

SEC Petition Evaluation Report Petition SEC-00080

Report Rev #:0

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Petition Administrative Summary			
Petition Under Evaluation			
Petition #	Petition Type	Petition B Qualification Date	DOE/AWE Facility Name
SEC-00080	83.13	May 7, 2007	NUMEC Apollo

Petitioner Class Definition
<i>All employees in all locations at the Nuclear Materials and Equipment Corporation (NUMEC) facility located in Apollo, Pennsylvania, from 1957 through 1983.</i>

Proposed Class Definition
All Atomic Weapons Employer (AWE) employees who were monitored, or should have been monitored, for exposure to ionizing radiation while working at the NUMEC Plant in Apollo, Pennsylvania for a number of work days aggregating at least 250 work days from January 1, 1957 through December 31, 1983, or in combination with the work days within the parameters established for one or more other classes of employees in the Special Exposure Cohort.

Related Petition Summary Information			
SEC Petition Tracking #(s)	Petition Type	DOE/AWE Facility Name	Petition Status
SEC00047	83.13	NUMEC-Apollo	Merged with SEC00080

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

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Evaluation Report Summary: SEC-00080, NUMEC Apollo

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) as defined by 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*.

Petitioner-Requested Class Definition

Petition SEC-00080 qualified on May 7, 2007, requested that NIOSH consider the following class: *All employees in all locations at the Nuclear Materials and Equipment Corporation (NUMEC) facility located in Apollo, Pennsylvania, from 1957 through 1983.*

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 NUMEC Plant in Apollo, Pennsylvania for a number of work days aggregating at least 250 work days from January 1, 1957 through December 31, 1983, or in combination with the work days within the parameters established for one or more other classes of employees in the Special Exposure Cohort.

Feasibility of Dose Reconstruction

Pursuant to EEOICPA and 42 C.F.R. § 83.13(c)(1), NIOSH has established that it does not have access to sufficient information to (1) estimate the maximum radiation dose incurred by any member of the class; or (2) estimate radiation doses more precisely than a maximum dose estimate. Available data resources do not allow estimating the maximum internal and external potential exposure to members of the proposed class under plausible circumstances during the plant's operational period.

Health Endangerment Determination

Per EEOICPA and 42 C.F.R. § 83.13(c)(3), a health endangerment determination is required because NIOSH has determined that it does not have sufficient information to estimate dose for the members of the proposed class.

NIOSH did not identify any evidence supplied by the petitioners or from other resources that would establish that the proposed class was exposed to radiation during a discrete incident likely to have involved exceptionally high-level exposures. However, evidence indicates that some workers in the proposed class may have accumulated substantial chronic exposures through episodic intakes of radionuclides, combined with external exposures to gamma, beta, and neutron radiation. Consequently, NIOSH has determined that health was endangered for those workers covered by this evaluation who were employed for at least 250 aggregated work days either solely under their employment or in combination with work days within the parameters established for other SEC classes (excluding aggregate work day requirements).

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SEC Petition Evaluation Report for SEC-00080

ATTRIBUTION AND ANNOTATION: This is a single-author document. All conclusions drawn from the data presented in this evaluation were made by the OCAS Lead Technical Evaluator: Lara Hughes, NIOSH OCAS. 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 all employees who worked in all areas at the NUMEC Plant in Apollo, Pennsylvania during the period from January 1, 1957 through December 31, 1983. It provides information and results of analyses 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. This report also does not contain the final determination as to whether the proposed class will be added to the SEC (see Section 2.0).

This evaluation was conducted in accordance with the requirements of EEOICPA, 42 C.F.R. pt. 83, and the guidance contained in the Office of Compensation Analysis and Support's (OCAS) *Internal Procedures for the Evaluation of Special Exposure Cohort Petitions*, OCAS-PR-004.

2.0 Introduction

Both EEOICPA and 42 C.F.R. pt. 83 require NIOSH to evaluate qualified petitions requesting that HHS 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 class of employees through NIOSH dose reconstructions.¹

42 C.F.R. § 83.13(c)(1) states: *Radiation doses can be estimated with sufficient accuracy if NIOSH has established that it has access to sufficient information to estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred in plausible circumstances by any member of the class, or if NIOSH has established that it has access to sufficient information to estimate the radiation doses of members of the class more precisely than an estimate of the maximum radiation dose.*

Under 42 C.F.R. § 83.13(c)(3), if it is not feasible to estimate with sufficient accuracy radiation doses for members of the class, NIOSH must also then determine whether or not there is a reasonable likelihood that such radiation doses may have endangered the health of members of the class. The regulation requires NIOSH to assume that any duration of unprotected exposure may have endangered

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>.

