contractors or subcontractors who worked at the Y-12 facility in Oak Ridge, Tennessee during the period from March 1, 1943 through December 31, 1947 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 in the Special Exposure Cohort (SEC).

| Related Petition Summary Information | | | |
|---|---|---|---|
| SEC Petition Tracking #(s) | Petition Type | DOE/AWE Facility Name | Petition Status |
| SEC-00018 | 83.13 | Y-12 Plant | Evaluation completed |
| SEC-00026 | 83.13 | Y-12 Plant | Evaluation completed |
| SEC-00028 | 83.13 | Y-12 Plant | Evaluation completed |

| Related Evaluation Report Information | |
|---|---|
| Report Title | DOE/AWE Facility Name |
| SEC Petition Evaluation Report SEC-00018 | Y-12 Plant |
| SEC Petition Evaluation Report SEC-00028 | Y-12 Plant |

| | | |
|---|---|---|
| **OCAS Lead Technical Evaluator:** | [Signature on file] | 5/14/2008 |
| | *Lara Hughes* | Date |

| | | |
|---|---|---|
| **Peer Review Completed By:** | [Signature on file] | 5/14/2008 |
| | *LaVon B. Rutherford* | Date |
| **SEC Petition Evaluation Reviewed By:** | [Signature on file] | 5/14/2008 |
| | *J. W. Neton* | Date |
| **SEC Evaluation Approved By:** | [Signature on file] | 6/06/2008 |
| | *Larry J. Elliott* | Date |

This page intentionally left blank

# Evaluation Report Summary: SEC-00098, Y-12 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 DOE employees, DOE contractors, or subcontractors, who worked at the Y-12 facility in Oak Ridge, Tennessee during the period from March 1, 1943 through December 31, 1947 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 in the Special Exposure Cohort (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 adequate and reliable personal monitoring data, workplace monitoring data, and source term descriptions, making the reconstruction of internal doses infeasible.

Health Endangerment Determination

The NIOSH evaluation did not identify evidence supplied by 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, 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 radionuclides 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.

This page intentionally left blank

# Table of Contents

This page intentionally left blank

# SEC Petition Evaluation Report for SEC-00098

## 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 OCAS Team Lead Technical Evaluator: Lara Hughes. 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 a specific facility during a specified time. It provides information and analysis germane to considering a petition for adding a class of employees to the Congressionally-created SEC.

NIOSH previously evaluated (in evaluation report SEC-00018) the feasibility of performing dose reconstruction for workers at Y-12 who were employed from March 1943 through December 1947.[1] In that report, NIOSH concluded that it was not feasible to estimate radiation doses with sufficient accuracy for workers who worked in uranium enrichment operations and other radiological activities at the Y-12 site. The Advisory Board on Radiation and Worker Health (the Board) and the Secretary of Health and Human Services concurred with NIOSH's determination; therefore the recommended class was added to the SEC on September 24, 2005. After the effective date, and during the Department of Labor's (DOL) initial phase of administering the class, DOL identified difficulties in administering the class as NIOSH had intended. The class evaluation in this report is intended to clarify that previous class definition for workers at the Y-12 site from March 1943 to December 1947.

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 the 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

[1] The NIOSH recommended class for SEC-00018 is defined: All DOE, DOE contractors, or subcontractors, or AWE employees who worked in uranium enrichment operations or other radiological activities at the Y-12 facility in Oak Ridge, Tennessee from March, 1943 through December, 1947.

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.[2]

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 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.[3]

## 3.0 NIOSH-Proposed Class Definition and Petition Basis

The NIOSH-proposed class includes all DOE employees, DOE contractors, or subcontractors, who worked at the Y-12 facility in Oak Ridge, Tennessee for the period from March 1, 1943 through December 31, 1947 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 (excluding aggregate work day requirements) established for other classes of employees included in the SEC. During this period, employees at this facility were involved with various processes either directly related to or in support of the calutron operations for uranium enrichment or other smaller-scale radiological processes.

The evaluation responds to Petition SEC-00098, 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 Y-12 as a Laboratory Analyst from January 19, 1944 through August 22, 1946. NIOSH's determination that it is unable to complete a dose reconstruction for an EEOICPA claimant is a qualified basis for submitting an SEC petition pursuant to 42 C.F.R. § 83.9(b).

## 4.0 Radiological Operations Relevant to the Proposed Class

The following subsections summarize the radiological operations at the Y-12 facility from March 1, 1943 to December 31, 1947 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

[2] 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.
[3] 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.

