SEC Petition Evaluation Report
Petition SEC-00149

Report Rev #: 0 Report Submittal Date: August, 17 2009

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

Petitioner Administrative Summary			
Petition Under Evaluation			
Petition #	Petition Type	Petition A Receipt Date	DOE/AWE Facility Name
SEC-00149	83.14	July 21, 2009	Metals and Controls Corp.

NIOSH-Proposed Class Definition
All Atomic Weapons Employees who worked at Metals and Controls Corp. in Attleboro, MA, from January 1, 1952 to December 31, 1967, for a number of work days aggregating at least 250 work days, occurring either solely under this employment, or in combination with work days within the parameters established for one or more other classes of employees included in the SEC.

Related Petition Summary Information			
SEC Petition Tracking #(s)	Petition Type	DOE/AWE Facility Name	Petition Status
None			

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

ORAU Lead Technical Evaluator:	**ORAU Review Completed By:**
Joseph Guido	Michael Kubiak

Peer Review Completed By:	[Signature on file] *Thomas P. Tomes*	8/17/2009 *Date*
SEC Petition Evaluation Reviewed By:	[Signature on file] *J. W. Neton*	8/18/2009 *Date*
SEC Evaluation Approved By:	[Signature on file] *Larry Elliott*	8/19/2009 *Date*

This page intentionally left blank

Evaluation Report Summary: SEC-00149, Metals and Controls Corp.

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

NIOSH-Proposed Class Definition

All Atomic Weapons Employees who worked at Metals and Controls Corp. in Attleboro, MA, from January 1, 1952 to December 31, 1967, for a number of work days aggregating at least 250 work days, occurring either solely under this employment, or in combination with work days within the parameters established for one or more other classes of employees included in the SEC.

Feasibility of Dose Reconstruction Findings

NIOSH lacks sufficient information, which includes thorium internal monitoring and/or air sampling data, to allow it to estimate with sufficient accuracy the potential internal exposures to thorium to which the proposed class may have been subjected.

NIOSH finds that it is likely feasible to reconstruct with sufficient accuracy the occupational internal and external dose from uranium and radium as well as the medical dose for Metals and Controls Corp. workers.

- Principal sources of internal radiation for members of the proposed class included exposures to uranium, thorium, and radium (Ra-226). Exposure to uranium and thorium occurred during the fabrication of uranium- and thorium-bearing components (including reactor fuel, metallic alloys, and metallic foils). Exposure to radium was limited to a single process, involving the manufacture of electrical breakers containing radium-bearing luminescent markers.

- NIOSH has obtained uranium urinalysis bioassay data for the period 1953 through 1967. NIOSH has not located any internal monitoring data specific to thorium exposures. The limited area air sampling results available to NIOSH are specific to uranium-processing operations and are inadequate to bound internal intakes from thorium operations. NIOSH has found no usable information with which to assess thorium air concentrations and has not identified sufficient documentation to define and quantify the total thorium source term during the period from 1952 through 1967.

- NIOSH has determined that reconstruction of internal dose from thorium is not feasible for the period from January 1, 1952 through December 31, 1967 due to the lack of thorium-specific monitoring or source term data.

- NIOSH has determined that reconstruction of the internal dose from uranium for monitored workers as well as internal exposure to radium is likely feasible.

- Principal sources of external radiation for members of the proposed class included exposures to beta and gamma radiation during the activities noted above. Additionally, there was external exposure from industrial radiography and non-destructive testing (Bavley, 1958).

- NIOSH has obtained external monitoring data for the period 1953 through 1967 and has determined that reconstruction of external dose for monitored workers is likely feasible.

- Although NIOSH found that it is not possible to completely reconstruct radiation doses for the proposed class, NIOSH intends to use any internal and external monitoring data that may become available for an individual claim (and that can be interpreted using existing NIOSH dose reconstruction processes or procedures). Therefore, dose reconstructions for individuals employed at Metals and Controls Corp. during the period from January 1, 1952 through December 31, 1967, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate.

Health Endangerment Determination

The NIOSH evaluation did not identify any evidence supplied by the petitioners or from other resources that would establish that the class was exposed to radiation during a discrete incident likely to have involved exceptionally high-level exposures, such as nuclear criticality incidents or other events involving similarly high levels of exposures. However, the evidence reviewed in this evaluation indicates that some workers in the class may have accumulated chronic radiation exposures through intakes of thorium. 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.

Table of Contents

Tables

SEC Petition Evaluation Report for SEC-00149

ATTRIBUTION AND ANNOTATION: This is a single-author document. All conclusions drawn from the data presented in this evaluation were made by the ORAU Team Lead Technical Evaluator: Joe Guido; MJW Corporation. These conclusions were peer-reviewed by the individuals listed on the cover page. The rationales for all conclusions in this document are explained in the associated text.

1.0 Purpose and Scope

This report evaluates the feasibility of reconstructing doses for employees who worked at 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.

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

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

2.0 Introduction

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

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

[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.

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

3.0 NIOSH-Proposed Class Definition and Petition Basis

The NIOSH-proposed class includes all Atomic Weapons Employees who worked at Metals and Controls Corp. in Attleboro, MA, from January 1, 1952 to December 31, 1967, for a number of work days aggregating at least 250 work days, occurring either solely under this employment, or in combination with work days within the parameters established for one or more other classes of employees included in the SEC. During this period, employees at this facility were involved with fabricating thorium foils, enriched uranium foils, and enriched uranium fuel elements.

The evaluation responds to Petition SEC-00149 which was submitted by an EEOICPA claimant whose dose reconstruction could not be completed by NIOSH due to a lack of sufficient dosimetry-related information. This claimant was employed as a [identifying information redacted] from 1957 through 1988. 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 Metals and Controls Corp. from January 1, 1952 to December 31, 1967 and the information available to NIOSH to characterize particular processes and radioactive source materials. Using available sources, NIOSH has attempted to gather process and source descriptions, information regarding the identity and quantities of radionuclides of concern, and information describing processes through which the radiation exposures of concern may have occurred and the physical environment in which they may have occurred. The information included within this evaluation report is meant only to be a summary of the available information.

4.1 Operations Description

Operations with radioactive materials began at the site in 1952 when Metals and Controls, Inc., began fabricating enriched uranium foils. Metals and Controls became a division of Texas Instruments in 1959 (NRC, 1997). For the purposes of this discussion, both "TI" and "Metals and Controls" are used interchangeably to describe the same facility, albeit at different points in time. From 1952 through 1965, under a variety of government contracts, Metals and Controls fabricated enriched uranium fuel elements for the U.S. Naval Reactors Program, the U.S. Air Force, other U.S. Government-funded research, and a few commercial customers. From 1965 through 1981, TI fabricated fuel for the High Flux Isotope Reactor at Oak Ridge National Laboratory and other Government-owned research

[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.

reactors. Depleted uranium and processed natural uranium were also used at the facility for research and development.

Operations with radioactive materials were initially conducted in portions of what is now Building 4, with very limited operations conducted in Building 3. In 1956, Metals and Controls constructed Building 10 to house all manufacturing work involving radioactive materials; by 1957, all such work was moved to that location. Processing included the fabrication of uranium foils for reactor experiments and fuel components, fabrication of complete reactor cores for the Naval Reactors program, and fabrication of uranium fuel elements for experimental and research reactors (NRC, 1997).