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 at least 250 aggregated work days within the parameters established for the class or in combination with work days within the parameters established for other SEC classes (excluding aggregate work day requirements).

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 petitioner(s) and to the Advisory Board on Radiation and Worker Health (Board). The Board will consider the NIOSH evaluation report, together with the petition, petitioner(s) comments, and other information the Board considers appropriate, in order 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 decision process, petitioners may seek a review of certain types of final decisions issued by the Secretary of HHS.²

3.0 Petitioner-Requested Class/Basis

Two petitions associated with the NUMEC Apollo site requested that NIOSH consider classes for addition to the SEC:

- Petition SEC-00047, qualified on January 11, 2007, requested that NIOSH consider the following class: *All office employees who worked at the NUMEC Apollo, Pennsylvania, facility from January 1, 1957 through December 31, 1983.*
- Petition SEC-00080, qualified on May 7, 2007, requested that NIOSH consider the following class for addition to the SEC: *All employees in all locations at the NUMEC Apollo site, from 1957 through 1983.*

NIOSH merged the two petitions for the purpose of this evaluation because the class requested in SEC00047 is encompassed by the class requested in SEC00080. Therefore, all references to SEC00080 in this report cover SEC00047 as well, unless otherwise indicated.

The petitioners provided information and documentation in support of their belief that accurate dose reconstruction for all NUMEC workers is not possible. In addition, NIOSH identified several SEC related issues that supported the qualification of this petition for evaluation. NIOSH deemed the following information sufficient to qualify SEC00080 for evaluation:

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>.

- During the qualification review process and the early stages of the evaluation process, NIOSH identified an apparent lack of dosimetry data for the early operational periods at NUMEC Apollo (1957 through 1959).
- NIOSH has learned during the qualification review process that the company “Controls for Environmental Pollution” (CEP) has been implicated in data falsification and that its bioassay analyses provided to NUMEC cannot therefore be considered reliable.

NIOSH modified the petitioner’s proposed class to be consistent with language used in SEC class definitions. The class for this report is defined as: all Atomic Weapons Employer (AWE) employees who were monitored, or should have been monitored, for exposure to ionizing radiation while working at the NUMEC Plant in Apollo, Pennsylvania, for a number of work days aggregating at least 250 work days from January 1, 1957 through December 31, 1983, or in combination with the work days within the parameters established for one or more other classes of employees in the Special Exposure Cohort.

4.0 Data Sources Evaluated by NIOSH

NIOSH sought to identify and evaluate all potential information resources considered relevant to determining the feasibility of dose reconstruction for the class of employees proposed for this petition. This included determining the availability of information on personal monitoring, area monitoring, industrial processes, and radioactive source materials.

4.1 Site Profile

A Site Profile typically provides specific information derived from available documentation of historical practices at the specified site. Dose reconstructors can use the Site Profile to evaluate internal and external dosimetry data for monitored and unmonitored workers, and to supplement, or substitute for, individual monitoring data. Site Profiles are also typically used in evaluating SEC petitions.

A Site Profile has not yet been prepared for the NUMEC Apollo site for several reasons, including security classification issues.

4.2 ORAU Technical Information Bulletins (OTIBs) and Procedures

An ORAU Technical Information Bulletin (OTIB) is a general working document that provides guidance for preparing dose reconstructions at particular sites or categories of sites. An ORAU Procedure provides specific requirements and guidance regarding EEOICPA project-level activities, including preparation of dose reconstructions at particular sites or categories of sites.

Currently, no site-specific or operations-specific OTIBs or ORAU Procedures have been developed that can either address NUMEC-Apollo dose reconstruction issues or be effectively used to evaluate dose potential for the NUMEC Apollo site employees.

4.3 Facility Employees and Experts

Interviews were performed with several former workers at the NUMEC Apollo site, several of whom shared their knowledge regarding processes and the radiological control situation in the plant, as well as the occurrence of small-scale incidents. The information gained in these interviews was largely confirmed by reports available from other information sources, such as the NIOSH Site Research Data Base (SRDB).

4.4 Previous Dose Reconstructions

NIOSH reviewed its NIOSH OCAS Claims Tracking System (NOCTS) to locate EEOICPA-related dose reconstructions that might provide information relevant to this petition evaluation. Table 4-1 summarizes the results of this review for the period January 1, 1957 through December 31, 1983.