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

The principal source of information for this section is the *Technical Basis Document for the Y-12 National Security Complex – Site Description*, ORAUT-TKBS-0014-2.

With the completion of the Pilot Plant (Building 9731) in March 1943, Y-12 (operated at the time by Tennessee Eastman Company (TEC)) began enriching uranium. Y-12 had the specific mission of separating the fissionable isotope uranium-235 from uranium feedstock, using an electromagnetic separation process in a device called a calutron (*Cali*fornia *U*niversity Cyclo*tron*). Due to atomic weapons development, there was a need for rapid production of enriched uranium, which in turn led to a large increase in both the number and the efficiency of operational calutrons. Major components necessary for the efficient operation of the calutron were magnets and associated power supplies; high voltage triodes for current control; special high voltage supplies; high current X-ray cables; and large vacuum systems to keep the calutrons under negative pressure. Between 1943 and 1947 the Y-12 plant employed over 50,000 workers, with a peak of 22,000 workers employed at a single time in mid-1945.

Inside the calutrons, during the electromagnetic separation process, atoms from the uranium source (contained in a charge bottle) were ionized and accelerated to a given electrical potential. When the ions entered the magnetic field, their velocity became a function of their mass and charge, which made it possible to collect the uranium isotopes separately. Only 4% to 20% of the uranium in the source actually reached the collectors; the rest either remained in the source or coated the inside of the calutron. Labor-intensive cleaning was necessary to remove the uranium residue from the calutrons. There were two calutron stages; the first being the alpha stage, which produced a slightly enriched product of about 10% to 30%. Next, the product was further enriched in the second (beta) stage until a sufficient enrichment factor was reached (up to 95%). At the time of peak production, there were 1,152 calutrons at Y-12. After 1945, the alpha calutron stage was replaced by the gaseous diffusion process from the K-25 plant, which then produced the feed material for the beta stage. After 1947, the calutrons were no longer used for uranium enrichment.

Other processes related to calutron operations included production of feed material, salvaging and recycling of the residual uranium, and conversion of enriched material into the final product. The feed material for the calutron was in the form of volatile uranium tetrachloride, which had to be produced from natural quality uranium trioxide using a chemical process involving either liquid- or vapor-phase chlorination with carbon tetrachloride. The uranium recycling process consisted of removal of the various chemical forms of uranium from the interior components of the calutron. The reclaimed uranium was mainly in form of uranyl nitrate – nitric acid solution, which to be reused had to be converted back to uranium trioxide and then to uranium tetrachloride. The highly enriched uranium from the beta stage was converted to $UF_4$ (green salt) for shipment, using reduction and hydrofluorination with anhydrous hydrogen fluoride.

Scientists at Y-12 performed a variety of other radiological activities at Y-12, which were related to the developmental nature of the uranium enrichment process. Examples of some of those activities consisted of:

- The development and distribution of beneficial radioactive isotopes for use in research and medicine;
- The development of a battery-operated neutron monitor;
- The maintenance and use of a large $^{226}Ra$ source for radiographic examinations;
- Analysis of samples of enriched isotopes of iron, chromium and lithium;
- A study of the relative behavior of thorium and uranium in ether extractions; and
- The development of a rapid procedure for the separation of trace amounts of thorium from large amounts of uranium.

## 4.2 Radiation Exposure Potential from Operations

NIOSH has determined that the potential for external radiation dose existed for all Y-12 employees who were present at the site due to operations related to uranium enrichments and other radiological activities whose extent and exposure potential are not well-known. Gamma and X-rays, as well as beta radiation from uranium processing and the calutron operations, were a major source of external exposure. The primary radiation hazard for the calutron operator, who was typically located on a stool in front of the control panel, was the X-rays generated by the high-voltage equipment. Specific X-ray exposures resulted from the rectifier tubes in the cubicles of the alpha and beta calutrons. In 1944, lead glass was installed to reduce the number of X-rays entering the cubicles through the ports. Workers involved with the chemical conversion of the uranium oxide materials into uranium tetrachloride, the recovery of residues from the calutrons and the processing of the final product into other chemical forms received external exposures to gamma radiation as well as some exposure to beta radiation from ingrowth of uranium progeny. The neutron exposure potential was relatively small, but there was a chance of workers being exposed to indirect neutrons as a result of ($\alpha$.n) reactions from highly enriched uranium or directly from neutron sources that were present at the site. Also, Y-12 was using neutron generating devices to calibrate instruments, particle accelerators and conduct fissile material testing onsite, which would have contributed to neutron exposures.