Information on the handling and processing of thorium is limited. The use of thorium at Metals and Controls Corp. is indicated in undated product literature (M&C, unknown date-b, p. 45; Drummey, 1956, p. 60; TI, 1959) and from a 1960 brochure (TI, 1960). Based on these references, Metals and Controls supplied thorium foil strips for criticality experiments, source tests, and reactivity tests. Thorium was vacuum-melted and cast into flat ingots. These ingots were subsequently rolled to the desired thickness. A 1964 health and safety manual references thorium use (M&C, 1964), while the 1968 version of this document (M&C, 1968) makes no mention of thorium. No versions are available in the intervening years or prior to the 1964 version.

A comprehensive listing of thorium shipments from the Fernald Site during the period 1952 through 1985 (Thorium Shipments, 1952-1985, p. 109) documents shipments of small quantities of thorium metal (less than 15 kg each) to Metals and Controls Corp. in June 1955, February 1957, and October 1957. Documentation of another thorium shipment (this time involving Brookhaven National Laboratory and Argonne National Laboratory) is available for a June 1957 shipment (Huke, 1954). A 1957 uranium exposure assessment, conducted by the Environmental Measurement Laboratory, lists the production of thorium foils as one of the processes at Metals and Controls Corp. (AEC, 1957). The only definitive information on the amount of thorium at Metals and Controls Corp. is from a 1962 nuclear safety analysis that lists the total quantity of thorium as 244 kg (ASTRA, 1962).

Waste handling, processing of scrap metal and residues, and treatment of waste acids and water were conducted inside Building 5 and outside Building 5 in areas known as the Metals Recovery Area and the Stockade. A waste evaporator and an incinerator were operated in Building 5 and the adjacent Metals Recovery Area. Scrap and waste generated in the manufacturing processes were returned to the U.S. Government; however, some materials contaminated with low levels of radioactivity were buried onsite adjacent to Building 11.

Following cessation of fuel fabrication operations in 1981, TI initiated remediation of uranium contamination in the buildings and surrounding exterior locations. Remediation and final surveys of contaminated portions of Buildings 4 and 10 were completed in 1985, and the NRC staff approved release of these buildings for unrestricted use. Residual radioactive contamination remained in the burial area east of Building 11 and west of the relatively recently-constructed Building 12. Initial remediation of the burial area was completed in December 1992. A confirmatory survey conducted by the Oak Ridge Institute for Science and Education (ORISE) in December 1992 identified some remaining contamination on the walls of the excavation. In July 1993, the licensee completed additional remediation activities. An ORISE confirmatory survey in December 1993 did not identify any remaining residual contamination in the burial area in excess of the NRC criteria for release for unrestricted use (NRC, 1997).

Records indicate that Metals and Controls Corp. fabricated fuel elements for production reactors, but it is unclear whether its work was related to the nuclear weapons complex. For example, Metals and Controls Corp. fabricated uranium foils for reactor experiments and fuel components, fabricated complete reactor cores for the Naval Reactors program, and fabricated uranium fuel elements for experimental and research reactors. Records indicate shipments of depleted uranium between Rocky Flats and Metals and Controls Corp. during the period from 1955 to 1958 (Uranium Shipments, 1955-1958). Table 4-1 shows process information for Metals and Controls Corp.

Table 4-1: Metals and Controls Corp. Areas Involving Radiological Activities or Storage

Location	Room or area	Use or Equipment Contained	Comments
Building 10 (aka Building N, A-10)		Nuclear fuel production	Also called the Nuclear Building. Eight-foot fence with one access-monitored personnel entrance enclosed the area.
	Upper breakdown area	Ovens, rolling mills	
	Lower breakdown area	Cutting machines (shears, etc.) for de-jacketing the rolled uranium and alloy	
Building 4		Initial metallurgical work (cladding uranium, rolling foils and plates)	Only part of building was used and only until Building 10 was available.
Building 3		Very limited initial metallurgical work	Only part of building was used and only until Building 10 was available.
Building 5 (aka Building E)		Evaporator; incinerator; waste handling, processing of scrap metal and residues, treatment of waste acids and water	The "Waste Treatment Building" or "Waste Treatment Area" serving the entire site (including non-AEC areas). Removed in the mid-1960s.
	Under lean-to adjacent to Building 5	Incinerator for contaminated clothing, waste paper, etc.	Removed in the mid-1960s.
	Open pit about 300 ft. from Building 5	Burning of zirconium waste chips and wooden skids	Probably what was called the "Metals Recovery Area."
Stockade	Fenced yard area near Building 5	Storage of radioactive waste prior to disposal	Removed in the mid-1960s.
Building 1		Affixing luminescent beads (containing radium) to toggle switches.	Based on an interview with a former employee, the radium work in Building 1 occurred between 1965 and 1967 (Documented Communication, 2008).

4.2 Radiation Exposure Potential from Operations

Fabricating, machining, and alloying operations involving uranium and thorium have a potential to generate airborne radioactivity, and thus, internal exposure to these materials. This potential would be greatest in locations where material was handled and where operations occurred, and would likely vary depending on the exact nature of the operation and the configuration of local ventilation systems. There is a potential for external radiation exposure in areas where uranium and thorium were handled and stored with an increased likelihood of exposure in storage areas. During high-temperature operations involving depleted uranium and thorium, there would also be an increased exposure potential from beta radiation due to the separation of volatile, beta-emitting progeny of U-238 and thorium.

4.3 Time Period Associated with Radiological Operations

Per the DOE Office of Health, Safety and Security, the time period associated with Atomic Weapons Employer (AWE) operations at Metals and Controls Corp. is from 1952 through 1967 (DOE, 2009). NIOSH has discovered no additional data to support more specific dates for the beginning and end of AWE operations. Therefore, AWE operations at Metals and Controls Corp. are assumed to have started on January 1, 1952, and ended on December 31, 1967.

4.4 Site Locations Associated with Radiological Operations

In the company's license termination request, only Buildings 3, 4, and 10 are noted as having been used in radioactive material processing (TI, 1982). Subsequent correspondence indicates that the potentially-impacted area was expanded to include Buildings 1, 5, 11, and the outside areas around Buildings 11 and 12 (Survey, 1997; Remediation, 1996). Based on this information, these are the only areas associated with radiological operations. Except as noted in Table 4-1 for Building 10, NIOSH has very limited information describing any access control practices at the Metals and Controls Corp. site; thus, NIOSH is unable to determine which workers may or may not have entered the identified radiological areas.

4.5 Job Descriptions Affected by Radiological Operations

Given the general lack of process knowledge or detailed source term information, and the potential for workplace radioactive contamination in the affected locations, it is not possible to determine that any specific work group was not potentially exposed to radioactive material releases or possible subsequent contamination. NIOSH has found no documentation associating job titles and/or job assignments with specific radiological operations or conditions. Without such information, NIOSH is unable to determine which workers may or may not have entered identified radiological areas; thus, NIOSH is unable to define potential radiation exposure conditions based on worker job descriptions.