Table 4-1: Number of NUMEC Apollo Claims Submitted Under the Dose Reconstruction Rule (January 1, 1957 through December 31, 1983)	
Description	Totals
Total number of claims submitted for dose reconstruction	133
Total number of claims submitted for energy employees who meet the proposed class definition criteria	133
Number of dose reconstructions completed for energy employees who meet the proposed class definition criteria	53
Number of claims for which internal dosimetry records were obtained for the identified years in the proposed class definition	92
Number of claims for which external dosimetry records were obtained for the identified years in the proposed class definition	43

There were 133 claims filed for former employees at the NUMEC Apollo site and dose reconstructions have been completed for 53 claimants (~ 40%). Of those, 38 claims were completed in 2007 and they used either the available monitoring data (24 had internal dosimetry information and 11 had external dosimetry information) or a more generic approach, as discussed below. Fifteen claims were completed in 2005 before the majority of the currently available dosimetry information became available to NIOSH in early 2007. Those 15 cases involved circumstances that allowed for the use of either an overestimating or underestimating dose reconstruction methodology. These methods make use of relatively limited and case-specific information that are not necessarily sufficient to demonstrate feasibility of estimating radiation doses for a class of employees, which may include individuals for whom these methods are inappropriate. NIOSH has reviewed the overestimating techniques employed in the completed dose reconstructions. The overestimating techniques do not support dose reconstruction for all cancers as required by the SEC rule.

4.5 NIOSH Site Research Database

The NIOSH Site Research Database (SRDB) currently contains 989 documents pertaining to the NUMEC sites (Apollo and Parks). The majority of the available information consists of personnel and area monitoring records, health and safety reports, incident reports, correspondence between NUMEC and AEC/NRC and decommissioning records. All documents have been carefully reviewed to obtain information on monitoring data and process information at NUMEC and the information has been assessed to determine the feasibility of reconstructing doses for the class of employees. At this point what the available documentation in the SRDB lacks are 1) detailed process information regarding the thorium operations, 2) process descriptions regarding the production of Po-Be and Ra-Be sources, 3) internal monitoring data for the 1957-1960 time period, and 4) information regarding the use of plutonium compounds at NUMEC Apollo.

5.0 Radiological Operations Relevant to the Proposed Class

All operations conducted at the NUMEC Apollo site involving radioactive materials during the entire history of the plant's operations are considered relevant to the proposed class.

5.1 NUMEC Apollo Plant and Process Descriptions

The NUMEC Apollo Nuclear Fuel Facility was located in the town of Apollo, 33 miles northeast of Pittsburgh, in Armstrong County, Pennsylvania. The plant is located in a small industrial area across from a largely residential area, bordered by the main street (U.S. Route 66, Warren Avenue) and the Kiskiminetas River. The facility consisted of one main bay, the East Bay, and three smaller attached bays, known as the West Bay, the Box Shop and the Annex. They were bordered on the north, south and west by a metals processing facility not affiliated with NUMEC. The parking lot area contained a laundry building and the Small Block Building. The laundry building began operations in 1960, during which articles of protective clothing used at nuclear power plants and nuclear fuel manufacturing facilities were washed, dried, and packaged for return shipping. In March 1965, the NUMEC laundry building license was amended to permit the decontamination of control rod drive mechanisms owned by the U.S. Navy. The Small Block building was used for storage of process equipment. The NUMEC office building was located outside the plant area across the main street facing the NUMEC Apollo plant and also supported the NUMEC facility in Parks Township (BWXT, 1997, Fogel, 1992)

The NUMEC Apollo Nuclear Fuel Facility was first licensed by AEC in July 1957, it operated under AEC and NRC license SNM 145. The plant started operations in 1957 with the small scale production of high and low enriched uranium fuel. Between 1958 and 1983 the Apollo facility produced low enriched uranium (LEU) dioxide fuel for use in commercial nuclear power reactors. The process consisted of the conversion of uranium hexafluoride (UF_6) to uranium dioxide (UO_2). In 1963 an additional production line was added to produce high enriched uranium (HEU) fuel for US Naval propulsion reactors. From 1958 through the 1960's, NUMEC started processing unirradiated enriched uranium scrap under license from the U. S. Atomic Energy Commission (AEC, 1958). In 1961 the AEC issued a license to NUMEC to produce Plutonium-Beryllium sources (AEC, 1961). Other smaller operations consisted of analytical laboratories, UO_2 pellet production and research and development into coating techniques for uranium microspheres (BWXT, 1997). HEU operations at