All workers employed at the Y-12 plant also had a potential for internal radiation exposure as a result of uranium enrichment and other radiological operations performed at the site. The primary source of internal radiation exposure at Y-12 was airborne uranium particles produced during the handling and preparation of feed materials for the calutrons, and uranium recovery, recycling, and salvage operations. Uranium-bearing compounds at the Y-12 facility during the covered time period included (but were not limited to) (ORAUT-TKBS-0014-2):

- Uranium oxide ($U_3O_8$)
- Uranium dioxide ($UO_2$)
- Uranium trioxide ($UO_3$)
- Uranium hexafluoride ($UF_6$)
- Ammonium diuranate [$(NH_4)_2U_2O_7$]
- Uranyl nitrate [$UO_2(NO_3)_2$]
- Uranium peroxide ($UO_4 \cdot 2H_2O$)
- Uranium tetrachloride ($UCl_4$)
- Uranium pentachloride ($UCl_5$)
- Uranium tetrafluoride ($UF_4$)

Uranium-235 and uranium-238 isotopes are primarily alpha-emitters; uranium-235 also emits a gamma ray at 185 keV (54 % emission fraction). The short-lived uranium-238 progeny (thorium-234, protactinium-234m, and protactinium-234) are beta- and photon-emitters.

Sources indicate (Clinton Engineer Works, unknown date) that particularly high exposures to uranium tetrachloride occurred during the chemistry operations required during bottle filling for the alpha and beta calutrons. High exposures to uranium oxides (via dust inhalation) occurred during uranium tetrachloride production and during the recovery of uranium salts from the calutrons. Since the calutrons were closed systems and were operated under a high vacuum, there was little potential for inhalation exposure to the calutron operator during normal operation. Other radiological operations such as thorium extraction could have resulted in internal exposures as well, even though most of these operations were conducted on a smaller scale than the calutron operations.

### 4.3 Time Period Associated with Radiological Operations

The timer period evaluated in this report covers the first era of the Y-12 plant operations, during which uranium enrichment was the main mission of the facility. The Y-12 Site Profile indicates that uranium processing, including initial testing and training operations, began when the Pilot Plant was completed in March 1943. Electromagnetic uranium enrichment at Y-12 ended in 1947 after the calutrons were no longer used to support uranium enrichment. Recovery, reclamation and salvage of residual uranium started in 1944 and continued until 1951 (ORAUT-TKBS-0014-2). In 1947, a different contractor (the Carbide and Carbon Chemicals Company (C&CCC)) took over the management at Y-12, and the plant mission changed from uranium enrichment to the processing and fabrication of uranium and other nuclear materials.

### 4.4 Site Locations Associated with Radiological Operations

The Y-12 facility is comprised of many different buildings where many different (often experimental) activities occurred. NIOSH does not have access to information from the proposed class period to clearly define which buildings supported radiological activities. Without such information, NIOSH is unable to determine that any specific group of workers was not potentially exposed to radioactive materials or contamination resulting from site operations. Consequently, the entire Y-12 site is included in the proposed SEC class.

### 4.5 Job Descriptions Affected by Radiological Operations

Y-12 workers were potentially exposed to radiation in areas around the calutrons where uranium was processed (received, analyzed, converted, recycled, and/or purified) and in other areas were radiological operations took place. NIOSH has determined that all workers on the site, independent of job description, had the potential to be exposed to radiation and that job titles are insufficient to determine whether or not a worker was involved in radiological operations.

## 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) 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.

Personal monitoring data are available through DOE for monitored individuals who worked at the Y-12 site, albeit with a very limited amount of data available for the period under evaluation. Documents with information specific to the Y-12 site have been acquired through NIOSH data capture visits to the site. All site-specific documents identified from these data capture efforts are available in NIOSH's Site Research Data Base (SRDB).

## 5.1 Internal Personnel Monitoring Data

Personal internal monitoring data for the pre-1948 period are available in the form of a very limited number of fluorometric analyses of uranium in urine. The limited data appear to be a result of special urinalysis for workers suspected of having potential intakes, such as recovery and salvage operations workers (Author unknown, 1945 or 1946). The urinalysis program was initiated in 1944, and about 150 individual urinalysis results are available for 1945. NIOSH has determined that the available internal monitoring data are too limited in amount and scope to support internal dose reconstruction for Y-12 employees prior to 1948 (ORAUT-TKBS-0014-5).

