SEC Petition Evaluation Report
Petition SEC-00175, Addendum

Report Rev #: Addendum Report Submittal Date: March 12, 2015

Subject Expert(s):	Christopher Miles, Mutty Sharfi
Site Expert(s):	N/A

Petition Administrative Summary

Petition Under Evaluation

Petition #	Petition Type	Petition Receipt Date	Qualification Date	DOE/AWE Facility Name
SEC-00175	83.13	June 30, 2010	September 7, 2010	Grand Junction Facilities

Petitioner-Requested Class Definition

All – Laborers, labor supervisors, painters, grounds personnel, and Fire Chief who worked at the Grand Junction Operations Office from 1943 through July 31, 2010.

Class Evaluated by NIOSH (In this Addendum)

The class of workers evaluated in this addendum includes all on-site personnel who worked at the Grand Junction Facilities site from February 1, 1975 through July 31, 2010.

NIOSH-Proposed Class(es) to be Added to the SEC (In this Addendum)

All employees of the Department of Energy, its predecessor agencies, and its contractors and subcontractors who worked at the Grand Junction Facilities site in Grand Junction, Colorado, during the period from February 1, 1975 through December 31, 1985, for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees in the Special Exposure Cohort.

Related Petition Summary Information

SEC Petition Tracking #(s)	Petition Type	DOE/AWE Facility Name	Petition Status
SEC-00175	83.13	Grand Junction	One class added to the SEC

Related Evaluation Report Information

Report Title	DOE/AWE Facility Name
SEC Petition Evaluation Report for Petition SEC-00175 (dated January 12, 2011)	Grand Junction Operations Office (now referred to as Grand Junction Facilities)

ORAU Lead Technical Evaluator: Christopher Miles **ORAU Peer Review Completed By:** Michael Kubiak

Peer Review Completed By:	[Signature on File] *Thomas Tomes*	3/12/2015 *Date*
SEC Petition Evaluation Reviewed By:	[Signature on File] *J. W. Neton*	3/13/2015 *Date*
SEC Evaluation Approved By:	[Signature on File]` *Stuart L. Hinnefeld*	3/13/2015 *Date*

This page intentionally left blank

SEC-00175 Addendum Summary: Grand Junction Facilities

This evaluation report addendum 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 presented an SEC-00175 Special Exposure Cohort Evaluation Report (NIOSH, 2011) regarding the Grand Junction Facilities (Grand Junction – previously designated as the Grand Junction Operations Office [GJOO]) to the Advisory Board on Radiation and Worker Health (Advisory Board) on February 24, 2011. In its report, NIOSH evaluated the feasibility of reconstructing radiation doses for all workers who worked at Grand Junction during the time period of 1943 through July 31, 2010. Based on its research at that time, NIOSH defined a single class of employees for which it could not estimate radiation doses with sufficient accuracy from March 23, 1943 through January 31, 1975.

The internal dose reconstruction infeasibility identified by NIOSH for the March 23, 1943 through January 31, 1975 time period was due to a lack of data necessary to fully reconstruct internal doses during that time period, including doses from radon. By February 1, 1975, sampling operations had ended, and the large quantities of uranium concentrate, the source of radon emissions, had been removed from the site. The external dose reconstruction infeasibility identified by NIOSH for the March 23, 1943 through December 31, 1959 time period was due to a lack of external dose monitoring data. Beginning in 1960, worker exposures were reported to the Atomic Energy Commission (AEC) and DOE in the form of annual reports. Those reports provide sufficient information to bound external exposures at Grand Junction after 1959.

NIOSH concluded in its initial SEC-00175 Evaluation Report that internal dose reconstruction was likely feasible for the period from February 1, 1975 through July 31, 2010, and that external dose reconstruction was likely feasible for the period from January 1, 1960 through July 31, 2010. NIOSH also found it likely feasible to reconstruct occupational medical dose for the Grand Junction workers with sufficient accuracy from March 23, 1943 through July 31, 2010.

During its presentation of the initial SEC-00175 Evaluation Report to the Advisory Board, NIOSH indicated that it had recently received additional data that was pertinent to the post-1975 period at Grand Junction, which had not yet been fully evaluated. At that time, NIOSH indicated that it would continue its evaluation of the post-1975 period and include its findings in a revision to the SEC-00175 Evaluation Report, or in the issuance of an addendum. The purpose of this addendum is to fulfill that commitment.

NOTE: This SEC-00175 Evaluation Report Addendum only addresses those sections in the NIOSH 2011 Grand Junction Operations Office (GJOO) (now referred to as Grand Junction Facilities) Site Evaluation Report that require further discussion; therefore, the section numbering and table numbering is not contiguous. For context, some of the original surrounding text may be included with the revised text. The sections requiring additional discussion begin below.

Petition Evaluation Report Addendum Summary

Class Evaluated by NIOSH (in this Addendum)

In its 2011 Evaluation Report, NIOSH defined a single class of employees for which it could not estimate radiation doses with sufficient accuracy from March 23, 1943 through January 31, 1975. NIOSH also concluded in the 2011 evaluation that internal and external dose reconstruction were likely feasible for the period February 1, 1975 through January 31, 2010. Since issuing the 2011 SEC-00175 Evaluation Report, NIOSH has continued its evaluation of the post-1975 period. This current report documents that effort. The class of workers evaluated in this SEC-00175 Addendum includes all on-site personnel who worked at the Grand Junction Facilities site from February 1, 1975 through July 31, 2010.

NIOSH-Proposed Class to be Added to the SEC

Based on its continued research, and consideration of uranium and thorium operations discovered after the issuance of its 2011 Evaluation Report, NIOSH has concluded that there are insufficient data available to estimate uranium or thorium intakes, including their associated progeny, prior to 1986. NIOSH has therefore expanded the class of employees for which NIOSH recommends inclusion in the SEC. The NIOSH-proposed class resulting from this present evaluation includes all employees of the Department of Energy, its predecessor agencies, and its contractors and subcontractors who worked at the Grand Junction Facilities site in Grand Junction, Colorado, during the period from February 1, 1975 through December 31, 1985, for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees in the Special Exposure Cohort.

Feasibility of Dose Reconstruction

In addition to the dose reconstruction infeasibilities identified in the 2011 Evaluation Report, NIOSH now finds it is not feasible to estimate internal exposures with sufficient accuracy for all workers at the site from February 1, 1975 through December 31, 1985. In this SEC-00175 Addendum, NIOSH has determined that there is insufficient information to estimate internal dose from intakes of uranium, thorium, and their associated progeny, from February 1, 1975 through December 31, 1985. NIOSH has determined however, that partial internal dose reconstructions can be performed for workers who were monitored for uranium or thorium intakes during this period.

With the exception of the class defined for the period from February 1, 1975 through December 31, 1985, per EEOICPA and 42 C.F.R. § 83.13(c)(1), NIOSH has established that it has access to sufficient information to: (1) estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred in plausible circumstances; or (2) estimate radiation doses more precisely than an estimate of maximum dose. Information available to NIOSH is sufficient to document or estimate the maximum internal and external potential exposure to members of the evaluated class under plausible circumstances during the specified period from January 1, 1986 through July 31, 2010.

The NIOSH dose reconstruction feasibility findings for this current evaluation are based on the following:

- Principal sources of internal radiation dose for members of the evaluated class included exposures to natural uranium and thorium and their decay products. The modes of exposure were inhalation and ingestion during the processing of ores or ore concentrates or during the subsequent re-suspension of these materials.

- In this current evaluation, NIOSH has determined that there are insufficient data available to bound intakes of uranium, thorium, and their associated long-lived progeny, for the period from February 1, 1975 through December 31, 1985. Although sampling operations had ended by February 1, 1975, and the large quantities of uranium concentrate (the major source of radon emissions) had been removed from the site, NIOSH has determined that smaller-scale operations involving crushing and grinding of uranium and thorium ores continued at least through 1988. Operations in the Sample Plant involving high-grade uranium and thorium ores, particularly the crushing and grinding operations, were a potential source of internal exposures. NIOSH has now concluded that there are insufficient internal dosimetry data or air monitoring data available to estimate uranium or thorium intakes prior to 1986. Beginning in the first quarter of 1986, air monitoring data are available which are sufficient to bound intakes of uranium and thorium until the site internal dosimetry program was fully implemented by 1991.

- Based on the lack of internal dose monitoring data or air monitoring data for Grand Junction Facilities workers during the period from February 1, 1975 through December 31, 1985, NIOSH has determined that sufficiently accurate internal dose reconstruction is not feasible. However, NIOSH has identified sufficient information and data to support bounding internal dose estimates for the period from January 1, 1986 through July 31, 2010, using available air monitoring and bioassay data.

- NIOSH finds that it is likely feasible to reconstruct dose from radon for the Grand Junction Facilities workers with sufficient accuracy from February 1, 1975 through July 31, 2010.