NUMEC Apollo were discontinued in 1978, and LEU and all other processing operations involving radioactive materials had ceased by the end of 1983. By October 1984, all of the chemical conversion process equipment had been decontaminated and removed either to allowable scrap sales outlets or to licensed radioactive waste disposal sites. A decommissioning plan for the idle plant site, which was submitted to the NRC in 1991, was subsequently approved and implemented. The facility's license was formally terminated on April 14, 1997 (Fogel, 1992).

The following is a summary list and the associated time frames of the operations documented for the NUMEC Apollo facility:

- HEU production: 1957-1978
- LEU production: 1957-1984
- HEU and LEU scarp recovery: 1958 – 1960's
- Po-Be neutron source production: started in 1961
- UO₂ pellet production: started in 1961
- Research and Development for coating of uranium microspheres: start in 1961
- Thorium operations: started in 1963
- Laundry operations: 1959 - 1984

Some of the smaller research and experimental operations at NUMEC Apollo are not very well documented. NUMEC operated a plutonium production facility nearby in Parks Township, PA, both plants shared management, administration and health and safety operations, and workers sometimes were transferred between the two facilities. Since the main office building in Apollo supported both facilities, most available documents are labeled as pertaining to "Apollo" and it is impossible to determine to which site a given document refers. Thus, for some of the smaller processes, it is not possible to tell at which site they were performed, given the current amount of information available.

In late 1964 and early 1965, NUMEC was contracted by Bettis Atomic Power Laboratory to produce thorium oxide (ThO₂) pellets to be used for nuclear fuel. During this operation, an unknown amount of ThO₂ was processed at NUMEC. A rough outline of the planned production process is available in form of correspondence between NUMEC and the AEC Oak Ridge operations office (Forscher, 1963), as well as some of the air sampling that was done to monitor the air contamination during the processes. There are 87 general air samples, 19 process samples and 11 breathing zone samples available from the thorium production operations in 1964 and early 1965. The extent and duration of the thorium operations at NUMEC is unknown at this point. The available process description is not sufficiently detailed to use source term information to permit addressing the thorium exposure in dose reconstructions.

The NUMEC facility at Parks Township handled all plutonium processing and the available documentation does not indicate that major amounts of plutonium were handled at the Apollo plant. However, NUMEC Apollo was licensed to handle significant amounts of plutonium mostly in coated or encapsulated form. The laundry operations at the Apollo site most likely had plutonium residues resulting from the handling of the work clothing from both NUMEC facilities. There is insufficient information to permit the construction of a source term model for plutonium at the NUMEC Apollo plant.

5.2 Radiological Exposure Sources from NUMEC Apollo Site Operations

Based on reviews of documents identified in section 4.0, and from evaluations of the available dosimetry data, NIOSH has concluded that workers at NUMEC Apollo had the potential for radiological internal exposures (from radioactive materials including uranium, thorium, plutonium and polonium) and external exposures (from beta-gamma and neutron radiation) during the performance of work at the site.

Uncontrolled stack releases from the Apollo plant could have caused the exposure of on-site personnel to elevated ambient levels of radioactive dust. Based on an assessment of stack releases in 1966 by NUMEC Health Physicist Roger Caldwell, the 124 stacks of the NUMEC uranium facility frequently exceed permissible levels of ^{234}U due to filter leakage and poor filter seals. He also pointed out that the stack geometry was highly unfavorable to dispersion and facilitated downwash of the released particles due to insufficient stack height, rain hats and building wake effects. This resulted in little off-site contamination, but may have posed an exposure potential for on-site workers (Caldwell, 1967). Stack monitoring was taking place at a rate of only a few stack samples per day, which resulted in most stack effluents going largely unmonitored. Only a very limited amount of these stack sample results are available to NIOSH.

6.0 Summary of Available Monitoring Data for the Proposed Class

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

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

Personal monitoring data are available through the NRC for monitored individuals that worked at NUMEC Apollo from 1960 to the end of the decommissioning phase. Data capture efforts have included formal requests to the former site operator Babcock and Wilcox (BWXT) and the NRC and all site-specific documents identified from these efforts are available on the SRDB or the OCAS SEC Application (OSA).