## 5.2 External Personnel Monitoring Data

NIOSH has not located any external monitoring data for Y-12 employees working during the time period evaluated in this report (ORAUT-TKBS-0014-6).

## 5.3 Workplace Monitoring Data

For the operating period from March 1, 1943 through December 31, 1947, area monitoring techniques were used as the primary measure of radiation exposure control at Y-12. The available area monitoring data include condenser R-chamber results measuring the external penetrating radiation adjacent to the control cubicles in the calutron buildings, and about 900 records of area air monitoring results on radioactive dust concentrations from the various processes related to uranium enrichment.

Radiation was generated by the rectifier units within the high-voltage circuitry of the calutrons. Y-12 began measuring the X-ray exposures to calutron operators in August 1943. Generally, the measurements were only taken sporadically during development of the calutrons; however, the process of taking the measurements itself indicates awareness of a potential radiation hazard. Measurements resulting from the use of a condenser R-chamber indicate that although the variations in exposures adjacent to the calutron cubicles corresponded to the variations in the rectifier tubes, generally the operators in front of the cubicle were not exposed to more than the tolerance level of 0.1 R/d. NIOSH does not know when engineering controls were initiated, but most of the monitoring took place in spring 1944, when different types of glass shielding were being evaluated for use in protecting the calutron operators. Sometime before 1944, lead glass was installed in the calutron operator area, which resulted in the reported measured exposure levels being "negligible" (Various authors, 1943-1944; Bale, 1944). Lead glass was also installed at the viewing ports, which are the points where the worker could receive the most exposure.

A formal air dust monitoring program was not established until 1945, but some dust concentration measurements were taken in April 1944 at select locations. Initial sample collection was accomplished using a "polaragraph," and later an ionization chamber. The formal air dust monitoring program attempted to systematically monitor all production buildings. General area air samplers were installed in different sections of each building at locations where personnel would be spending the majority of their time; some of the samplers were used to target specific operations. NIOSH has no indication that any of the air sampling data were measuring breathing zone exposures. Also, information regarding the sampling frequency is not available. The available air sampling data are consistent with a 2001 report by ORAU (Watson, 2001), which indicated that Y-12 workers had a high internal uranium exposure potential during the time period from 1943 through 1947. Some workers, such as the calutron operators, had very little exposure to airborne uranium because the calutrons were operated under a vacuum. However, other operations, such as the calutron cleaning and uranium recycling operations, resulted in air concentrations of several hundred and several thousand percent above the calculated maximum allowable air concentration. NIOSH was unable to locate any air monitoring data for any of the other radiological processes at Y-12 during the covered period evaluated in this report.

### 5.4 Radiological Source Term Data

NIOSH does not have documentation that will provide a comprehensive summary of the total quantities of uranium and other radionuclides stored or used at the Y-12 site. However, ORAUT-TKBS-0014-2 indicates that over 50,000 kg of uranium tetrachloride was processed in the calutrons during the time period covered in this evaluation. NIOSH has been unable to obtain any detailed documentation that would allow a source term determination for any of the other radiological activities and their associated occupational exposures.

## 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 the basis of which 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

As indicated in Section 5, NIOSH does not have access to sufficient uranium urinalysis records to estimate internal exposures for the March 1943 through December 1947 time period. Also, NIOSH does not have records relating to other *in vitro* (fecal, nasal, sputum, etc.) or *in vivo* (whole-body, lung or other organ count) analyses for the period evaluated in this report. Available air sampling data are not suitable for an accurate estimate of intake scenarios.

Urine sampling as a measure to control for internal exposure for personnel did not become a routine practice until 1948 (Souleyrette, 2003). Special urine and blood analyses for uranium were implemented by TEC in late 1944 for groups of workers who were suspected to have high exposure potentials such as recovery and salvage department workers (Author unknown, 1945 or 1946). Urine samples were analyzed for uranium using a fluorometric method. The extent and frequency of the sampling program remains unknown since not all relevant data could be retrieved during data capture efforts, and it is therefore unknown if the available data represent high, low or average concentrations to which a worker could have been exposed. Although routine urine analyses are available for later periods at Y-12, the calutron period is a unique operation and cannot be compared to any of the processes used in the later periods; recovering uranium from the inside of the calutrons required significant manual work. Thus, NIOSH has determined that the use of bioassay data from later years (beyond the time period evaluated in this report) would not be representative of earlier exposure levels, when the calutrons were in operation.