5.0 Summary of Available Monitoring Data for the Proposed Class

NIOSH obtained film badge data covering the entire operational period (Dosimetry Records, 1953-1960; Dosimetry Records, 1960-1966; Dosimetry Records, 1965-1967) and uranium urinalysis results covering all operational period years with the exception of 1952 (Urinalysis Results, various years). There are no monitoring data available specific to radium and thorium exposures. Limited dust sampling results exist for 1957, with total alpha monitoring conducted in February, 1957 (AEC, 1957). No other air monitoring data are available.

5.1 Data Capture Efforts and Sources Reviewed

In addition to examining its Site Research Database (SRDB) to locate documents supporting the evaluation of the proposed class, NIOSH identified and reviewed numerous data sources to locate information 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 personnel monitoring, workplace monitoring, and radiological source term data.

NIOSH data capture efforts for Metals and Controls Corp. focused on historical source term, process, and dosimetry data available at the current location of the former Metals and Controls Corp. facility. Attachment 1 contains a summary of Metals and Controls Corp. documents. The summary provides specific data capture details for each document retrieved.

5.2 Worker Interviews

NIOSH has reviewed the computer-assisted telephone interviews conducted for claims filed with NIOSH for energy employees who worked at Metals and Controls Corp. during the period from 1952 through 1967. These interviews provided no information to change NIOSH's feasibility determination and did not indicate any potential sources for additional monitoring or process data.

Based on the sparse data available for thorium operations at Metals and Controls Corp., NIOSH determined that additional worker interviews would neither change the feasibility determination nor allow NIOSH to limit the class to specific locations. Therefore, no additional interviews were pursued.

5.3 Internal Personnel Monitoring Data

Bioassay data consist of uranium urinalyses and include measurements by fluorimetry and gross alpha counting. Bioassay data are first available in 1953. At least some data were located for all years of the class period 1952 through 1967, except for 1952. As of 1957, workers were providing samples quarterly; each month about one-third of the workers exposed to radioactive material provided 500- to 1000-ml urine samples (Bavley, 1957).

Uranium urinalysis was performed using a combination of either chemical or radiometric techniques. There are some indications that, at times, the type of analysis might have been related to the uranium enrichment being handled (Loysen, 1957). For example, in reply to a Massachusetts Department of Labor and Industries question (Elkins, 1957), Metals and Controls Corp. noted that the urinalyses being analyzed by chemical methods would be adjusted for the increased activity due to the enrichment of the uranium (Loysen, 1957).

No urinalysis data are available pertinent to thorium exposures. This is consistent with the monitoring practice outlined in the 1964 Health Physics Operations Manual, which states, “No techniques are presently available for thorium body burden determinations, except for weighted exposure averages. As soon as an accurate technique is developed, it will be employed” (M&C, 1964). Accordingly, it would seem likely that air sampling data would have been used to assess thorium exposures; however, such data are not available to NIOSH.

5.4 External Personnel Monitoring Data

External monitoring data are available for the period 1953 through 1967. However, the completeness of this data set cannot be determined. Texas Instruments staff conducted a search for dosimetry records for a particular individual for the period 1952-1967 (Elliot, 2005). TI stated that they could not speculate on the completeness of the archived data, and for that particular individual, they could find external data only for 1955. Other employees' dosimetry data seems more complete; it is possible that this particular individual was not required to be monitored for the entire period.

5.5 Workplace Monitoring Data

Bavley said that until mid-1957, air sampling was performed by "the corporation insurance carrier," but then instruments were purchased and plant personnel began to do them (Bavley, 1957). Bavley and Metals and Controls Corp. documentation subsequently noted that the Metals and Controls HP staff was performing the air sampling (in-plant and effluent) as well as performing the sample analyses (Bavley, 1957; M&C, 1964).

Air sampling consisted of general area air samples, breathing zone air samples, and operational air samples. Metals and Controls (M&C, 1964) stated:

> *Each operation employing radioactive material, in which aerosols can be produced, shall be sampled on a routine basis.*
>
> *This schedule shall maintain an average frequency of at least 50 samples per week under normal operating conditions.*
>
> *Whenever possible at least 50% of the total number of air samples shall be breathing zone type.*
>
> *Also, new or modified operations were to be "intensively" sampled at start up and stack monitoring was required bimonthly.*

For the week of February 11, 1957, the AEC reported airborne concentrations measured during Metals and Controls Corp. operations involving primarily 5% enriched uranium (AEC, 1957). No other air monitoring data have been located.

5.6 Radiological Source Term Data

Available information on the source term at Metals and Controls Corp. is summarized in Table 5-1.

Table 5-1: Summary of the Metals and Controls Corp. Source Term
(This table spans three pages)

Material	Process or Operation	Content and Form Notes	Amount and Period	References
Production Materials				
Uranium metal, natural	Melting; shearing fuel foils; pickling, polishing, cropping, and assembling fuel plates into fuel elements, cladding with zircalloy, Al, or stainless steel; alloying		Early operations used metal, as did at least some work in 1957-1963; later operations usually did not. 1 Jan 1962 inventory: for AEC, 61 kg; for other licensees, 192 kg	FUSRAP, undated; ASTRA, 1962
Uranium metal, depleted	Melting; shearing fuel foils; pickling, polishing, cropping, and assembling fuel plates into fuel elements, cladding with zircalloy, Al, or stainless steel; alloying		At least some work in 1957-1963. M & C to supply to Argonne 39,000 metal pieces fabricated from 68,000 kg of depleted U metal derbies @ ~0.0040 wt % U-235; Jan 1962 inventory: 158 kg for AEC, 346 kg for other licensees	ANL, 1960; M&C, unknown date-b; M&C, 1959; FUSRAP, undated; ASTRA, 1962
Uranium metal, enriched	Melting; shearing fuel foils; pickling, polishing, cropping, and assembling fuel plates into fuel elements, cladding with zircalloy, Al, or stainless steel; alloying	1957-1963: enriched to $\leq$ 20% (e.g., 20%, 3.2%, 2.2%, 1.8%). Westinghouse Atomic Power Division (WAPD) elements: <5%. Later reactor fuel (High Flux Isotope Reactor (HFIR), Battelle reactor, etc.) usually 90% or more. Intermediate enrichment sometimes made by combining 93% enriched U with natural or depleted U.	Jan 1962 inventory: for AEC, 1,264 kg U @93%; for other licensees, 18 kg @93%, 71 kg @20%, 1449 kg @3.2%, 3932 kg @2.2%, 363 kg @1.8%.	FUSRAP, undated; AEC, 1957; ASTRA, 1962
Uranium metal, recycled	Probably same as above		"On several occasions"	FUSRAP, undated
U_3O_8	Alloying, pressing, annealing, cladding; pickling, polishing, cropping, and assembling fuel plates into fuel elements	U_3O_8 powder for HFIR fuel plates: enrichment, 93 wt %; density 8.2 g/cc; U @84.5 wt %; U-235 density 6.45 g/cc. 15.18-18.44 g U-235 per plate; max of 24 plates at a time, or 360 kg U-235	Mostly later operations	FUSRAP, undated
UO_2	Mixing in powdered form with stainless steel powder, rolling to make plates	UO_2 in GE Vallecitos Reactor plates varied from 20 to 30 wt %	Few cores required UO_2. Vallecitos reactor: over 1000 plates made, containing about 30 kg of U-235 total	FUSRAP, undated; AEC, 1957; M&C, unknown date-a
Thorium	Making foils		1 Jan 1962 inventory: for AEC, 198 kg for others, 46 kg	ASTRA, 1962; AEC, 1957; M&C, 1964