Bioassay data from urinalysis are available from December 1960 through 1976 for workers at the NUMEC Apollo plant. Initial sample analysis was provided by the AEC Health and Safety Laboratory (HASL). Starting in 1961 NUMEC employed several different commercial contractors for urine bioassay analyses. Fecal bioassay for uranium is available from 1966-1976. Urine and fecal bioassay data for the period when CEP served as the bioassay contractor (1976-1993) is excluded from this summary as discussed in section 7.1. NUMEC Apollo personnel were also evaluated by whole body counting (WBC) from 1968-1985. NUMEC initially used the services from the Helgeson mobile body counter and later had a contract with the University of Pittsburgh to perform the WBCs. Employees at

the uranium facility were monitored for ^{235}U , employees at the plutonium facility received monitoring for $^{239}\text{Pu}/^{241}\text{Am}$.

External dosimetry data for NUMEC employees are available from 1961-1983. It appears that external dosimetry was mainly used for area monitoring and that personal external monitoring was available only to a small number of employees who had external exposure potential.

Several reports by the HASL contain the earliest uranium air monitoring data from samples collected in 1960 (AEC, 1960a, 1960b). NUMEC specific air sampling data sheets are available starting in 1961 in the form of general air samples (1961-1968) and breathing zone monitoring for uranium dust which is available from 1961-1982. Air sample results for thorium are available for parts of 1964 and 1965 and consist of 87 general air and 11 breathing zone samples. No additional monitoring results for thorium have been located.

7.0 Feasibility of Dose Reconstruction for the Proposed Class

The feasibility determination for the proposed class of employees covered by this evaluation report is governed by both EEOICPA and 42 C.F.R. § 83.13(c)(1). Under that Act and rule, radiation doses can be estimated with sufficient accuracy if NIOSH can establish that it has access to sufficient information to estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred in plausible circumstances by any member of the class, or if NIOSH has established that it has access to sufficient information to estimate the radiation doses of members of the class more precisely than an estimate of the maximum radiation dose. If NIOSH has access to sufficient information for either case, NIOSH would then determine that it is feasible to conduct dose reconstructions.

In determining the feasibility of dose reconstructions, NIOSH typically evaluates whether current or completed NIOSH dose reconstructions succeed in estimating the potential radiation exposure of the class with sufficient accuracy. If it finds that this is not the case, NIOSH then systematically evaluates all other available types of monitoring data, process and source or source term data, which then together or individually might allow NIOSH to arrive either at a maximum or more precise dose estimate that members of the class might have incurred. This approach is discussed in the OCAS SEC Petition Evaluation Internal Procedures which are available at <http://www.cdc.gov/niosh/ocas>.

7.1 Pedigree of NUMEC Apollo Site Data

Evaluation of the feasibility of dose begins with an evaluation of the pedigree of the available data and information. An analysis of data pedigree addresses the background, history, and origin of the data. It requires consideration of data collection, management, dosimetry methodologies and their changes over time; primary versus secondary data sources and whether they match; and whether data are internally consistent. All these issues allow the researcher to come to a conclusion about the data's quality, credibility, reliability, representativeness, sufficiency and suitability to be used for dose reconstruction. The feasibility evaluation is performed after all data pedigree issues have been settled.

Initial occupational exposure surveys to radioactive dust at NUMEC Apollo were reported in the AEC Health and Safety Laboratory (HASL) surveys performed between 1959 and 1961. Initial urine

bioassay samples (12/1960) are also available directly from sample analyses by HASL. Starting in 1961, bioassay and external (TLD) monitoring was performed by external contractors, and dosimetry information on NUMEC is available in the form of data sheets provided by the contractors. The sheets indicate the company that performed the analyses and the name of the employee providing the sample. Air sampling in form of general area monitoring, fixed and lapel breathing zone sampling was done by NUMEC health and safety personnel, and the results recorded on log sheets indicating sample location, instrumentation used, count time and any additional comments regarding the sampling process. Sheets are typically signed by the sample collector and the health and safety technician performing the analysis.

Secondary exposure data for NUMEC personnel are available in form of exposure summary sheets sent to each employee upon termination. The summaries list all the external and internal dose results that were collected during the employment period. NUMEC also had a contract with the University of Pittsburgh for whole body counts (WBC) on employees. The WBC data is largely available in form of secondary data –in summary documents provided from the contractor and in the form of letters sent to NUMEC employees to inform them of the results.