As mentioned previously in Section 5.0, there are approximately 900 general air sampling records available. However, the sampling strategy and frequencies are unknown and it is not possible to determine whether the data represent high, low, or average concentrations to which a worker could have been exposed. The calutrons were unique among the uranium production processes. The

continuous improvements in process efficiency resulted in a substantial amount of time for activities such as disassembly, product recovery, and general maintenance; all of these activities would have resulted in substantial exposure potential for workers at the Y-12 facility, as indicated by the air sampling data. Furthermore, it is not possible for NIOSH to determine whether personnel who had a low exposure potential while operating the calutrons or doing other support operations also may have supported the recycling and recovery operations, which involved very high uranium dust exposures. Some available documentation suggests that some calutrons continued to operate while recycling and cleaning activities were going on at other calutrons, indicating that there was a high exposure potential to the calutron operators as well as to all other personnel in the area. The absence of breathing zone data makes it impossible for NIOSH to establish maximum exposure scenarios. Also, surrogate data from later years at Y-12 cannot be used because of the uniqueness of the calutron operations during the 1943 through 1947 time period.

NIOSH cannot establish maximum exposure scenarios based on process data or source term data because of the high variability and lack of documentation regarding the source material levels of enrichment and the production rate of the operations. The calutron operations and related support activities, such as the recycling and cleaning processes, are not comparable to any other operations for which NIOSH has access to adequate monitoring data. In addition, NIOSH has no air monitoring data, source term, or process information associated with the other radiological activities at Y-12. Consequently, NIOSH is unable to estimate internal exposures based on the data available.

Although NIOSH has concluded that there are inadequate data to permit sufficiently accurate reconstruction of internal doses at Y-12, NIOSH intends to use any available internal monitoring data that may be available for an individual claim (and can be interpreted using existing NIOSH dose reconstruction processes or procedures) to support partial internal dose reconstructions for claimants not qualifying for inclusion in the SEC.

## 6.2 Feasibility of Estimating External Exposures

This evaluation responds to a petition based on NIOSH determining that internal radiation exposures to uranium isotopes could not be reconstructed for a dose reconstruction referred to NIOSH by the Department of Labor (DOL). As noted above, HHS considers this determination 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. Consequently, it is not necessary for NIOSH to evaluate the feasibility of reconstructing external radiation exposures for the class covered by this report.

NIOSH has determined that external exposures directly associated with the calutron uranium enrichment processes can be estimated through a combination of available dose rate data, measured dose rates from similar material, and source term information.

NIOSH has information that other radiological activities were taking place at Y-12 during the period evaluated in this report. NIOSH has no external monitoring data, source term or process information associated with these activities. Therefore NIOSH cannot estimate a maximum external exposure scenario for these activities.

NIOSH considers it feasible to adequately reconstruct the occupational medical dose for Y-12 workers for the covered period. Although no exposure data are available for the medical X-rays performed during this time, surrogate data were used to develop an exposure matrix for the Y-12 Site Profile (ORAUT-TKBS-0014-3).

## 7.0 Summary of Feasibility Findings for Petition SEC-00098

This report evaluated the feasibility for estimating the dose, with sufficient accuracy, for all DOE employees, DOE contractors, or subcontractors who worked at the Y-12 facility in Oak Ridge, Tennessee from March 1, 1943 through December 31, 1947. NIOSH determined that it lacks the internal dosimetry data necessary to reconstruct the internal exposures from uranium enrichment and other radiological activities. In addition, NIOSH lacks external dosimetry or source term information regarding the external exposures resulting from other radiological activities 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 internal and external radiation exposures received by members of this class of employees.

Although the main mission of the Y-12 site during the period evaluated in this report was the electromagnetic enrichment of uranium in the calutrons, it also included a range of other smaller-scale radiological operations. Since exposure potential at the site may not have been limited to only specific buildings or groups of workers, NIOSH recommends that the class definition include all employees who worked at the site during the specified time period.

While NIOSH is unable to estimate the potential internal exposures, NIOSH concludes that adequate reconstruction of external doses for workers directly involved with the calutron uranium enrichment, and the occupational medical dose for all workers, is feasible (ORAUT-TKBS-0014-3).

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

Members of this class at the Y-12 facility may have received internal exposures from inhalation and ingestion of uranium and other radionuclides used at the site. NIOSH lacks sufficient information, which includes bioassay results, workplace monitoring data, or sufficient process and radiological source information, that would allow it to estimate the potential internal exposure to which the proposed class may have been exposed.