- NIOSH finds that it is likely feasible to reconstruct occupational medical dose for the Grand Junction Facilities workers with sufficient accuracy from February 1, 1975 through July 31, 2010.

- NIOSH finds that it is likely feasible to reconstruct external dose for the Grand Junction Facilities workers with sufficient accuracy from February 1, 1975 through July 31, 2010.

Pursuant to 42 C.F.R. § 83.13(c)(1), NIOSH determined that there is insufficient information for the period from February 1, 1975 through December 31, 1985 to either: (1) estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred under plausible circumstances by any member of the class; or (2) estimate the radiation doses of members of the class more precisely than a maximum dose estimate.

Although NIOSH found that it is not possible to completely reconstruct radiation doses for 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 the Grand Junction Facilities during the period from February 1, 1975 through December 31, 1985, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate.

NIOSH concludes pursuant to 42 C.F.R. § 83.13(c)(1), that there is sufficient information to either: (1) estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred under plausible circumstances by any member of the class; or (2) estimate the radiation doses of members of the class more precisely than a maximum dose estimate for the period at Grand Junction Facilities from January 1, 1986 through July 31, 2010.

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 from February 1, 1975 through December 31, 1985.

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 at Grand Junction Facilities or in combination with work days within the parameters established for other SEC classes. For the period from January 1, 1986 through July 31, 2010, a health endangerment determination is not required because NIOSH has determined that it has sufficient information to estimate dose for the members of the evaluated class.

Table of Contents

Tables

This page intentionally left blank

SEC Petition Evaluation Report Addendum for SEC-00175

1.0 Purpose and Scope

This report evaluates the feasibility of reconstructing doses for all on-site personnel who worked at Grand Junction Facilities from February 1, 1975 through July 31, 2010. It provides information and 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.

This evaluation was conducted in accordance with the requirements of EEOICPA, 42 C.F.R. pt. 83, and the guidance contained in the Division of Compensation Analysis and Support's (DCAS) *Internal Procedures for the Evaluation of Special Exposure Cohort Petitions*, OCAS-PR-004.[1]

3.2 Class Evaluated by NIOSH

NIOSH concluded in its 2011 SEC-00175 Evaluation Report that internal and external dose reconstruction was likely feasible for the period from February 1, 1975 through July 31, 2010. NIOSH also concluded in that 2011 evaluation that it is likely feasible to reconstruct occupational medical dose for the Grand Junction workers with sufficient accuracy. During its February 2011 presentation of the initial SEC-00175 Evaluation Report to the Advisory Board, NIOSH indicated that it had recently received additional data that were pertinent to the post-1975 period at Grand Junction which had not yet been fully evaluated. At that time, NIOSH indicated that it would continue its evaluation of the post-1975 period. The class of workers evaluated in this addendum includes all on-site personnel who worked at the Grand Junction Facilities site from February 1, 1975 through July 31, 2010.

3.3 NIOSH-Proposed Class to be Added to the SEC

Based on its research of the class under evaluation, NIOSH has defined a single class of employees for which NIOSH cannot estimate radiation doses with sufficient accuracy. The NIOSH-proposed class to be added to the SEC includes all employees of the Department of Energy, its predecessor agencies, and its contractors and subcontractors who worked at the Grand Junction Facilities site, in Grand Junction Colorado, during the period from February 1, 1975 through December 31, 1985, for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees in the SEC.

[1] DCAS was formerly known as the Office of Compensation Analysis and Support (OCAS).

4.3 Facility Employees and Experts

To obtain additional information for its initial evaluation of Petition SEC-00175, NIOSH interviewed eight former Grand Junction employees and one former Grand Junction contractor. Those interviews were conducted by telephone by members of the ORAU Team; the references for those documented communications are identified in Section 4.3 of the initial SEC-00175 Evaluation Report. As part of this current evaluation, NIOSH conducted eight additional interviews of former Grand Junction Facility employees. References for these more recent interviews are provided below:

- Personal Communication, 2014a, *Personal Communication with a Former Grand Junction Employee*; Telephone Interview by ORAU Team; October 15, 2014; SRDB Ref ID: 137017

- Personal Communication, 2014b, *Personal Communication with a Former Grand Junction Employee*; Telephone Interview by ORAU Team; October 17, 2014, 12:00 PM EST; SRDB Ref ID: 137895

- Personal Communication, 2014c, *Personal Communication with a Former Grand Junction Employee*; Telephone Interview by ORAU Team; October 21, 2014, 3:00 PM EST; SRDB Ref ID: 137019

- Personal Communication, 2014d, *Personal Communication with a Former Grand Junction Employee*; Telephone Interview by ORAU Team; October 31, 2014; SRDB Ref ID: 138965

- Personal Communication, 2014e, *Personal Communication with a Former Grand Junction Employee*; Telephone Interview by ORAU Team; December 18, 2014, 11:00 AM EST; SRDB Ref ID: 139114

- Personal Communication, 2014f, *Personal Communication with a Former Grand Junction Employee*; Telephone Interview by ORAU Team; December 11, 2014, 11:00 AM EST; SRDB Ref ID: 139115

- Personal Communication, 2014g, *Personal Communication with a Former Grand Junction Employee*; Telephone Interview by ORAU Team; December 10, 2014, 11:00 AM EST; SRDB Ref ID: 139116

- Personal Communication, 2014h, *Personal Communication with a Former Grand Junction Employee*; Telephone Interview by ORAU Team; October 24, 2014, 9:00 AM MST; SRDB Ref ID: 139128

4.5 NIOSH Site Research Database

NIOSH also examined its Site Research Database (SRDB) to locate documents supporting the assessment of the evaluated class. At the time when the initial SEC-00175 Evaluation Report was written, there were 603 documents in this database that were identified as pertaining to Grand Junction. Presently, there are 1,719 documents in the database pertaining to Grand Junction. These documents, particularly the more recent documents, were evaluated for their relevance to this petition. The documents include historical background on data types, monitoring, dust sampling, air monitoring, urinalysis data, fecal analysis, the radiological control program, medical monitoring, process materials, and process descriptions.

5.0 Radiological Operations Relevant to the Class Evaluated by NIOSH

This present evaluation is for the time period at the Grand Junction Facilities from February 1, 1975 through July 31, 2010. This section includes relevant discussions of the earlier years because those early operations would have likely resulted in residual contamination potentially impacting workers in later years. The following subsections, therefore, summarize radiological operations at the Grand Junction Facilities from 1943 through July 31, 2010, and the information available to NIOSH to characterize particular processes and radioactive source materials. From available sources NIOSH has gathered process and source descriptions, information regarding the identity and quantities of the radionuclides of concern, and information describing processes through which radiation exposures may have occurred and the physical environment in which they may have occurred. The information included within this SEC-00175 Evaluation Report Addendum is intended only to be a summary of the available information and a summary of evaluations that have been performed after the presentation of the original SEC-00175 Evaluation Report.

5.1.1 Grand Junction General Operations

In 1943 the Manhattan Engineer District purchased the Grand Junction site. A refinery was operated on the site from 1943 to 1946 to treat and concentrate uranium oxide from "green sludge," a byproduct of vanadium production in the area. Approximately 1,180 tons of uranium oxide and a comparable amount of vanadium concentrate were produced and shipped offsite for further refining (WASTREN, 2001b, PDF p. 15).

Beginning in 1947, AEC operated a uranium concentrate sampling plant and assay laboratory on site. Between 1948 and 1971, a total of approximately 172,500 tons of uranium oxide and 14,500 tons of vanadium oxide passed through the facility in steel drums. The remaining stockpiled vanadium and uranium concentrates were shipped offsite in 1965 and 1975, respectively (WASTREN, 2001b, PDF p. 15).

By February 1, 1975, concentrate sampling operations had ended and the site mission had changed to mainly off-site work (e.g., National Uranium Resource Evaluation (NURE) and Uranium Mill Tailings Remedial Action Project (UMTRA); although on-site work with uranium and thorium ores and mill tailings continued in the Sample Preparation Laboratory, Building 7A.

Building 7A was constructed as an addition to Building 7 in 1956. Reconstruction and remodeling of the facility took place during the period from 1978 through 1986 (WASTREN, 2001a). There were no renovations to the facility after 1986.

Work in the Sample Preparation Laboratory included processing thousands of samples for analysis. It also involved numerous short-term processing efforts of uranium and thorium ores, and tailings used in the fabrication of calibration materials and pads.

The Sample Preparation Laboratory (Building 7A) in Building 7 was the location with the highest potential for internal dose after January 31, 1975. The grinding, crushing, and preparation of these samples occurred in Building 7A. In March 2001, the sample preparation operations were moved to Building 46. Analytical chemistry operations ended in late 2003. Some sample preparation for off-site analysis was conducted in a small area of Building 32 until at least 2007.