Upon careful evaluation of the data pedigree, only a single major data pedigree issue was discovered during the analysis of available data. The contractor “Controls for Environmental Pollution” (CEP) was used by NUMEC to analyze urine and fecal bioassay samples from 1976-1993. Available information indicates that CEP was the sole contractor used for this period at NUMEC. In 1994, CEP had come under suspicion of data falsification for analyses performed for Sandia National Laboratories (Sandia) from 1992-1994. The allegations were serious enough that federal authorities executed a search warrant for the records at CEP and NRC and DOE issued press releases to their licensees that the accuracy of the data provided by CEP was questionable. Even though the NUMEC period almost completely predates these events; there is no indication for what time period the CEP data can be considered reliable and it is not clear what actions were taken by NUMEC in response to these allegations. A 1994 press release by the NRC to its licensees states that the events related to CEP give reason to question the sample results received from the company.

7.2 Internal Radiation Doses at NUMEC Apollo

Based on the review of documents from the resources identified in section 4.0, from evaluations of available claimant dosimetry data, and other information deficiency considerations; NIOSH has concluded that information pertaining to internal dosimetry is inadequate to ensure sufficiently accurate internal exposures can be reconstructed for the NUMEC Apollo operations. Specifically:

- **Internal monitoring data from 1957 through 1959 do not appear to exist, and exposure modeling using back extrapolation of co-worker data would likely be inconclusive.**

Although several data capture initiatives for NUMEC Apollo have been completed, NIOSH has been unable to find any evidence that internal monitoring data exist for the 1957 through 1959 time period, which were the first few years of AWE operations at the site.

As a possible means to offset this data gap, NIOSH evaluated using a co-worker model to develop dose estimates based on a “back-extrapolation” approach. However, to ensure that the co-worker

model could properly bound actual internal exposures during the unmonitored period, NIOSH would need to have detailed process information that would support an assumption that work activities conducted during 1957, 1958, and 1959 were substantively similar to the operations conducted in later years for which exposure data are available. Indications are that activities in 1957 -1959 involved start up operations or pilot activities and small scale processing. Based on NIOSH's evaluation of startup or pilot activities at other facilities, the assumption that operations were similar and exposures were similar or less is not always true. NIOSH has found, based on lessons learned from pilot activities, engineering controls are added to reduce exposure potential to the production force. Therefore, NIOSH has concluded that it is not feasible to determine a bounding dose estimate for the internal exposures for this time period.

- **Information providing an adequate description of the thorium operations at NUMEC Apollo is not available.**

During the data capture phase, NIOSH identified some air sampling data for thorium. The samples dated from the 1964 and 1965 and consisted of 87 general area samples, 19 process samples and 11 breathing zone samples. NIOSH has information suggesting that NUMEC fabricated ThO₂ pellets for the Bettis Atomic Power Laboratory, and that this activity probably began in late 1963 or early 1964. The process for this fabrication work is generally described in correspondence with AEC (Forscher, 1963); but NIOSH has been unable to find detailed process descriptions or information concerning the overall scope of the thorium work, i.e. when actual operations stopped and if the operations were decontaminated and decommissioned and whether all thorium was removed from the site. It is NIOSH's assessment that the limited information on the period of operation, the small number of breathing zone samples, and the lack of detailed information describing the work processes would make it impossible to establish accurate bounding conditions for potential exposures associated with the NUMEC Apollo thorium work.

- **Bioassay data provided by the company "Controls for Environmental Pollution" (CEP) is not suitable for use**

CEP had come under suspicion of data falsification in 1994 after bioassay data provided to Sandia were found to be questionable. In November 1994, both DOE and the NRC advised contractors and/or licensees to seriously question the accuracy of any analytical results provided by CEP (NRC, 1994).

The seriousness of the Sandia events calls into question the reliability of CEP's analytical services for other nuclear facilities, including those it provided to NUMEC Apollo from 1976 to 1993. NIOSH is not aware of any documentation that would limit the time period during which CEP's analytical processes were considered to be flawed, or show that only the early 1990s data provided to Sandia should be considered suspect. Therefore, unless documentation can be located to support a different conclusion, NIOSH has concluded that it must consider all CEP data provided to NUMEC Apollo to be suspect, and should not use these data to support dose reconstructions, SEC evaluations, or the development of co-worker models. Since CEP was the major bioassay contractor for NUMEC from 1976 to 1993, this creates a large gap in the monitoring data available for dose reconstruction.