## 8.0 Evaluation of Health Endangerment for Petition SEC-00098

The health endangerment determination for the class of employees covered by this evaluation report is governed by EEOICPA and 42 C.F.R. § 83.14(c) and § 83.13(c)(3). Pursuant to these requirements, if it is not feasible to estimate with sufficient accuracy radiation doses for members of the class, NIOSH

must determine that there is a reasonable likelihood that such radiation doses may have endangered the health of members of the class. The regulations require NIOSH to assume that any duration of unprotected exposure may have endangered the health of members of a class when it has been established that the class may have been exposed to radiation during a discrete incident likely to have involved levels of exposure similarly high to those occurring during nuclear criticality incidents. If the occurrence of such an exceptionally high-level exposure has not been established, then NIOSH is required to specify that health was endangered for those workers who were employed for a number of work days aggregating at least 250 work days within the parameters established for the class or in combination with work days within the parameters established for one or more other classes of employees in the SEC.

NIOSH has determined that members of the class were not exposed to radiation during a discrete incident likely to have involved levels of exposure similarly high to those occurring during nuclear criticality incidents. However, the evidence reviewed in this evaluation indicates that some workers in the class may have accumulated chronic radiation exposures through intakes of radionuclides and from direct exposures 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-00098

The evaluation defines a single class of employees for which NIOSH cannot estimate radiation doses with sufficient accuracy. This class includes all DOE employees, DOE contractors, or subcontractors, who worked at the Y-12 facility in Oak Ridge, Tennessee during the period from March 1, 1943 through December 31, 1947 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 in the Special Exposure Cohort (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 are 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, to avoid delaying consideration of the current claim. At this time, NIOSH has not identified a second similar class of employees at the Y-12 facility for the March 1, 1943 through December 31, 1947 time period for whom dose reconstruction may not be feasible other than the one already established in SEC-00018.

# 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-0014-2, *Technical Basis Document for the Y-12 National Security Complex – Site Description,* Rev. 01 PC-2; Oak Ridge Associated Universities (ORAU); Oak Ridge, Tennessee; October 25, 2006; SRDB Ref ID: 30038

ORAUT-TKBS-0014-3, *Technical Basis Document for the Y-12 National Security Complex – Occupational Medical Dose*, Rev. 00 PC-3; Oak Ridge Associated Universities (ORAU); Oak Ridge, Tennessee; April 18, 2006; SRDB Ref ID: 30040

ORAUT-TKBS-0014-5, *Technical Basis Document for the Y-12 National Security Complex – Occupational Internal Dose*, Rev. 02 PC-1; Oak Ridge Associated Universities (ORAU); Oak Ridge, Tennessee; October 10, 2006; SRDB Ref ID: 30047

ORAUT-TKBS-0014-6, *Technical Basis Document for the Y-12 National Security Complex – Occupational External Dosimetry,* Rev. 00 PC-3; Oak Ridge Associated Universities (ORAU); Oak Ridge, Tennessee; May 11, 2006; SRDB Ref ID: 30048

Author unknown, 1945 or 1946, *Tuballoy in Urine, Developments since April 1945*, note regarding urine bioassay program at Y-12 during TEC period. SRDB Ref ID: 31238.

Bale, 1944, *Radiation Measurements in Y-12 Area of Clinton Engineering Works, 26 and 27 January 1944*; William F. Bale; February 9, 1944; SRDB Ref ID: 14145

Clinton Engineer Works, unknown date, *Number of Over Exposures to Hazards Noted in Chart B*; Clinton Engineer Works; unknown date; SRDB Ref ID: 8652

Souleyrette, 2003, *Summary of Historical Monitoring Techniques Provided to NIOSH for EEOICPA Data Requests*, Revision 0; M. L. Souleyrette, Y-12 National Security Complex; February 18, 2003; SRDB Ref ID: 8586

Various authors, 1943-1944, *Miscellaneous memos discussing X-ray measurements in calutron cubicles*, August 11, 1943 through May 11, Brosemer, R.O., Conklin, F. R., England, W.B., Hall, H. L., Hull, V. C., Marks, L. W., Schmidt, A., Sterner, J. H.; SRDB Ref ID: 17359

Watson, 2001, *Radiation Dosimetry Information Resource Evaluation*; Evelyn E. Watson and W. G. Tankersley, Oak Ridge Associated Universities; October 31, 2001; SRDB Ref ID: 31324