Instrument Calibration Models

From 1974 to 1984, Grand Junction supported the NURE Program, which was a nationwide uranium modeling effort. During this program, mainly non-ore samples (drilling cores, etc.) were collected from off-site locations. The samples were returned to the site for processing. Some of the samples were crushed, ground to the proper size, and blended in the sample preparation area in Building 7A, prior to analysis in the Analytical Chemistry Laboratory, Building 20. The sample preparation activities presented the greatest potential for internal exposures after the end of concentrate sampling and storage in January 1975.

Instrument calibration models, consisting of concrete mixed with radioactive materials, were constructed at Grand Junction over its history. The models were in the form of pads and boreholes. Models were developed to support the NURE program as well as the remediation programs.

Thorium Models

Thorium was never routinely processed at Grand Junction. However, Th-232 was handled sporadically in relatively small quantities to develop the instrument calibration sources or models (pads and boreholes) for ore exploration and environmental remediation. Although the small amount of Th-232 present in the calibration models (approximately 40 kg) was orders of magnitude less than the tons of uranium ore, uranium concentrate, and uranium mill tailings handled on site, there still existed the potential for intakes of Th-232 during the 1975-1988 time period, particularly during thorium ore crushing and grinding operations in the Sample Preparation Laboratory.

NIOSH has identified at least twenty-seven calibration models containing thorium that were manufactured at Grand Junction between 1975 and 1985. Descriptions of these models, including details about the manufacturing process for some of them, can be found in various documents that are available to NIOSH (Mathews, 1978; Ward, 1978; Leino, 1994). The model manufacturing process generally involved crushing and grinding thorium ore to a specified mesh size and then blending it down to a much lower concentration with sand or some other non-radioactive diluents. For some of the thorium-containing models, monazite sand was the thorium starting material. This sand was of the proper mesh size and did not require crushing or grinding. The blended mixtures would then be

mixed uniformly with cement to form solid shapes. For the bore-hole type models the shapes were generally cylindrical, with dimensions of several feet wide by several feet deep, with a bore-hole drilled through the center that radiation detection probes could be lowered into for calibration.

There were only two campaigns involving thorium that took place after 1985. The first of those campaigns is described in a 1987 report, *Construction and Characterization of the TL/TH Thorium Calibration Pads* (Steele, 1987). Four sets of thorium-232 containing pads were constructed (2 pads per set). Each set consisted of a high (TH) and a low (TL) pad. Each pad was 5-ft in diameter and 2-ft tall, with a 3-inch diameter hole drilled horizontally through the center. The TH pads were approximately 45 pCi/g Th-232 and the TL pads were about 11 pCi/g. Their construction required approximately 200 pounds of thorium ore. The thorium concentration of the starting material (ore) was 7441 pCi/g (6.8% Th). This operation, at least the thorium handling part of the operation, was completed in 1986.

The only other thorium campaign taking place at Grand Junction after 1985 was the manufacture of soil-based uranium disequilibrium and mixed uranium-thorium series radionuclide reference materials (Donivan, 1988). The operation was completed in 1988. Two sets of radionuclide reference materials were prepared for use by remedial action contractors and cognizant Federal and State agencies. A total of six reference materials, two sets comprising three reference materials each, were prepared with varying concentrations of radionuclides using mill tailings materials, ores, and a river-bottom soil diluent. One set (disequilibrium set) contains varying amounts of uranium with nominal amounts of radium-226. The other set (mixed-nuclide set) contained varying amounts of U-238 and Th-232 decay series nuclides. All materials were ground, dried, and blended thoroughly to ensure homogeneity. A total of 7.8 kg of thorium ore starting material was used for this operation.

Uranium Models

In addition to the calibration models containing thorium, as described in the discussion above, very similar calibration models were also prepared which contained uranium. Generally speaking, whenever thorium models were manufactured, companion models containing uranium were also manufactured during the same time period. The starting material for the uranium models was high-grade uranium ore (5-10% U_3O_8) or uranium mill tailings. Like the thorium model production operations, grinding and crushing of uranium ore (or tailings) was necessary to produce the uranium models.

5.2.1 Internal Radiological Exposure Sources from Grand Junction Operations

Inhalation and ingestion of uranium- and thorium-ore dust and uranium-concentrate dust generated during the preparation of samples for analysis, and in the manufacture of calibration models and reference materials, were the primary sources of internal exposure for Grand Junction workers after January 1975.

5.2.1.1 Uranium

The most radiologically hazardous on-site work after January 1975 appears to have taken place in the sample preparation area of Building 7. A 1980 environmental monitoring report (Environmental

Monitoring, 1980) stated that the Sample Plant prepared approximately 1000 samples per month, but that the majority of the samples were not uranium ores but were exploration samples of low radioactivity. It indicated that the principal environmental problem was the dust generated from grinding and crushing. The report also states that occasionally, very high-grade uranium or thorium ore (5-10 percent U_3O_8 or ThO_2) were handled in the preparation of calibration models. This operation could produce dust which exceeded the uranium-in-dust standard. The relevant American Conference of Government and Industrial Hygienists (ACGIH) standard at the time was 0.2 mg/m^3 of uranium.

5.2.1.2 Thorium

Thorium ore and thorium-containing monazite sand were occasionally used in the construction of instrument calibration models (see Section 5.1.1 above). Crushing and grinding thorium ore during these activities would have resulted in a potential airborne thorium hazard (Environmental Monitoring, 1980).

6.1 Available Grand Junction Internal Monitoring Data

Bioassay Data

When the Grand Junction site was established, it was recognized that bioassay may be required for personnel "directly exposed to special materials" (Ruhoff, 1943). However, there is no comprehensive database of bioassay results for the Grand Junction site. A limited number of bioassay results are contained in documents captured by NIOSH for the period 1945 through 1999, as shown in Table 6-1.

There are samples from 1984 to 1986 (Bioassay, Jan1984-Dec1986). These samples, however, are primarily identified as initial (baseline) samples, and most are for off-site remediation workers, making the data irrelevant for estimating on-site intakes. These were urine and fecal samples which were generally analyzed by alpha spectroscopy. The samples were typically analyzed for U-234/235/238, but often included Th-230 and Ra-226. There are also fecal bioassay data for some workers who were performing grinding operations with uranium mill tailings in the Sample Preparation Laboratory (Bioassay, Apr1985-Mar1987). The samples collected for the post-1975 period were for both off-site and on-site work. Therefore, for a given worker, the samples might not be for work that is covered by EEOICPA. For part of this period, there was a pre-job sampling program, and many of the samples were collected for this purpose. After 1990, the practice was to collect pre-job samples but discard them after a period (about one year) if the worker had not been exposed to greater than 10% of a DAC or 40 DAC-hours. There is some duplication of the data available to NIOSH. Data were sometimes re-sent by the contract laboratories due to reanalyzed samples, etc. Some sample collection dates are missing in the references. Some of the gaps in bioassay data might represent periods of little activity. For example, the Grand Junction Project Office Remedial Action Program (GJPORAP) started in 1984, when initial surveys and assessments were completed. The actual period of decontamination and decommissioning (D&D) work did not begin until 1988, with the "extensive" decontamination of Buildings 33 and 35 (Vanderheiden, 1993) and the start of the remediation of the outdoor tailings contamination.

Within Table 6-1, it should be noted that there is some overlap in the references and that some of the early results are not very legible. The small number of results captured to date is due to two factors: (1) only a relatively small number of workers on site directly handled the radioactive materials; workers were sampled based on perceived likelihood of intakes (just as workers are sampled under current DOE standards); and (2) the captured data are from general site records rather than individual exposure records (which would likely represent a more complete dataset).

A review of the claimants in NIOSH's database indicates that some workers do have bioassay measurements included in their records; however, there are not enough claimants with bioassay information available to indicate which workers were routinely included in a bioassay program.

Initially, urine samples were analyzed for total uranium by fluorometric methods by the AEC New York Operations Office Health and Safety Laboratory. It appears that bioassay samples were subsequently analyzed on site, but the dates are unclear. In 1971, the sampling plant was shut down (GJ Contractors, undated), and by early 1975, the remaining drums of uranium concentrate stored on site were shipped out. While analytical laboratory operations continued, the source term for most workers was then reduced to residual building and environmental contamination. The on-site analytical laboratory did not accept high-activity samples, and the workers were not required to be in a bioassay program (Personal Communication, 2010h). Bioassay requirements were determined on a case-by-case basis by the Health and Safety Plan that governed the specific decontamination and decommissioning project (Henwood, 1986; Personal Communication, 2010c). A site procedure entitled *Internal Radiation Dosimetry Program* was revised in 1990 to comply with DOE Order 5480.11; the revision required weekly samples for subcontractors and monthly samples for site employees if they were working in an Airborne Radioactivity Area (Procedure, 1990).