Table 5-1: Summary of the Metals and Controls Corp. Source Term (This table spans three pages)				
Material	**Process or Operation**	**Content and Form Notes**	**Amount and Period**	**References**
Production Materials				
Sealed Sources				
Ra-226 luminous indicators	Manufacture of toggle switches containing luminescent glass beads (containing radium 226)	Luminous glass bead with radium coating. Activity estimated at 0.12 µCi each bead	1965 through 1967, 5000 buttons total.	TI, 1997; Documented Communication, 2008; ORAU, 2008
Calibration and check sources			AECL Co-60 sealed source, 12.2 mCi; 3 NBS U_3O_8 alpha standard sources; Ra source, 40 µCi; C-14 and Ra check sources for use with meters	M&C, 1964
Wastes and Remainders				
Salvageable noncombustibles	Collected in 55-gallon drums and stored prior to disposition	Equipment and non-U metal contaminated with U or (probably less often) Th; surveyed for surface contamination prior to disposition	Scrap metal @ >25,000 dpm per 100 cm^2 had to be decontaminated before disposition; could be free-released if <500 dpm per 100 cm^2 average, <5000 dpm per 100 cm^2 max. Equipment: limit of <50 dpm per 100 cm^2 removable and <500 dpm per 100 cm^2 fixed, except that actual work surfaces could be 2000 fixed, for free release	M&C, 1964
Non-salvageable non-combustibles	Collected in 55-gallon drums and stored prior to disposition	Junk/rubbish contaminated with U, sometimes Th; disposed of through AEC, other licensees, or onsite burial		M&C, 1964
Incinerator ash	Dry-vacuumed or wet down and shoveled into drums; sampled from each drum and analyzed for U-235	From burning contaminated paper, protective clothing; drums accumulated until enough for disposal at AEC or licensed burial ground	Maximum of 350 g U-235 per burn batch	M&C, 1964
Acid solutions	Collected in 55-gallon drums with polyethylene liners, stored prior to disposition; process wastes were analyzed for U-235, while laboratory wastes were tracked via a running tally of additions	Process acid solutions (e.g., pickling solutions) that were exhausted or in which U content was approaching the allowable limit; laboratory acid wastes	The maximum safe concentration limit was taken to be 2 g U-235 per liter	AEC, 1957

Table 5-1: Summary of the Metals and Controls Corp. Source Term (This table spans three pages)				
Material	**Process or Operation**	**Content and Form Notes**	**Amount and Period**	**References**
Production Materials				
Miscellaneous liquids requiring concentration before recovery	Collected in 55-gal drums, allowed to settle; after analysis of supernatant, supernatant processed through a 600-gal evaporator; drum-settled sludge was consolidated in 55-gal drums, while evaporator sludge was pumped into other 55-gal drums; in both, vermiculite was added to the sludge in the drums, which were stored until disposed of. Except: if there was little or no settling and analysis showed radioactive content was below 10 C.F.R. pt. 20 limits for release, liquid was not processed but was released to the sewers	Solutions or easily dispersible solutions: incinerator washings, floor drainage, evaporator flushings, etc. Collected in drums to >1000 gal total. Sludge left after settling was sampled and consolidated into drums for disposal; supernatant was processed through evaporator. Drum-settled and evaporator sludge both shipped to AEC-licensed facility for burial	Contained enriched, natural, and/or depleted U and Th in concentrations higher than those permitted to be released but not concentrated enough for direct reclamation; analysis showed that after settling, 95% of the U-235 was contained in the drum sludge and there was usually about 90% supernatant and 10% sludge in the drums prior to processing. The maximum allowable quantity of U-235 in the evaporator was 350 g; the maximum in drum-settled sludge was 430 g (taken to be equivalent to 2 g/L)	M&C, 1964; ASTRA, 1962

6.0 Feasibility of Dose Reconstruction for the Proposed Class

42 C.F.R. § 83.14(b) states that HHS will consider a NIOSH determination that there was insufficient information to complete a dose reconstruction, as indicated in this present case, to be sufficient, without further consideration, to conclude that it is not feasible to estimate the levels of radiation doses of individual members of the class with sufficient accuracy.

In the case of a petition submitted to NIOSH under 42 C.F.R. § 83.9(b), NIOSH has already determined that a dose reconstruction cannot be completed for an employee at the DOE or AWE facility. This determination by NIOSH provides the basis for the petition by the affected claimant. Per § 83.14(a), the NIOSH-proposed class defines those employees who, based on completed research, are similarly affected and for whom, as a class, dose reconstruction is similarly not feasible.

In accordance with § 83.14(a), NIOSH may establish a second class of co-workers at the facility for whom NIOSH believes that dose reconstruction is similarly infeasible, but for whom additional research and analysis is required. If so identified, NIOSH would address this second class in a separate SEC evaluation rather than delay consideration of the claim currently under evaluation (see Section 10). This would allow NIOSH, the Board, and HHS to complete, without delay, their consideration of the class that includes a claimant for whom NIOSH has already determined a dose reconstruction cannot be completed, and whose only possible remedy under EEOICPA is the addition of a class of employees to the SEC.

This section of the report summarizes research findings by which NIOSH determined that it lacked sufficient information to complete the relevant dose reconstruction and on which basis it has defined the class of employees for which dose reconstruction is not feasible. NIOSH's determination relies on the same statutory and regulatory criteria that govern consideration of all SEC petitions.

6.1 Feasibility of Estimating Internal Exposures

NIOSH has evaluated the available personnel and workplace monitoring data and source term information and has determined that there are insufficient data for estimating internal exposures, as described below.

NIOSH has not located any internal monitoring data specific to thorium exposures.

While NIOSH has obtained area air sampling results for one operation in 1957, these results are specific to uranium-processing operations and are inadequate to bound internal intakes from thorium operations. Additionally, NIOSH has found no usable information with which to assess thorium air concentrations.

NIOSH has not identified sufficient documentation to define and quantify the total thorium source term during the AWE operations period. Definitive information is available indicating that thorium processing occurred during the period 1954 through 1964; however, this same documentation does not provide a clear understanding of the potential use of thorium either before or after this period. Without additional documentation, NIOSH can make no assumptions about the relative amounts of thorium processing that would have been encountered at the site during the period from January 1, 1952 through December 31, 1967. There is therefore insufficient source term information available to NIOSH to bound internal exposures to thorium for the period from January 1, 1952 through December 31, 1967.

NIOSH has obtained uranium urinalysis results for the period 1953-1967. These data can be used to reconstruct uranium exposure to monitored personnel. NIOSH has obtained sufficient workplace and source term information to bound internal exposures to Ra-226 during toggle-switch manufacturing for the period January 1, 1965 through December 31, 1967.

NIOSH does not have access to sufficient personnel monitoring, workplace monitoring, or source term data to estimate potential internal exposures to thorium during the period of AWE operations from January 1, 1952, through December 31, 1967. Consequently, NIOSH finds that it is not feasible to estimate, with sufficient accuracy, total internal exposures and resulting doses for the class of employees covered by this evaluation.