To offset this data gap, NIOSH ruled out using a co-worker model to develop dose estimates based on a bioassay data prior to the CEP period, because a co-worker model could properly bound actual internal exposures only if the process activities were substantively similar to the years for which exposure data are available. This cannot be considered a valid assumption given the fact that the first major decommissioning operations started at NUMEC in 1978 with the disassembly of the HEU processing operations and that the exposure scenarios that are encountered during decommissioning operations are different compared to production operations. Therefore NIOSH has concluded that it has insufficient data to establish an accurate bounding estimate for internal doses from uranium from 1976-1983.

- **No monitoring data, process description, or source term data exist for plutonium or concerning the fabrication of Ra-Be and Po-Be neutron sources at NUMEC Apollo.**

Historical documentation indicates that NUMEC fabricated Ra-Be and Po-Be neutron sources and was also licensed to handle plutonium at the Apollo site. Additionally the laundry building was handling all the work clothing from the plutonium processing facility, which resulted in plutonium exposure potential for the workers handling the laundry. However, to date NIOSH has not been able to find any detailed process descriptions for these operations, any source term data, any personnel or area monitoring data specifically associated with these processes, or any records establishing the exact time period these operations took place. Therefore NIOSH has concluded that it has insufficient data to establish an accurate bounding estimate for doses resulting from these operations.

- **Potential elevated ambient radiation levels from stack releases of the Apollo plant are not well documented.**

A report authored by NUMEC health physicist Roger Caldwell in 1967 highlighted some problems related to the stack releases from the Apollo plant. There were 124 filtered stacks on the roof of the plant, and whereas sampling was frequent, it was done on a rather small scale, and it is possible that many releases would have gone undetected. Caldwell pointed out that there was a problem with leakage of particulate material through the stack filters, mainly consisting of ^{234}U . In addition, the geometry of the stacks (insufficient height, rain hats, and building wake effects) resulted in insufficient dispersion of stack releases and downwash, which could have caused elevated dust exposures to on-site workers. Only very limited stack monitoring data are available for the operations in the early 1960's and it is not possible to reconstruct the release scenario based on limited process information for uranium and thorium operations.

Although NIOSH has concluded in this evaluation that there is a lack of sufficient data to permit estimating and/or reconstructing NUMEC Apollo internal doses with sufficient accuracy, NIOSH does intend to use any available non-CEP internal data that may be included in an individual's file (and that can be interpreted using existing NIOSH dose reconstruction processes or procedures) to support a partial internal dose reconstruction for non-presumptive cancers and/or cases that have less than 250 working-days of employment.

7.3 External Radiation Doses at NUMEC Apollo

Based on its review of documents from the resources identified in section 4.0, from evaluations of available claimant dosimetry data, and other information deficiency considerations, NIOSH has concluded that information pertaining to external dosimetry is inadequate to ensure that sufficiently accurate external exposures can be reconstructed for the NUMEC Apollo operations. Specifically:

- **Information is lacking to adequately characterize the Radium-Beryllium and Polonium-Beryllium neutron source fabrication operations conducted at NUMEC Apollo.**

Historical documentation indicates that NUMEC fabricated Ra-Be and Po-Be neutron sources. However, NIOSH was unable to find any detailed process descriptions for these operations, any source term data, any personnel or area monitoring data specifically associated with these processes, nor records establishing the exact time period these operations took place. Therefore NIOSH has concluded that it has insufficient data to establish an accurate bounding estimate for doses resulting from these operations.

Although NIOSH has determined in this evaluation that there is a lack of sufficient data to permit estimating and/or reconstructing NUMEC Apollo external doses with sufficient accuracy, NIOSH does intend to use any available external data that may be included in an individual's file (and that can be interpreted using existing NIOSH dose reconstruction processes or procedures) to support a partial external dose reconstruction for non-presumptive cancers and/or cases that have less than 250 working-days of employment. NIOSH also concluded that medical X-rays that were performed as a condition of employment for NUMEC Apollo personnel can be reconstructed for all members of the class using claimant favorable assumptions as well as the applicable protocols in the complex-wide Technical Information Bulletin, *Dose Reconstructions from Occupationally Related Diagnostic X-Ray Procedures* (ORAUT-OTIB-0006).

7.4 Summary of Feasibility Findings for Petition SEC-00080

This report evaluates the feasibility for completing dose reconstructions for employees at the NUMEC Apollo site from January 1957 through December 1983. Table 7-2 summarizes the results of the feasibility findings at NUMEC Apollo for each exposure source during the time period from January 1957 through December 1983.