Table 6-1: Grand Junction Office Bioassay Data in the Site Research Database
(This table spans multiple pages)

Year	Approx. No. of Results	Company/Organization	SRDB Ref IDs	Notes
1945	11	GJ Mill (Refinery)	16855	U in urine, 1 set[a] in Jun
1949	7	None shown	3306	U in urine, all from Dec.
1953	11	American Cyanamid	6645	U in urine, 2 sets - Jul and Dec
1953	4	American Cyanamid	11452	U in urine, 1 set in Dec
1953	32	American Smelting	3319	U in urine, 3 sets Feb, May, and Sep
1953	22	American Smelting	11452	U in urine, 2 sets - Feb and May
1954	10	American Cyanamid	6645	U in urine, 2 sets - Feb and Jul
1954	10	American Cyanamid	11452	U in urine, 2 sets - Feb and Jul
1954	24	American Smelting	3319	U in urine, 2 sets - Jan and Nov
1954	13	American Smelting	11452	U in urine, 2 sets - Jan and May
1956	66	Lucius Pitkin	3307, 3397	U in urine; 3 sets - May, Jun, and Oct
1956	1	None shown	76923	U in urine; result reported Aug 0.009 mg/l
1956	1	None shown	76924	U in urine; result reported Jul 0.078 mg/l
1956	47	Lucius Pitkin	98104	Urinalysis Report, collected 5/24/11
1957	49	Lucius Pitkin	3307, 3397	U in urine; 2 sets - May and Oct
1957	49	Lucius Pitkin	98104	Urinalysis Report, collected 5/24/11
1958	25	Lucius Pitkin	3307, 3397	U in urine, 1 set - Jun

Table 6-1: Grand Junction Office Bioassay Data in the Site Research Database
(This table spans multiple pages)

Year	Approx. No. of Results	Company/Organization	SRDB Ref IDs	Notes
1958	29	Lucius Pitkin	11451	U in urine, 1 set in Dec
1958	1	None shown	76938	One "composite" U in urine sample, 0.016 mg/l from Feb
1958	1	None shown	76940	U in urine; one sample, 0.032 mg/l from Jan
1958	63	Lucius Pitkin	98104	Urinalysis Report, collected 5/24/11
1959	31	Lucius Pitkin	3307, 3397	U in urine, 1 set - Jun; plus 1 Aug result
1959	28	Lucius Pitkin	11451	U in urine, 1 set in Dec
1959	59	Lucius Pitkin	98104	Urinalysis Report, collected 5/24/11
1960	49	Lucius Pitkin	3307, 3397	U in urine, 2 sets - Jun and Dec
1960	49	Lucius Pitkin	98104	Urinalysis Report, collected 5/24/11
1961	57	Lucius Pitkin	3307, 3397	U in urine; 2 sets - Jun and Dec; plus 2 Jan results and 1 Mar result.
1961	58	Lucius Pitkin	98104	Urinalysis Report, collected 5/24/11
1962	26	Lucius Pitkin	3307, 3397	U in urine, 1 set - Jun; plus 1 Jan result
1962	49	Lucius Pitkin	98104	Urinalysis Report, collected 5/24/11
1963	44	Lucius Pitkin	98104	Urinalysis Report, collected 5/24/11
1964	See Notes	Lucius Pitkin	14442	Annual report for 1964. 8 employees sampled in Jul and Dec. One additional in Dec. Results were in the range from 0.008 to 0.021 mg/l, below the reference point[b] (RP) of 0.05 mg/l.
1964	10	Lucius Pitkin	98104	Urinalysis Report, collected 5/24/11
1965	47	Lucius Pitkin	98104	Urinalysis Report, collected 5/24/11
1966	64	Lucius Pitkin	98104	Urinalysis Report, collected 5/24/11
1967	71	Lucius Pitkin	98104	Urinalysis Report, collected 5/24/11
1968	70	Lucius Pitkin	98104	Urinalysis Report, collected 5/24/11
1969	See Notes	Lucius Pitkin	13800	Annual report for 1969. In Mar, 23 samples were collected. All were below the reference point of 0.025 mg/l with 4 exceptions who were re-sampled. In Oct, 17 samples were collected and all were below the RP with again 4 exceptions. Re-sampling showed 3 of 4 were below. Two employees are listed by name with results of 0.054 and 0.077 mg/l.
1969	55	Lucius Pitkin	98104	Urinalysis Report, collected 5/24/11
1970	27	Lucius Pitkin	98104	Urinalysis Report, collected 5/24/11
1971	30	Lucius Pitkin	98104	Urinalysis Report, collected 5/24/11
1972	See Notes	Lucius Pitkin	13802	Annual report for 1972. No. of samples not given, but all were in the range of 0.001 to 0.008 mg/l.
1972	11	Lucius Pitkin	98104	Urinalysis Report, collected 5/24/11
1973	See Notes	Lucius Pitkin	13803	Annual report for 1973. No. of samples not given, but all were in the range of 0.001 to 0.056 mg/l.
1973	52	Lucius Pitkin	98104	Urinalysis Report, collected 5/24/11
1974	14	Lucius Pitkin	98104	Urinalysis Report, collected 5/24/11

Table 6-1: Grand Junction Office Bioassay Data in the Site Research Database
(This table spans multiple pages)

Year	Approx. No. of Results	Company/Organization	SRDB Ref IDs	Notes
1984	1	Bendix	97742	Exposure history for specific individual, collected 5/23/11
1984	1	Bendix	97813	Exposure history for specific individual, collected 5/25/11
1984-1986	1589	Bendix	98107	Urinalysis Sampling Log, collected 5/24/11
1986	16	INEL	97808	Bioassay Report for Grand Junction, collected 5/21/11
1986	8	UNC Technical Services	98096	Bioassay Report for Grand Junction, collected 5/24/11
1986	8	INEL	125901	Bioassay Report for Grand Junction, collected 5/24/11
1990	2	Lawrence Livermore National Laboratory	97808	Internal Dose Assessments for 1990, collected 5/21/11
1990	133	Thermo Analytical	97828	Radiological Analysis Results for Ra in urine, collected 5/24/11
1990	109	GeoTech	97828	1990 Bioassay Results, collected 5/24/11
1991	8	Thermo Analytical	97828	Radiological Analysis Results in urine, collected 5/24/11
1991	20	Thermo Analytical	97847	Radiological Analysis Results in urine, collected 5/24/11
1991	20	Thermo Analytical	97849	Radiological Analysis Results in urine, collected 5/24/11
1991	6	Thermo Analytical	97851	Radiological Analysis Results in urine, collected 5/24/11
1991	43	Thermo Analytical	97852	Radiological Analysis Results in urine, collected 5/24/11
1991	30	Thermo Analytical	97854	Radiological Analysis Results in urine, collected 5/24/11
1991	30	Thermo Analytical	97856	Radiological Analysis Results in urine, collected 5/24/11
1991	5	Thermo Analytical	97857	Radiological Analysis Results in urine, collected 5/24/11
1991	8	Thermo Analytical	97858	Radiological Analysis Results in urine, collected 5/24/11
1991	1	GeoTech	97637	Exposure history for specific individual, collected 5/23/11
1991	1	GeoTech	97679	Exposure history for specific individual, collected 5/23/11
1991	22	Thermo Analytical	97838	Radiological Analysis Results in urine, collected 5/24/11
1991	18	Thermo Analytical	97839	Radiological Analysis Results in urine, collected 5/24/11

Table 6-1: Grand Junction Office Bioassay Data in the Site Research Database
(This table spans multiple pages)

Year	Approx. No. of Results	Company/Organization	SRDB Ref IDs	Notes
1991	11	Thermo Analytical	97842	Radiological Analysis Results in urine, collected 5/24/11
1991	5	Thermo Analytical	97843	Radiological Analysis Results in urine, collected 5/24/11
1991	13	Thermo Analytical	97871	Radiological Analysis Results in urine, collected 5/24/11
1991	20	Thermo Analytical	97878	Radiological Analysis Results in urine, collected 5/24/11
1991	24	Thermo Analytical	97880	Radiological Analysis Results in urine, collected 5/24/11
1991	20	Thermo Analytical	97882	Radiological Analysis Results in urine, collected 5/24/11
1991	65	Thermo Analytical	97883	Radiological Analysis Results in urine, collected 5/24/11
1991	20	Thermo Analytical	97884	Radiological Analysis Results in urine, collected 5/24/11
1991	27	Thermo Analytical	97885	Radiological Analysis Results in urine, collected 5/24/11
1991	20	Thermo Analytical	97886	Radiological Analysis Results in urine, collected 5/24/11
1991	7	Thermo Analytical	97887	Radiological Analysis Results in urine, collected 5/24/11
1991	32	Thermo Analytical	97888	Radiological Analysis Results in urine, collected 5/24/11
1991	1	Thermo Analytical	97889	Radiological Analysis Results in urine, collected 5/24/11
1991	63	Thermo Analytical	97890	Radiological Analysis Results in urine, collected 5/24/11
1991	31	Thermo Analytical	97891	Radiological Analysis Results in urine, collected 5/24/11
1991	24	Thermo Analytical	97892	Radiological Analysis Results in urine, collected 5/24/11
1991	49	Thermo Analytical	97893	Radiological Analysis Results in urine, collected 5/24/11
1991	49	Thermo Analytical	97894	Radiological Analysis Results in urine, collected 5/24/11
1991	49	Thermo Analytical	97895	Radiological Analysis Results in urine, collected 5/24/11
1991	49	Thermo Analytical	98090	Radiological Analysis Results in urine, collected 5/24/11
1991-1992	139	GeoTech	97763	Radon log in sheets, collected 5/24/11
1992	15	Chem-Nuclear Geotech	97762, 97809	Internal Dose Assessments for 1992, collected 5/21/11