Although NIOSH found that it is not possible to completely reconstruct internal radiation doses for the period from January 1, 1952 through December 31, 1967, NIOSH intends to use any internal monitoring data that may become available for an individual claim (and that can be interpreted using existing NIOSH dose reconstruction processes or procedures). Dose reconstructions for individuals employed at Metals and Controls Corp. during the period from January 1, 1952 through December 31, 1967, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate.

6.2 Feasibility of Estimating External Exposures

This evaluation responds to a petition based on NIOSH determining that internal radiation exposures to thorium could not be reconstructed for a dose reconstruction referred to NIOSH by the Department of Labor (DOL). As noted above, HHS will consider this determination to be sufficient without further consideration to determine that it is not feasible to estimate the levels of radiation doses of individual members of the class with sufficient accuracy. Consequently, it is not necessary for NIOSH to fully evaluate the feasibility of reconstructing external radiation exposures for the class of workers covered by this report.

NIOSH has obtained external dosimeter results for monitored individuals for 1953 through 1967. NIOSH has determined that reconstruction of the external dose for monitored workers is feasible. NIOSH has obtained sufficient workplace and source term information to bound external exposures to Ra-226 during toggle-switch manufacturing for the period January 1, 1965 through December 31, 1967.

Adequate reconstruction of medical dose is likely to be feasible by using claimant-favorable assumptions in the complex-wide Technical Information Bulletin, *Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures* (ORAUT-OTIB-0006).

Although NIOSH found that it is not possible to completely reconstruct radiation doses for all workers for the period from January 1, 1952 through December 31, 1967, NIOSH intends to use any external monitoring data that may become available for an individual claim (and that can be interpreted using existing NIOSH dose reconstruction processes or procedures). Dose reconstructions for individuals employed at Metals and Controls Corp. during the period from January 1, 1952 through December 31, 1967, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate.

6.3 Class Parameters Associated with Infeasibility

This report evaluates the feasibility for completing dose reconstructions for the AWE operations period at Metals and Controls from 1952 through 1967. NIOSH has discovered no data to support more specific dates for the beginning and end of thorium operations. NIOSH therefore recommends that the proposed class include the entire AWE-covered period of January 1, 1952 through December 31, 1967.

As discussed in Section 4.4, NIOSH has sufficient information to identify the specific areas in which radiological operations were likely conducted. However, NIOSH does not have information on the controls in place to restrict access to the identified radiological areas, with the exception of Building 10 after 1956.

NIOSH has found insufficient documentation associating job titles and/or job assignments with specific radiological operations or conditions. Although NIOSH has identified the site locations where radiological operations were likely to have been conducted, NIOSH does not have information defining the access controls that were in place across the site (with the exception of Building 10 after 1956). Without such information, NIOSH is unable to determine which workers or work groups may or may not have entered the identified radiological areas; NIOSH is thus unable to define the proposed

SEC class based on worker job descriptions. Therefore, NIOSH recommends that the proposed class definition include all Atomic Weapons Employees who worked at Metals and Controls Corp. during the specified time period.

7.0 Summary of Feasibility Findings for Petition SEC-00149

This report evaluates the feasibility for completing dose reconstructions for employees at Metals and Controls Corp. from January 1, 1952 through December 31, 1967. NIOSH determined that members of this class may have received radiation exposures from operations involving uranium, thorium, and radium. NIOSH lacks sufficient information, which includes biological monitoring data, sufficient air monitoring information, or sufficient process and radiological source information that would allow it to estimate the potential internal thorium exposure to which the proposed class may have been exposed.

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

Although NIOSH found that it is not possible to completely reconstruct radiation doses for the proposed class, NIOSH intends to use any internal and external monitoring data that may become available for an individual claim (and that can be interpreted using existing NIOSH dose reconstruction processes or procedures). Therefore, dose reconstructions for individuals employed at Metals and Controls Corp. during the period from January 1, 1952 through December 31, 1967, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate.

8.0 Evaluation of Health Endangerment for Petition SEC-00149

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

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

9.0 NIOSH-Proposed Class for Petition SEC-00149

The evaluation defines a single class of employees for which NIOSH cannot estimate radiation doses with sufficient accuracy. This class includes all Atomic Weapons Employees who worked at Metals and Controls Corp. in Attleboro, MA, from January 1, 1952 to December 31, 1967, for a number of work days aggregating at least 250 work days, occurring either solely under this employment, or in combination with work days within the parameters established for one or more other classes of employees included in the SEC.

10.0 Evaluation of Second Similar Class

In accordance with § 83.14(a), NIOSH may establish a second class of co-workers at the facility, similar to the class defined in Section 9.0, for whom NIOSH believes that dose reconstruction may not be feasible, and for whom additional research and analyses is required. If a second class is identified, it would require additional research and analyses. Such a class would be addressed in a separate SEC evaluation rather than delay consideration of the current claim. At this time, NIOSH has not identified a second similar class of employees at Metals and Controls Corp. for whom dose reconstruction may not be feasible.

11.0 References

42 C.F.R. pt. 81, *Guidelines for Determining the Probability of Causation Under the Energy Employees Occupational Illness Compensation Program Act of 2000;* Final Rule, Federal Register/Vol. 67, No. 85/Thursday, p 22,296; May 2, 2002; SRDB Ref ID: 19391

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

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

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

AEC, 1957, *Metals and Controls, Inc., Attleboro, Massachusetts, Occupational Exposure to Airborne Contaminants*, HASL-M&C-1; U. S. Atomic Energy Commission Health and Safety Laboratory, New York Operations Office; April 26, 1957; SRDB Ref ID: 7060

ANL, 1960, *Materials Processing Contract No. 31-109-38-1162*, to G. L. Williams (M&C Nuclear, Inc.) from J. H. McKinley (Argonne National Laboratory); January 15, 1960; SRDB Ref ID: 7063, pdf pp. 74-78

ASTRA, 1962, *Analysis of Possible Nuclear Material Losses and Possible Liabilities Associated with Present Fuel Manufacturing at Metals & Controls, Inc.*, ATSTRA 410-6.2; ASTRA; March 12, 1962; SRDB Ref ID: 13612

Bavley, 1957, *Metals and Controls Corp., Nuclear Products Division, Attleboro,* correspondence to Dr. Elkins; Mr. Bavley; July 10, 1957; SRDB Ref ID: 13669, pdf p. 7

Bavley, 1958, *Metals and Controls Nuclear, Inc., Attleboro regarding January 10, 1958 Visit*, correspondence to Dr. Elkins; Mr. Bavley; January 13, 1958; SRDB Ref ID: 13669, pdf pp. 4-5

Documented Communication, 2008, *Radium Usage in Military Circuit Breakers Manufactured at the Metals and Controls Facility*, ORAU telephone interview with former Metals and Controls employee; January 28, 2008; SRDB Ref ID: 42115

DOE, 2009, *Metals and Controls Corp*., facility profile, U.S. Department of Energy, Facility List Database for the Energy Employee Occupational Illness Compensation Program; last updated 06-04-08; accessed 07-13-09; http://hss.energy.gov/healthsafety/fwsp/advocacy/faclist/findfacility.cfm