Table 7-2: Summary of Feasibility Findings for SEC-00080		
January 1957 through December 1983		
Source of Exposure	Reconstruction Feasible	Reconstruction Not Feasible
Internal		X ¹
- Uranium	X ²	
- Other Radionuclides		X ¹
External		X ³
- Gamma		X ³
- Beta		X ³
- Neutron		X ³
- Occupational Medical x-ray	X ³	

Notes:

¹ With the exception of any available non-CEP internal data that may be included in an individual's file (and that can be interpreted using existing NIOSH dose reconstruction processes or procedures) – for the purpose of completing a partial internal dose reconstruction for non-presumptive cancers and/or cases that have less than 250 working days of employment.

² For the time period where uranium bioassay data is available (1960-1976)

³ With the exception of any available external data that may be included in an individual's file (and that can be interpreted using existing NIOSH dose reconstruction processes or procedures), and medical X-rays that were performed as a condition of employment for NUMEC Apollo personnel – for the purpose of completing a partial external dose reconstruction for non-presumptive cancers and/or cases that have less than 250 working days of employment.

8.0 Evaluation of Health Endangerment for Petition SEC-00080

The health endangerment determination for the class of employees covered by this evaluation report is governed by both EEOICPA and 42 C.F.R. § 83.13(c)(3). Under these requirements, if it is not feasible to estimate with sufficient accuracy radiation doses for members of the class, NIOSH must also determine that there is a reasonable likelihood that such radiation doses may have endangered the health of members of the class. Section 83.13 requires 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.

Based on the apparent complete lack of dosimetry data for some periods of operation, uncertainty about the exact nature and duration of some NUMEC Apollo processes, and the compromised integrity of the CEP bioassay data, NIOSH has concluded that it is not feasible to estimate radiation dose for members of the proposed class with sufficient accuracy based on the sum of information from available resources.

This NIOSH evaluation did not identify any evidence from the petitioner or from other resources that would establish that the class was exposed to radiation during a discrete incident or similar conditions resulting from the failure of radiation exposure controls likely to have produced levels of exposure similarly high to those occurring during nuclear criticality incidents. NIOSH is not aware of any report of such an occurrence at the facility during this period. NIOSH finds that the primary radiation exposure hazards to employees resulted from chronic exposures from inhalation and ingestion of radionuclides, combined with external exposures to gamma, beta, and neutron radiation. 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. A modification of the class definition regarding health endangerment and minimum required employment periods was not required.

9.0 NIOSH-Proposed Class for Petition SEC-00080

Based on its research, NIOSH accepted the petitioner-requested class to define a single class of employees for which NIOSH cannot estimate radiation doses with sufficient accuracy.

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 NUMEC Plant in Apollo, Pennsylvania for a number of work days aggregating at least 250 work days from January 1, 1957 through December 31, 1983, or in combination with the work days within the parameters established for one or more other classes of employees in the Special Exposure Cohort.

The class is proposed because:

- No bioassay data exist for the 1957-1959 time period at NUMEC Apollo and exposure scenarios for workers involved in the NUMEC start up operations cannot be reconstructed,
- Detailed descriptions for process and duration of the thorium operations are lacking and potential exposure scenarios for those workers cannot be reconstructed,
- Bioassay sample analyses performed by CEP cannot be considered technically valid and cannot be used to estimate doses,
- Detailed descriptions of operations involving plutonium or the production of the Ra-Be and Po-Be neutron sources are not available and potential exposure scenarios cannot be reconstructed,
- No data exists on stack emissions from uranium and thorium operations, and potential exposures to elevated air dust resulting from these emissions cannot be reconstructed.

These actions are based on existing, approved NIOSH processes used in dose reconstruction for claims under EEOICPA. NIOSH's guiding principle in conducting these dose reconstructions is to ensure that the assumptions used are fair, consistent, and well-grounded in the best available science. Simultaneously, uncertainties in the science and data must be handled to the advantage, rather than to the detriment, of the petitioners. When adequate personal dose monitoring information is not available, or is very limited, NIOSH may use the highest reasonably possible radiation dose, based on reliable science, documented experience, and relevant data to determine the feasibility of reconstructing the dose of an SEC petition class. NIOSH contends that it has complied with these standards of performance in determining that it would not be feasible to reconstruct the dose for the class proposed in this petition.

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10.0 References

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- 42 C.F.R. 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
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