Table 6-1: Grand Junction Office Bioassay Data in the Site Research Database
(This table spans multiple pages)

Year	Approx. No. of Results	Company/Organization	SRDB Ref IDs	Notes
1992	7	GeoTech	97792	Memo about bioassay results and recommended follow-up testing, collected 5/23/11
1992	28	GeoTech	97784	Evaluation of Uranium Oxide Spill, collected 5/23/11
1992	18	Thermo Analytical	97841	Radiological Analysis Results in urine, collected 5/24/11
1995	12	RUST Geotech	97828	Internal Radiation Dose Assessment for Individuals Visiting, collected 5/24/11
1995	7	RUST Geotech	90511	7 fecal samples sent to Teledyne Brown Engineering Environmental Services for alpha-spec analysis (U)
1995	10	RUST Geotech	90512	10 urine samples sent to Teledyne Brown Engineering Environmental Services for alpha-spec analysis (U, Th-230, and Ra-226).
1995	18	RUST Geotech	90513	18 urine samples sent to Teledyne Brown Engineering Environmental Services for alpha-spec analysis (U, Th-228/230, and Ra-226).
1995	7	RUST Geotech	90514	7 fecal samples sent to Teledyne Brown Engineering Environmental Services for alpha-spec analysis. 4 Pu/Am and 3 U for 6 personnel (one had both)
1995	10	RUST Geotech	90515	10 urine samples sent to Teledyne Brown Engineering Environmental Services for alpha-spec analysis (U)
1995	12	RUST Geotech	90516	12 urine samples sent to Teledyne Brown Engineering Environmental Services for alpha-spec analysis (U, Th-230, and Ra-226)
1995	10	RUST Geotech	90517	10 urine samples sent to Teledyne Brown Engineering Environmental Services for alpha-spec analysis (U), collected 10/3/95
1996	11	MACTEC	90528	11 fecal samples sent to Teledyne Brown Engineering Environmental Services for alpha-spec analysis (U)
1997	12	MACTEC	90528	12 fecal samples sent to Teledyne Brown Engineering Environmental Services for alpha-spec analysis (U)
1997	9	MACTEC	90508	9 post-job fecal samples collected 5 days after potential exposure; sent to Teledyne Brown Engineering Environmental Services for alpha-spec analysis (U). Additional urine and fecal baseline results on pdf p. 65
1997	45	MACTEC	90510	45 urine samples sent to Lockheed-Martin Idaho Lab in 1997. Total U results in µg/l.
1997	10	MACTEC	90523	10 urine samples sent to Teledyne Brown Engineering Environmental Services for alpha-spec analysis (U), collected 1/6/97
1997	11	MACTEC	90524	11 fecal samples sent to Teledyne Brown Engineering Environmental Services for alpha-spec analysis (U), collected 11/12/97

Table 6-1: Grand Junction Office Bioassay Data in the Site Research Database (This table spans multiple pages)				
Year	**Approx. No. of Results**	**Company/Organization**	**SRDB Ref IDs**	**Notes**
1997	11	MACTEC	90525	11 fecal samples sent to Teledyne Brown Engineering Environmental Services for alpha-spec analysis (U), collected 11/12/97
1997	9	MACTEC	90526	9 fecal samples sent to Teledyne Brown Engineering Environmental Services for alpha-spec analysis (U), collected 11/12/97
1997	10	MACTEC	90527	10 urine samples sent to Teledyne Brown Engineering Environmental Services for alpha-spec analysis (U), collected 4/1/97
1997	23	MACTEC	90528	23 fecal samples sent to Teledyne Brown Engineering Environmental Services for alpha-spec analysis (U), collected 11/11/2010
1998	6	MACTEC	90507	4 urine samples collected in June 1998 sent to Lockheed Martin Idaho Technologies Company Bioassay Laboratory for total U as the result of an off-site incident (facial contamination from windblown tailings at Monticello). 2 fecal samples collected in September 1998 and analyzed for isotopic U following demolition work at the GJO site.
1999	670	MACTEC	90509	Radon personal dosimeter data for individuals using Landauer "DRNT" detector (track detector). Two quarterly periods and one semi-annual period. Exposures reported in pCi/l-days. Of the total, 24 were area monitors.

Notes:
[a] A "set" is a group of samples taken at approximately the same time.
[b] A definition of "reference point" was not located. Workers above the reference point were re-sampled.

Air Monitoring Data

In December 1985, three high-volume air samplers were installed on the site; air concentrations of uranium, Th-230, and Ra-226 are reported in annual environmental reports for 1986 through 1993 (Environmental Monitoring, 1986; Environmental Monitoring, 1987; Environmental Monitoring, 1988; Environmental Monitoring, 1989; Environmental Monitoring, 1990; Environmental Monitoring, 1991; Environmental Monitoring, 1992; Environmental Monitoring, 1993). Radon measurements are available in the annual environmental reports for 1987 through 1993.

In a 1986 memorandum, with the subject line "Summary of MPC-Time Weighted Exposure for the First Quarter," air monitoring results for [Redacted per Privacy Act] individuals performing grinding of uranium mill tailings are presented (Rothman, 1986). The results from these samples are presented in units of MPC-HRS/QTR (maximum permissible concentration-hours per quarter). Under worst-case assumptions, the maximally exposed individual received 307 MPC-HRS of exposure to soluble Th-230. The respirators that were worn for these individuals were assumed by NIOSH to provide zero protection. In the memorandum, the sample results were compared to allowable MPC-hours (Rothman, 1986). Because the samples were collected over an entire quarter, NIOSH considers these

data to be representative of grinding and crushing tailings in the Sample Preparation Laboratory. These data are also supported by bioassay data taken during the work (Bioassay, Apr1985-Mar1987).

Prior to the start of the D&D work in 1989, air sample data are scarce. The most radiologically hazardous on-site work at that time appears to have taken place in the sample preparation area. A 1980 environmental monitoring report stated that the Sample Plant prepared approximately 1000 samples per month, but that the majority of the samples were not uranium ores but were exploration samples of low radioactivity. It indicated that the principal environmental problem was the dust generated from grinding and crushing. The report also mentions air sampling being performed in the Sample Plant during July 1980 while ore samples were being prepared. The most concentrated sample contained 0.0046 mg/m^3 of uranium (Environmental Monitoring, 1980). The report indicates that the relevant ACGIH standard at the time was 0.2 mg/m^3 of uranium. The report also states that occasionally, very high-grade uranium or thorium ore (5-10 percent U_3O_8 or ThO_2) was handled in the preparation of calibration models. This operation could produce dust which exceeds the uranium-in-dust standard.

In a March 1990 document titled *Technical Basis for Bioassay Sampling for Sample Preparation Plant and Grand Junction Vicinity Property Workers*, a set of air monitoring data are presented for the Sample Preparation Laboratory (UNC Geotech, 1990, PDF p. 9). The data consist of isotopic air concentration measurements for Po-210, Ra-226, Th-230, Pb-210, U-238, and Bi-210. The data from these measurements are evaluated in the document whereby it is shown that Th-230 contributes to over 90% of the overall Committed Effective Dose Equivalent (CEDE) of the radionuclide mixture.

Five hundred and sixty-nine air sample measurements were recovered for on-site D&D work, post-1988, including both general area and breathing zone samples (Building 7 H&S Data, 1991-2001; Air Sampling, Nov-Dec1990; Building 12 H&S Data, 1991-2000; Building 18 H&S Data, 1991-2001; Building 20 H&S Data, 1990-2000; Building 28 H&S Data, 1986-2000; Building 31/31A H&S Data, 1990-1992; Building 36 H&S Data, 1992-1996; Building 938 H&S Data, 1993-1999; Building 3022 H&S Data, 1980-2000; Building 7A H&S Data, 1991-2001; Building 7A H&S Data, 2001; Building 7 H&S Data - Phase II, 1980-2000; Building 7 H&S Data - Phase I, 1972-1999; D&D Reports, 1985-1999). These samples indicate that air concentrations were well-controlled during these activities (generally less than 10% of the DAC or action level in use).