DOE-STD-1121-98, *DOE Standard Internal Dosimetry*; Department of Energy (DOE); December 1999; SRDB Ref ID: 12291

Dosimetry Records, 1953-1960, *Metals and Controls Dosimetry Records from March 1953 through June 1960*; 1953-1960; SRDB Ref ID: 15410

Dosimetry Records, 1960-1966, *Metals and Controls Dosimetry Records from June 1960 through 1966*; 1960-1966; SRDB Ref ID: 15411

Dosimetry Records, 1965-1967, *Metals and Controls Dosimetry Records from October 1965 through September 1967*; Vendor: Landauer; 1965-1967; SRDB Ref ID: 13654

Drummey, 1956, *Nation's First Private Nuclear Fuel Plant*; Jack Drummey; September 1956; SRDB Ref ID: 13634, pdf pp. 54-61

Elkins, H. B., 1957, letter to A. M. Carr from H. B. Elkins; no subject title; report on a site visit by Harold Bavley; November 5, 1957; SRDB Ref ID: 13669

Elkins, 1958, *Cover Letter for January 10th Plant Visit Report*, correspondence to T. J. Snyder; Hervey B. Elkins; January 15, 1958; SRDB Ref ID: 13669, pdf p. 3

Elliot, 2005, *Response to NIOSH Request for Personnel Exposure Under the EEIOCPA, letter to Oak Ridge Associated Universities, [Name Redacted], NIOSH ID [Redacted], Batch 651*, M. J. Elliot; Texas Instruments Incorporated, Attleboro, Massachusetts, February 14, 2005; SRDB Ref ID: 70579

FUSRAP, undated, *Database Report: MA.21 – Metals and Controls Corp., FSM Dept.*, FUSRAP (Formerly Utilized Sites Remedial Action Program) Stewardship Report, accessed on January 17, 2001 (http://www.projectperformance.com/fusrap/report_action.asp); SRDB Ref ID: 7092, pdf pp. 2-9

Huke, 1954, *Order for Thorium Foil*, correspondence and attachments; F. B. Huke; June 21, 1954; SRDB Ref ID: 62489—UCNI

Loysen, 1957, *Information regarding Possible Overexposure of X-Ray Department Personnel*, correspondence to Dr. Hervey B. Elkins; Peter Loysen; November 18, 1957; SRDB Ref ID: 13669, pdf pp. 14-15

M&C, unknown date-a, *The Aims that Guide Us*, booklet for employment at Metals and Controls; Metals and Controls, Inc.; unknown date; SRDB Ref ID: 13634, pdf pp. 2-20

M&C, unknown date-b, *Metals and Controls Corporation Fuel Element Fabrication*; Metals and Controls, Inc.; unknown date; SRDB Ref ID: 13634, pdf pp. 42-53

M&C, 1959, Quotation for providing nuclear materials to Argonne National Laboratory, to J. H. McKinley (ANL) from G. L. Williams (M&C Nuclear Metals, Inc).; November 30, 1959; SRDB Ref ID: 7063, pdf pp. 71-73

M&C, 1964, *Excerpts of Metals and Controls Standard Procedures Manual*; Metals and Controls, Inc.; 1964; SRDB Ref ID: 13642

M&C, 1968, *Metals and Controls Inc. Health and Safety Manual*; Metals and Controls, Inc.; August 15, 1968; SRDB Ref ID: 16985

NRC, 1997, *Removal of Texas Instruments, Inc. from Site Decommissioning Management Plan*, to The Commissioners from L. J. Callan, Executive Director of Operations, U.S. Nuclear Regulatory Commission; March 13, 1997; SRDB Ref ID: 21197

OCAS-TIB-009, *Estimation of Ingestion Intakes*, Rev. 0; Office of Compensation Analysis and Support (OCAS); Cincinnati, Ohio; April 13, 2004; SRDB Ref ID: 22397

ORAU, 2008, *Analytical Evaluation of the Amount of Radioactivity in a Radium Toggle Switch*; Oak Ridge Associated Universities (ORAU); May 1, 2008; SRDB Ref ID: 43010

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

ORAUT-OTIB-0070, *Dose Reconstruction During Residual Radioactivity Periods at Atomic Weapons Employer Facilities*, Rev. 00; Oak Ridge Associated Universities (ORAU); Oak Ridge, Tennessee; March 10, 2008; SRDB Ref ID: 41603

Remediation, 1996, *Texas Instruments, Attleboro, Massachusetts: Remediation of Exterior Areas Adjacent to Buildings 11 and 12*, Weston (consulting company); NRC License/Docket No.: SNM-23/70-33; Final Report Version 1.0; May 1996; SRDB Ref ID: 24625

Survey, 1997, *Texas Instruments, Attleboro, Massachusetts: Supplemental Surveys of Building Interiors, Overhead Structures, and Upper Walls*, prepared by CPS Environmental, Inc.; NRC License/Docket No.: SNM-23/70-33; February 1997; SRDB Ref ID: 24624

Thorium Shipments, 1952-1985, *FMPC Thorium Shipments to Customers 1952-1985 (Kilograms Thorium)*; SRDB Ref ID: 41375, pdf pp. 108-121

TI, 1959, *Nuclear Products: Uranium and Thorium Foil*, NU-3; Texas Instruments Incorporated, M&C Nuclear, Inc.; 1959; SRDB Ref ID: 13634, pdf p. 65

TI, 1960, *Fuels of the Future*, NU-1C; Texas Instruments Incorporated, M&C Nuclear, Inc.; 1960; SRDB Ref ID: 13634, pdf pp. 21-37

TI, 1982, Request *for Termination of Nuclear Regulatory Commission License SNM-23, Amendment One*; Texas Instruments Incorporated; November 1, 1982; SRDB Ref ID: 24623

TI, 1997, *Risk-Based Criteria for Addressing Radium within Flooring in Building 1*; Texas Instruments, Inc.; April 21, 1997; SRDB Ref ID: 26726

Uranium Shipments, 1955-1958, *Metals & Controls*, email from C. Shindledecker to K. Anders (DOE) regarding uranium shipments to Metals and Controls; August 3, 2001; SRDB Ref ID: 7092, pdf p. 25

Urinalysis Results, various years, Urinalysis Data Reports for M & C Nuclear, Inc.; Controls for Radiation, Inc.; various dates in the 1950s and 1960s; SRDB Ref ID: 13667

Attachment 1: Data Capture Synopsis

Table A1-1: Data Capture Synopsis For Metals And Controls Corp.