The annual atmospheric releases of radioactive materials are available for most years from 1992 through 2001. These reports indicated that very low levels were released; therefore, the on- and off-site concentrations would have been relatively low. The air monitoring data are summarized in Table 6-2. For the D&D period (1986-2001), numerous other examples of air monitoring, including breathing zone samples, have been located. For example, the remediation of Building 7, which was contaminated during use for sample preparation, was divided into three phases (areas). There were 60 area measurements and 15 personnel measurements made in Building 7 just in Phase III (Airborne Radioparticulates, 1994). Most of these measurements were made following a 1994 contamination incident caused by a water leak, and during removal of contaminated concrete in 1999. Other building health and safety data files contain similar air monitoring data (Building 11 H&S Data, 1993-1997; Building 12 H&S Data, 1991-2000; Building 18 H&S Data, 1991-2001; Building 20 H&S Data, 1990-2000; Building 26 H&S Data, 1980-1998; Building 28 H&S Data, 1986-2000; Building 29 H&S Data, 1997; Building 31/31A H&S Data, 1990-1992; Building 36 H&S Data, 1992-1996; Health and Safety Checklists, 1990-1991).

Table 6-2: Grand Junction Office Air Monitoring Data in the Site Research Database (This table spans multiple pages)				
Year	**Approx. No. of Results**	**Area/Company/ Organization**	**SRDB Ref IDs**	**Notes**
1945	3	GJ Mill (Refinery)	16855	All results below 25 μg/m^3; collected in Jun
1945	3	GJ Warehouse Area	16855	2 results above 25 μg/m^3
1945	2	Sampling Lab	16855	All results below 25 μg/m^3
1953	10	American Cyanamid	6650	Samples taken in May, Jul, and Aug. 3 samples in May are in terms of alpha counts/m^3.
1954	1	American Cyanamid	6650	Sample from Jun
1956	64	Lucius Pitkin	3307, 3397	Results appear to be GA; Jun and Sep; some are BZ samples
1956	6	Lucius Pitkin	3307, 3397	Results appear to be Ra; Ra analysis on some GA samples
1956	3	Lucius Pitkin	3337	Report in July of "high" air samples in auger sampling room; no concentrations given in this report but probably are those used for comparison with 1959 samples in 3343.
1956	See Notes	Lucius Pitkin	3393	Report not attached. Summarized as "In the initial sampling room the air samples were between 200 and 400 d/p/m^3. In the blender room they were of the order of 2,000." Probably included in 3307/3397.
1956	See Notes	National Lead	3382	Report not attached. Summarized as "of the 79 employees who were studied, all but [Redacted per Privacy Act] had exposures which were less than 50 d/m/m^3. Only [Redacted per Privacy Act] of the remaining [Redacted per Privacy Act] had a really significant exposure. [Redacted per Privacy Act] was exposed to uranium dust in a concentration of approximately 250 mg/m^3 (350 d/m/m^3)."
1956	79	National Lead	10241	Samples from Jul and Sep
1957	25	National Lead	10241	Samples from Apr and Sep
1959	14	Lucius Pitkin	3307, 3397	Results appear to be GA; Nov
1959	3	Lucius Pitkin	3343	22 samples taken in Aug by Grand Junction. Only three results were reported by NYOO in terms of concentrations
1959	22	Sampling Plant, Lucius Pitkin	11452	Samples from Aug
1960	28	Falling Stream Pilot Plant, Lucius Pitkin	3307, 3397	Results appear to be GA; Jun and Jul
1960	41	Grand Junction (general)	11452	Samples from Jun and Jul - Outside areas (environmental-type)
1961	12	Grand Junction (general)	11452	Samples from Nov - Outside areas (environmental-type)

Table 6-2: Grand Junction Office Air Monitoring Data in the Site Research Database (This table spans multiple pages)				
Year	**Approx. No. of Results**	**Area/Company/ Organization**	**SRDB Ref IDs**	**Notes**
1961	80	Sampling Plant, Lucius-Pitkin	3307, 3397	Results appear to be GA; Jun (most) and Sep
1967	5	Grand Junction AEC Compound	17031	Rn-222 levels in pCi/l; Jul, Sep, Oct, and Nov; included in 17034
1967	7	Grand Junction AEC Compound	17034	Rn-222 levels in pCi/l; Jul, Sep, Oct, Nov, and Dec
1967	16	Grand Junction (general)	82790	Radon levels in GJ area 1967-1968; 16 measurements are for one station in or near the AEC compound.
1968	9	Grand Junction (general)	17034	Rn-222 levels in pCi/l; Jan, Feb, Mar, Apr, Jun, and Aug
1986	See Notes	Grand Junction (general)	90851	Annual Environmental Report with particulate monitoring results for three stations.
1986	See Notes	Grand Junction (general)	29855	Statement that there are "no significant radionuclide emissions from GJPO facilities including the laboratories, sample preparation facility, and the radon chamber."
1986	300	Grand Junction (in doors)	6640	100 radon-daughter-concentration (RDC) measurements in each of Bldgs. 33, 34, and 35. RDCs averaged 0.0051, 0.177and, 0.0069 WL, respectively with 0 percent thoron.
1986	3	Grand Junction (in doors)	98100	MPC-time weighted exposure for first quarter 1986. Measurements taken in sample prep lab during time of grinding of uranium mill tailings.
1987	See Notes	Grand Junction (general)	90847	Annual Environmental Report with particulate monitoring results for three stations (total U, Th-230, Ra-226); radon monitoring results for three stations.
1988	See Notes	Grand Junction (general)	90846	Annual Environmental Report with particulate monitoring results for three stations (total U, Th-230, Ra-226); radon monitoring results for three stations.
1989	See Notes	Grand Junction (general)	90856	Annual Environmental Report with particulate monitoring results for four stations (total U, Th-230, Ra-226); radon monitoring results for three stations.

Table 6-2: Grand Junction Office Air Monitoring Data in the Site Research Database (This table spans multiple pages)				
Year	**Approx. No. of Results**	**Area/Company/ Organization**	**SRDB Ref IDs**	**Notes**
1989	569	Grand Junction (general)	89872, 89909, 89926, 89931, 89938, 89979, 89991, 90015, 90087, 90105, 90118, 90154, 90155, 90164, 93709	Air sample measurements for on-site D&D work, post-1988, including both general area and breathing zone samples.
1990	See Notes	Grand Junction (general)	90845	Annual Environmental Report with particulate monitoring results for four stations (total U, Th-230, Ra-226); radon monitoring results for three stations.
1990	1	Grand Junction (general)	37700	Annual atmospheric release of radioactive material
1990	16	Grand Junction (in doors)	100231	Technical basis document for internal dosimetry. Includes isotopic air concentration measurements for Bldg. 7A Sample Prep Laboratory.
1991	See Notes	Grand Junction (general)	90853	Annual Environmental Report with particulate monitoring results for four stations (total U, Th-230, Ra-226); radon monitoring results for eight stations.
1991	1	Grand Junction (general)	37700	Annual atmospheric release of radioactive material
1991	30	Grand Junction (in doors)	13191	Results of the DOE indoor radon study; 19 occupied buildings measured.
1992	See Notes	Grand Junction (general)	90860	Annual Environmental Report with particulate monitoring results for three stations (total U, Th-230, Ra-226); radon monitoring results for seven stations.
1992	1	Grand Junction (general)	37700	Annual atmospheric release of radioactive material
1993	See Notes	Grand Junction (general)	90857	Annual Environmental Report with particulate monitoring results for three stations (total U, Th-230, Ra-226); radon monitoring results for seven stations.
1993	1	Grand Junction (general)	37700	Annual atmospheric release of radioactive material
1994	1	Grand Junction (general)	37700	Annual atmospheric release of radioactive material
1996	1	Grand Junction (general)	76642	Annual atmospheric release of radioactive material
1998	1	Grand Junction (general)	44873	Annual atmospheric release of radioactive material

Table 6-2: Grand Junction Office Air Monitoring Data in the Site Research Database (This table spans multiple pages)				
Year	**Approx. No. of Results**	**Area/Company/ Organization**	**SRDB Ref IDs**	**Notes**
1999	1	Grand Junction (general)	44873	Annual atmospheric release of radioactive material
2000	1	Grand Junction (general)	44873	Annual atmospheric release of radioactive material
2001	1	Grand Junction (general)	44873	Annual atmospheric release of radioactive material

6.2 Available Grand Junction Operations External Monitoring Data

Exposure records are maintained at the Grand Junction office and in a database maintained by the Idaho National Laboratory (INL). Since the issuance of the initial SEC-00175 Evaluation Report, a data report was provided by INL that includes personnel believed to be associated with Grand Junction through the use of INL location codes (Dosimetry, 1986-2007). This report has data between the years 1982 and 1998 and contains over 15,000 records, each with a gamma and beta result. There are also occasional neutron results in this spreadsheet. The people listed in this report may include individuals involved in off-site remediation work. As a claimant-favorable assumption, all exposures listed in this report would be assumed to have occurred on the Grand Junction Facilities site.

A series of 25 files are available to NIOSH from Grand Junction that comprises dosimetry files. Each file contains documents for people whose last names begin with an A, B, C, etc. (some dosimetry data may be found in these files).

Note: *Table 6-7 is a new table that is not in the original SEC-00175 Evaluation Report. This table does not replace an existing table in the SEC-00175 Evaluation Report.*

Table 6-7: External Dosimetry Files *(This table spans multiple pages.)*	
SRDB Reference	**Filename**
102153	Dosimetry Files for Employees Last Name Starting With A
102195	Dosimetry Files for Employees Last Name Starting With B
102208	Dosimetry Files for Employees Last Name Starting With C
102229	Dosimetry Files for Employees Last Name Starting With D
102231	Dosimetry Files for Employees Last Name Starting With E
102233	Dosimetry Files for Employees Last Name Starting With F
102242	Dosimetry Files for Employees Last Name Starting With G
102343	Dosimetry Files for Employees Last Name Starting With H
102391	Dosimetry Files for Employees Last Name Starting With I
102393	Dosimetry Files for Employees Last Name Starting With J
102152	Dosimetry Files for Employees Last Name Starting With K
102158	Dosimetry Files for Employees Last Name Starting With L
102232	Dosimetry Files for Employees Last Name Starting With M

Table 6-7: External Dosimetry Files *(This table spans multiple pages.)*	
SRDB Reference	**Filename**
102410	Dosimetry Files for Employees Last Name Starting With N
102415	Dosimetry Files for Employees Last Name Starting With O
102472	Dosimetry Files for Employees Last Name Starting With P
102506	Dosimetry Files for Employees Last Name Starting With Q
102416	Dosimetry Files for Employees Last Name Starting With R
102450	Dosimetry Files for Employees Last Name Starting With S
102469	Dosimetry Files for Employees Last Name Starting With T
102151	Dosimetry Files for Employees Last Name Starting With U
102154	Dosimetry Files for Employees Last Name Starting With V
102155	Dosimetry Files for Employees Last Name Starting With W
102156	Dosimetry Files for Employees Last Name Starting With Y
102157	Dosimetry Files for Employees Last Name Starting With Z

Interviews with current workers indicate that there is no external monitoring currently (i.e., in 2010) performed for Grand Junction employees (Personal Communication, 2010b; Personal Communication, 2010d).

7.2 Evaluation of Bounding Internal Radiation Doses at Grand Junction

The principal sources of internal radiation doses after January 31, 1975, included potential inhalation and ingestion of natural uranium and thorium, and their associated progeny, resulting from ore crushing, grinding, and handling operations in the Sample Preparation Laboratory. The following subsections address the ability to bound internal doses, methods for bounding doses, and the feasibility of internal dose reconstruction.

7.2.1 Evaluation of Bounding Process-Related Internal Doses

The following subsections summarize the extent and limitations of information available for reconstructing the process-related internal doses of members of the class under evaluation.

7.2.1.1 Urinalysis Information and Available Data

As shown in Table 6-1, uranium urine and fecal samples for 1943-1999 have been captured from site and DOE records. The urinalysis program targeted workers who were directly exposed to the uranium ores and concentrates. Data have been captured for the operation of the refinery, the Small Pilot Plant, and the Sampling Plants. No urine bioassay data have been captured for the Large Pilot Plant.

Some urinalysis and fecal analysis data for on-site remediation activities from 1986 through 2001 have been recovered. These data are from contractor bioassay laboratories; the data packages include quality assurance data and information.

7.2.1.2 Fecal Samples

Some fecal data for on-site remediation activities from 1986 through 2001 have been recovered. These data are from contractor bioassay laboratories; the data packages include quality assurance data and information.

7.2.1.3 Airborne Levels

Air sample results have been recovered from site and DOE records for 1945-1993. The details are shown in Table 6-2. In 1985, 100 radon-daughter-concentration (RDC) measurements were located for each of three buildings that had once been used to process uranium. There are two sets of data, one from 1986 (Rothman, 1986) and one from 1990 (UNC Geotech, 1990), with uranium-in-air measurement results from the Sample Preparation Laboratory (Building 7A) during crushing and grinding operations. Thirty radon measurements were made of 19 buildings in 1989-1990 as a part of the DOE Indoor Radon Study (Radon, 1989-1990, pdf pp. 153-154). During remediation, Grand Junction documents frequently cite the data from the DOE Indoor Radon Study in terms of Working Level (WL), assuming a typical indoor equilibrium factor of 0.5. Other WL measurements in 1989 for Buildings 6 and 31, and in 1997-1998 for Buildings 7, 28, 30, 31A, 32, 54, and 810 were located in the available characterization data presented in NIOSH's 2011 SEC-00175 Evaluation Report (NIOSH, 2011). There was an extensive air sampling program during the D&D of the site buildings, including breathing zone samples (Airborne Radioparticulates, 1994).

7.2.3 Methods for Bounding Internal Dose at Grand Junction

7.2.3.1 Methods for Bounding Operational Period Internal Dose

NIOSH finds it is not feasible to estimate internal dose with sufficient accuracy for all workers on site from February 1, 1975 through December 31, 1985. There is insufficient information to estimate intakes of uranium and thorium (and associated progeny) until January 1, 1986. Although NIOSH found that it is not possible to completely reconstruct radiation doses for the proposed class, 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). Therefore, dose reconstructions for individuals employed at Grand Junction Facilities during the period from February 1, 1975 through December 31, 1985, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate.

Bounding Uranium Inhalation Intakes from January 1, 1985 through July 31, 2010

By February 1, 1975, concentrate sampling operations had ended and the site mission had changed to mainly off-site work (e.g., NURE, UMTRA). Some workers occupied areas that had been used for sampling operations (e.g., converted to office space). The area contained mainly fixed contamination, but there was loose contamination in some overhead spaces, in walls, and in areas that were normally unoccupied. The workers were mainly exposed to residual yellowcake contamination. While some of the process buildings from the Large Pilot Plant were still on site (Buildings 31, 33, 34, and 35), they were generally unoccupied and used for storage (D&D Report, 1995, pdf, p. 15). Some workers continued to be exposed to radioactive materials during sampling preparation, laboratory operations, waste processing, etc. This work included processing thousands of samples for analysis. It also

involved numerous short-term processing efforts of uranium and thorium ores, and tailings used in the fabrication of calibration materials and pads. The grinding and crushing of the samples and ores was performed in the Sample Preparation Laboratory in Building 7A (part of Building 7); the downblending of processed ores used in the calibration models was also performed in Building 7.

Grinding and crushing samples and the ores and tailings used in the calibration models had the greatest potential for worker intakes. Limited monitoring data is available from those activities. Grand Junction performed air sampling in July 1980 during crushing and grinding ore samples and reported the highest measured result of 0.0046 mg/m3 (3.1 pCi/m3) (Environmental Monitoring, 1980). No other data are available until 1986 when Sample Preparation Laboratory workers were monitored by tracking MPC-Hr exposure and by fecal bioassay. Additional monitoring data were reported in 1991. In 1991 the site implemented a more rigorous air monitoring and bioassay program.

The Sample Preparation Laboratory in Building 7 was the location having the highest potential for internal dose after January 31, 1975. The grinding, crushing, and preparation of these samples occurred in Building 7A. In March 2001, the sample preparation operations were moved to Building 46. Analytical chemistry operations ended in late 2003. Some sample preparation for off-site analysis was conducted in a small area of Building 32 until at least 2007. Analytical Chemistry Operations in Building 20 were related, but less hazardous than sample grinding, crushing, mixing, etc. in a ventilated but unenclosed area. The chemical digestions of rock and soil samples in Building 20 were carried out in hoods which were necessary because of the strong acids used.

Prior to January 1, 1986, air monitoring data from the Sample Preparation Laboratory are unavailable, other than the maximum measured uranium concentration in July 1980. During the first quarter of 1986, when samples potentially containing ore and/or tailings were prepared for the NURE and GJRAP programs, intake rates were calculated based on the maximum permissible concentration (MPC) Exposures limit. A memo from B. Rothman to A. N. Tschaeche (Rothman, 1986) is an example of MPC time-weighted exposures for the first quarter of 1986 for [Redacted per Privacy Act] workers performing grinding of uranium mill tailings. In the memo, the quarterly limit of 520 MPC-hours was provided. The existence of this memo is evidence that at least by 1986, worker intakes were being monitored and controlled using the MPC-hour limit. In the memo, Thorium-230 was used as the limiting radionuclide.

Building 7A was constructed (as a Sample Preparation Laboratory) as an addition to Building 7 in 1956. Reconstruction and remodeling of the facility took place during the period from 1978 through 1986 (WASTREN, 2001a). Due to these renovation activities, NIOSH has no assurance that the air concentrations measured in 1986 are representative for the period prior to the renovations. There were no renovations to the facility after 1986. NIOSH finds the single measurement from July 1980 to be insufficient to characterize intakes.