Data Capture Information	Documents Captured Description	Date Completed	Uploaded
Primary Site/Company Name: Metals and Controls Corp. AWE 1952-1967;Residual Radiation 1968-July 2006 Other Company Names: M & C M & C Nuclear Metals and Controls Nuclear Corp. Texas Instruments (Successor Company): Jon Weisberg, Attorney, 03/04/2009 Sensata Technologies (Successor Company): Steve Reynolds, General Counsel, 04/02/2007	Report of urinalysis, personnel monitoring surveys, contamination/radiation survey records of acid room #1, personnel external exposure report, personnel monitoring roster, film badge procedures, reactor fuel information, AEC and NRC licenses, applications, and amendments, health & safety manual for the HFIR Project, environmental surveys, and reports. Successor companies have no records beyond those already captured.	06/04/2009	90
State Contacted: Robert Walker, Director, MA Radiation Control Program	No relevant documents identified.	01/23/2007	0
Comprehensive Epidemiologic Data Resource (CEDR)	No relevant documents identified.	03/26/2008	0
Dade Moeller & Associates	Film badge results.	02/08/2006	1
Department of Labor/Paragon	Request for thorium foil.	12/29/2008	1
DOE Hanford Declassified Document Retrieval System (DDRS)	No relevant documents identified.	03/26/2008	0
DOE Legacy Management - Grand Junction	Clean-up of residual radioactive contamination information, survey of the Texas Instruments Inc. former burial site, contract between AEC and Metals and Controls, early history information, license SNM-23 documents and inspection reports, request for AEC to allocate 3 kilograms of U-235, and uranium production figures for Texas Instruments.	06/19/2009	33
DOE Legacy Management - MoundView (Fernald Holdings, includes Fernald Legal Database)	Fernald thorium metal production orders for Metals & Controls and thorium campaign data.	01/16/2008	10
DOE OpenNet	No relevant documents identified.	03/26/2008	0
DOE OSTI Energy Citations	No relevant documents identified.	03/28/2008	0
DOE OSTI Information Bridge	Site decommissioning management plan.	03/27/2008	1
Google	Removal of Metals and Controls from site decontamination management plan, radium buttons on toggle switches, Bureau of Mines metals yearbook, and an NRC list of contaminated sites.	04/04/2008	8

Table A1-1: Data Capture Synopsis For Metals And Controls Corp.			
Data Capture Information	**Documents Captured Description**	**Date Completed**	**Uploaded**
MJW Corporation	Symposium on occupational health experience and practices in the uranium industry.	09/30/2003	1
NARA - Atlanta	Excess uranium inventory at Metals and Controls.	03/20/2007	1
National Academies Press (NAP)	No relevant documents identified.	03/26/2008	0
National Nuclear Security Administration (NNSA) - Nevada Site Office	No relevant documents identified.	03/26/2008	0
NRC Agencywide Document Access and Management (ADAMS)	Flat fuel element documentation and site decontamination management requirements.	03/27/2008	5
ORAU Team	Project spreadsheet, data completion verification, and documented communications with successor company and process knowledge expert.	01/28/2008	4
Unknown	Airborne radioactivity survey, site history, surveys, material transfers with Fernald, thorium reports, and AEC reports to Congress.	07/22/2003	7
Washington State University (U.S. Transuranium and Uranium Registries)	No relevant documents identified.	03/27/2008	0
TOTAL			**162**

Table A1-2: Database Searches For Metals And Controls Corp.			
Database/Source	**Keywords**	**Hits**	**Uploaded**
CEDR http://cedr.lbl.gov/ COMPLETED 03/26/2008	"Metals and Controls" "M&C Nuclear" thorium "Texas Instruments" thorium	0	0
DOE OpenNet http://www.osti.gov/opennet/advancedsearch.jsp COMPLETED 03/26/2008	Metals and Controls Corporation in title Metals and Controls Corp. in title Texas Instruments in title "Metals and Controls Nuclear Corporation" in title "Metals and Controls Nuclear Corp" in title "Metals and Controls Corporation" in full text "Metals and Controls Corp." in full text "Texas Instruments" in full text	55	0

Table A1-2: Database Searches For Metals And Controls Corp.			
Database/Source	**Keywords**	**Hits**	**Uploaded**
	"Metals and Controls Nuclear Corporation" in full text "Metals and Controls Nuclear Corp" in full text "Metals & Controls Corporation" in full text "Metals & Controls Corp." in full text "Texas Instruments" in full text "Metals & Controls Nuclear Corporation" in full text "Metals & Controls Nuclear Corp" in full text "Metals and Controls" + 01/01/1947 - 03/19/2008 "M&C Nuclear" thorium "Texas Instruments" thorium		
DOE OSTI Information Bridge http://www.osti.gov/bridge/advancedsearch.jsp COMPLETED 03/27/2008	Metals and Controls Corporation in title Metals and Controls Corp. in title Texas Instruments in title Metals and Controls Nuclear Corporation in title Metals and Controls Nuclear Corp in title "Metals and Controls Corporation" in any field "Metals and Controls Corp." in any field "Texas Instruments" in any field "Texas Instruments" and radium in any field Metals and Controls Nuclear Corporation in any field "Metals and Controls Nuclear Corp" in any field "Metals & Controls Corporation" in any field "Metals & Controls Corp." in any field "Metals & Controls Nuclear Corporation" in any field "Metals & Controls Nuclear Corp" in any field "Metals and Controls" + 01/01/1947 - 03/19/2008 "M&C Nuclear" thorium "Texas Instruments" thorium, Attleboro	640	1
Energy Citations http://www.osti.gov/energycitations/ COMPLETED 03/28/2008	Research Org Contains (M & C Nuclear) Research Org Contains (Metals and Controls) "Metals and Controls" thorium "M&C Nuclear" thorium "Texas Instruments" thorium	97	0

Table A1-2: Database Searches For Metals And Controls Corp.			
Database/Source	**Keywords**	**Hits**	**Uploaded**
Google http://www.google.com COMPLETED 04/04/2008	radium "toggle switch" Navy radium "toggle switch" Navy "Metals and Controls" radioluminescent toggle switches "Metals and Controls Corporation" "Metals and Controls Nuclear Corporation" "Metals and Controls Nuclear Corp" "M & C Nuclear Corp" "Texas Instruments" Toggle Switch "USS Iowa" "Toggle Switch" "Navy Line Circuit Breakers" Radium Phosphorescence radium phosphorescence "toggle switch" "radium phosphorescence" "toggle switch" "Navy uses of radium in circuit boards" "Navy uses of radium in toggle switches" "Navy toggle switches" Navy "toggle switches" Navy radium "toggle switches" "USS Iowa" "Circuit Breakers" "USS Iowa" "Circuit Breaker" "Mil Spec" "Circuit Breakers" radium "Mil Spec" "Toggle Switch" radium Radium Lampenwerke toggle Radium Lampenwerke circuit "radium paint" "toggle switch" OR "Circuit Board" americium, OR Am241, OR Am-241, OR "AM 241", OR 241Am, OR 241-Am, OR "241 Am" +"Metals and Controls" -EEOICPA, -ORAU, -NIOSH ionium, OR Th230, OR Th-230, OR "Th 230", OR 230Th, OR 230-Th, OR "230 Th" +"Metals and Controls" -EEOICPA, -ORAU, -NIOSH thorium, OR Th232, OR Th-232, OR "Th 232", OR 232Th, OR 232-Th, OR "232 Th", OR "Z metal", OR myrnalloy, OR "chemical 10-66", OR "chemical 10-12" +"Metals and Controls" -EEOICPA, -ORAU, -NIOSH	37,248	8

Table A1-2: Database Searches For Metals And Controls Corp.			
Database/Source	**Keywords**	**Hits**	**Uploaded**
	ionium, OR UX1, OR UX2, OR Th-230, OR Th230, OR "Th 230", OR 230-Th, OR "230 Th", OR 230Th, OR Th-234, OR Th234, OR "Th 234", OR 234-Th, OR 234Th, OR "234 Th" +"Metals and Controls" -EEOICPA, -ORAU, -NIOSH radium, OR Ra-226, OR Ra226, OR "Ra 226", OR 226-Ra, OR 226Ra, OR 226-Ra, OR Ra-228, OR Ra228, OR "Ra 228", OR 228Ra, OR 228-Ra, OR "228 Ra" +"Metals and Controls" -EEOICPA, -ORAU, -NIOSH radon, OR Rn-222, OR Rn222, OR "Rn 222", OR 222Rn, OR 222-Rn, OR "222 Rn" +"Metals and Controls" -EEOICPA, -ORAU, -NIOSH thoron, OR Rn-220, OR Rn220, OR "Rn 220", OR 220Rn, OR 220-Rn, OR "220 Rn" +"Metals and Controls" -EEOICPA, -ORAU, -NIOSH americium, OR Am241, OR Am-241, OR "AM 241", OR 241Am, OR 241-Am, OR "241 Am" +"M&C Nuclear" -EEOICPA, -ORAU, -NIOSH ionium, OR Th230, OR Th-230, OR "Th 230", OR 230Th, OR 230-Th, OR "230 Th" +"M&C Nuclear" -EEOICPA, -ORAU, -NIOSH thorium, OR Th232, OR Th-232, OR "Th 232", OR 232Th, OR 232-Th, OR "232 Th", OR "Z metal", OR myrnalloy, OR "chemical 10-66", OR "chemical 10-12" +"M&C Nuclear" -EEOICPA, -ORAU, -NIOSH ionium, OR UX1, OR UX2, OR Th-230, OR Th230, OR "Th 230", OR 230-Th, OR "230 Th", OR 230Th, OR Th-234, OR Th234, OR "Th 234", OR 234-Th, OR 234Th, OR "234 Th" +"M&C Nuclear" -EEOICPA, -ORAU, -NIOSH radium, OR Ra-226, OR Ra226, OR "Ra 226", OR 226-Ra, OR 226Ra, OR 226-Ra, OR Ra-228, OR Ra228, OR "Ra 228", OR 228Ra, OR 228-Ra, OR "228 Ra" +"M&C Nuclear" -EEOICPA, -ORAU, -NIOSH		

Table A1-2: Database Searches For Metals And Controls Corp.			
Database/Source	**Keywords**	**Hits**	**Uploaded**
	radon, OR Rn-222, OR Rn222, OR "Rn 222", OR 222Rn, OR 222-Rn, OR "222 Rn" +"M&C Nuclear" -EEOICPA, -ORAU, -NIOSH thoron, OR Rn-220, OR Rn220, OR "Rn 220", OR 220Rn, OR 220-Rn, OR "220 Rn" +"M&C Nuclear" -EEOICPA, -ORAU, -NIOSH americium, OR Am241, OR Am-241, OR "AM 241", OR 241Am, OR 241-Am, OR "241 Am" +"Texas Instruments" +"Attleboro" -EEOICPA, -ORAU, -NIOSH ionium, OR Th230, OR Th-230, OR "Th 230", OR 230Th, OR 230-Th, OR "230 Th" +"Texas Instruments" +"Attleboro" -EEOICPA, -ORAU, -NIOSH thorium, OR Th232, OR Th-232, OR "Th 232", OR 232Th, OR 232-Th, OR "232 Th", OR "Z metal", OR myrnalloy, OR "chemical 10-66", OR "chemical 10-12" +"Texas Instruments" +"Attleboro" -EEOICPA, -ORAU, -NIOSH ionium, OR UX1, OR UX2, OR Th-230, OR Th230, OR "Th 230", OR 230-Th, OR "230 Th", OR 230Th, OR Th-234, OR Th234, OR "Th 234", OR 234-Th, OR 234Th, OR "234 Th" +"Texas Instruments" +"Attleboro" -EEOICPA, -ORAU, -NIOSH radium, OR Ra-226, OR Ra226, OR "Ra 226", OR 226-Ra, OR 226Ra, OR 226-Ra, OR Ra-228, OR Ra228, OR "Ra 228", OR 228Ra, OR 228-Ra, OR "228 Ra" +"Texas Instruments" +"Attleboro" -EEOICPA, -ORAU, -NIOSH radon, OR Rn-222, OR Rn222, OR "Rn 222", OR 222Rn, OR 222-Rn, OR "222 Rn" +"Texas Instruments" +"Attleboro" -EEOICPA, -ORAU, -NIOSH thoron, OR Rn-220, OR Rn220, OR "Rn 220", OR 220Rn, OR 220-Rn, OR "220 Rn" +"Texas Instruments" +"Attleboro" -EEOICPA, -ORAU, -NIOSH		

Table A1-2: Database Searches For Metals And Controls Corp.			
Database/Source	**Keywords**	**Hits**	**Uploaded**
	"Metals and Controls" + FUSRAP "M&C Nuclear" "Texas Instruments" thorium collimation OR photofluorography OR X-ray OR "X ray" OR Xray OR "x-ray screening" AND "Texas Instruments" AND Attleboro -NIOSH -EEOICPA -ORAU collimation OR photofluorography OR X-ray OR "X ray" OR Xray OR "x-ray screening" AND "Metals and Controls" AND Attleboro -NIOSH -EEOICPA –ORAU collimation OR photofluorography OR X-ray OR "X ray" OR Xray OR "x-ray screening" AND "M&C Nuclear" AND Attleboro -NIOSH -EEOICPA -ORAU		
Hanford DDRS http://www2.hanford.gov/declass/ COMPLETED 03/26/2008	"Metals and Controls" + thorium Document dates between 01/01/1947 - 03/22/2008 "M&C Nuclear" thorium "Texas Instruments" thorium	0	0
National Academies Press http://www.nap.edu/ COMPLETED 03/26/2008	"Metals and Controls" "M&C Nuclear" thorium "Texas Instruments" thorium	68	0
NNSA - Nevada Site Office www.nv.doe.gov/main/search.htm COMPLETED 03/26/2008	"Metals and Controls" + thorium "M&C Nuclear" thorium "Texas Instruments" thorium	0	0
NRC ADAMS Reading Room http://www.nrc.gov/reading-rm/adams/web-based.html COMPLETED 03/27/2008	Metals and Controls in title "Metals and Controls" in Title "Metal & Controls, Inc. in Addressee Affiliation "Texas Instruments, Inc" in Author Affiliation "Texas Instruments, Inc" in Addressee Affiliation "Toggle Switch" in title Radium in title "Metals and Controls" + thorium Document dates between 01/01/1947 - 03/22/2008	163	5

Table A1-2: Database Searches For Metals And Controls Corp.			
Database/Source	**Keywords**	**Hits**	**Uploaded**
	"M&C Nuclear" thorium "Texas Instruments" thorium		
U.S. Transuranium & Uranium Registries http://www.ustur.wsu.edu/ COMPLETED 03/27/2008	"Texas Instruments" OR "M&C Nuclear" OR "Metals and Controls" thorium	0	0

Table A1-3: OSTI Documents Ordered for Metals and Controls Corp.			
Document Number	**Document Title**	**Requested Date**	**Received Date**
No documents requested.			