In a document entitled *Technical Basis for Bioassay Sampling for Sample Preparation Plant and Grand Junction Vicinity Property Workers*, dated March 1990, a set of air monitoring data are presented for the Sample Preparation Laboratory (UNC Geotech, 1990, PDF p.9). The data consist of isotopic air concentration measurements for Po-210, Ra-226, Th-230, Pb-210, U-238, and Bi-210. The data from these measurements are evaluated in the document whereby it is shown that Th-230 contributes to over 90% of the overall Committed Effective Dose Equivalent (CEDE) of the radionuclide mixture.

It is unlikely that any worker would have routinely been exposed to airborne concentration exceeding the MPC limit without corrective actions being implemented. Although workers in the Sample Prep Lab were routinely issued respirators, NIOSH assumes that the respirators provided zero protection.

For the period of time from January 1, 1986 through December 31, 1990, bounding daily uranium intake rates for operators and laborers may be assigned by assuming that a worker received the MPC-hour limit every quarter. Thorium-230 may be assumed to be the limiting radionuclide. The applicable limiting MPC for Thorium-230 is 2.00E-12 µCi/mL (Heffelfinger, 1981). Uranium intakes for supervisors and office workers for this time period may be assigned as a ratio of the operator/laborer intake rate using guidance from Battelle-TBD-6000.

The document, *Technical Basis for Bioassay Sampling for Sample Preparation Plant and Grand Junction Vicinity Property Workers* (UNC Geotech, 1990), lays out the implementation of DOE Order 5840.11 for monitoring workers. In the document, it specifies that bioassay shall be collected if exposure indicates that a worker could be exposed to inhalation intake during the year that exceeded 200 DAC-hours. In addition, it indicates that a monitoring program must be in place for all workers that have the potential for 40 DAC-hours. Since this document was issued in early 1990, it is assumed that full implementation was not until the end of the year. Therefore, starting in 1991, it is assumed that unmonitored radiation workers would not have exceeded 200 DAC-hours in a given year (if they had they would have then been placed on a bioassay program). In addition, it is assumed that non-radiation workers would not have exceeded 40 DAC-hours in a given year. This document also reiterates that the controlling radionuclide was Thorium-230. The limiting DAC for Thorium-230 is 3.00E-12 µCi/mL (Heffelfinger, 1981). The isotopic ratios of the different radionuclides found in various uranium source materials processed at the Grand Junction Facility Sampling Plant after 1985 have been well characterized (Donivan, 1987). These ratios may be used to assign intakes of these other radionuclides, as a function of the Th-230 intake.

For an office worker scenario, a wealth of data was located in close-out survey reports. These reports summarized the characterization data that had been collected prior to the remediation or decommissioning of the site buildings. A summary of the characterization data is provided in NIOSH's 2011 SEC-00175 Evaluation Report (NIOSH, 2011). A review of the data indicates that most of the removable contamination was in inaccessible areas and was normally less than 1000 dpm/100 cm^2. This was also the Grand Junction limit for removable alpha or beta-gamma contamination. Therefore, 1000 dpm/100 cm^2 could be used with an appropriate re-suspension factor and respiration rate to calculate a bounding intake for either an office worker exposed to residual contamination or an analytical laboratory worker whose work area would have been controlled to well below this level on a long-term basis.

Investigations for site remediation began in 1984. The remedial investigation/feasibility study (RI/FS) was done in 1989. The Record of Decision (ROD) was approved in 1990 (GJ MAP, 1996). The tailings were removed in 1989-1994. A close-out survey by the independent verification contractor (IVC) for the outdoor areas of the site was completed in 1995 (Forbes, 1997). Additional close-out surveys and verifications were done for each building on site that was released for unrestricted use (Attachment 1 of NIOSH, 2011). Each close-out report includes a statement about the successful use of health and safety practices during the clean-up. In 2001, the site was turned over to a non-profit corporation and DOE leased back office and laboratory space.

Thousands of pages of health and safety data (e.g., RWPs, survey maps, field measurements, air samples) have been recently captured for the period 1991-2007, when most of the D&D activities took place (Building 7 H&S Data, 1991-2001; Building 11 H&S Data, 1993-1997; Building 12 H&S Data, 1991-2000; Building 18 H&S Data, 1991-2001; Building 20 H&S Data, 1990-2000; Building 26 H&S Data, 1980-1998; Building 28 H&S Data, 1986-2000; Building 29 H&S Data, 1997; Building 31/31A H&S Data, 1990-1992; Building 36 H&S Data, 1992-1996; Health and Safety Checklists, 1990-1991). Some bioassay data have also been captured for the period 1995-1999. There is no database of results that can readily be used for a co-worker study. However, from these data it is evident that the most highly-exposed workers were monitored. If no data are available for a D&D worker, the bounding dose scenario can be constructed from the health and safety data. For example, Buildings 7 and 7A were used for sample preparation and were extensively contaminated. Building 7 was remediated to unrestricted area levels and was transferred to the U.S. Army Reserve. Contaminated concrete was removed with a concrete saw and jack-hammer or "scabbled" (mechanical removal of a thin layer by a power tool). Walls with internal contamination were removed and rebuilt. Health and Safety monitoring data are available for these operations (Building 7 H&S Data, 1991-2001; Building 7A H&S Data, 1991-2001; Building 7A H&S Data, 2001; Building 7 H&S Data - Phase I, 1972-1999; Building 7 H&S Data - Phase II, 1980-2000). The bounding dose could then be assigned to other years with less data or less-intrusive work. NIOSH concludes that sufficient data are available to bound doses for D&D workers. By extension, these doses would bound workers with jobs requiring less exposure to contaminated materials.

Bounding Inhalation Intakes from Ra-226, Th-230, and Th-232

During a site characterization in 1985, the Th-232 in soils was insignificant compared to Ra-226 and would contribute a negligible additional dose (Henwood, 1986, pdf pp. 47-54).

For 1975-2001, the primary source term for an office worker in a former sampling building was yellowcake. Sample preparation and analytical laboratory workers were mainly exposed to non-ore materials and occasionally ore samples during NURE work. The UMTRA program and other environmental restoration activities carried out by Grand Junction only required the analysis of relatively small, low-activity samples. However, the chemical work was carried out in fume hoods. Protection from the highly-toxic acids used to digest rock samples would also have protected the workers from radioactive materials (Environmental Monitoring, 1980). Similarly, the sample preparation area required adequate ventilation to protect workers from silica dust, which would also have provided protection from radioactive materials. D&D workers were exposed to yellowcake during D&D of the sampling buildings (e.g., Buildings 7 and 7A). They were also potentially exposed to tailings during D&D of the former Large Pilot Plant buildings (31, 33, 34, and 35). Workers (mainly subcontractors) were exposed to tailings during the remediation of tailings and open land areas in 1989-1994. There is ample evidence of protective measures (i.e., dust suppression), H&S monitoring, and bioassays being collected during these operations (Health and Safety Checklists, 1990-1991). Some bioassay samples were analyzed for Th-230 and Ra-226 (see Table 6-1), indicating the site's awareness of the hazards of uranium tailings. Other workers on site who were not directly involved in the D&D of the former Large Pilot Plant buildings or the remediation of open land areas may have been exposed to Ra-226 and Th-230 from tailings as a result of this work. The dose to these workers can be accounted for by assigning ambient environmental internal dose.

There were only two campaigns involving thorium that took place after 1985. The first was the construction of the TL/TH pads (Steele, 1987). This operation, at least the thorium-handling part of the operation, was completed in 1986. The only other thorium campaign taking place at Grand Junction after 1985 was the manufacturing of the mixed uranium-thorium reference materials (Donivan, 1988), which was completed in 1988.

NIOSH finds that the method for bounding uranium intakes during this time period is also appropriate to bound thorium intakes for the same period. The rationale for this conclusion is that because the controls used for crushing and grinding uranium ore were the same as those used for crushing and grinding thorium, and both operations took place in the same facility, Bldg. 7A. Although the activity concentrations of the thorium and uranium ores were not identical, the target concentrations for the resulting thorium and uranium calibration models that were being produced were very similar, in terms of radioactivity. Therefore, if the specific activity of the thorium ores were higher than that of the uranium ores, corresponding less thorium ore would have be required to produce the thorium-containing models.

Based on interviews (Personal Communication, 2014e; Personal Communication, 2014g; Personal Communication, 2014h) with former workers, the time required to complete the construction of a calibration pad, either uranium or thorium, would not exceed a calendar month. The physical crushing and grinding of the thorium ore, which is the main source of exposure, would actually have been completed in much less time than a full month. For the purpose of bounding potential intakes of thorium from these operations a full calendar month of exposure to thorium ore is assumed for each operation involving crushing and grinding of thorium ore. Laborers and operators may therefore be assumed to be exposed to the MPC for a full month for each thorium operation if employed at that time. Since the exact dates of the construction of the pads are not known, the most claimant-favorable period (first potential month) should be assumed for the assignment of the thorium exposure. Thorium progeny should also be assumed to also be present, and at the same concentration as Th-232.

Bounding Intakes of Radon and Radon Decay Products (including thoron)

By February 1975, the last of the 103,776 drums of uranium concentrates had been shipped from the site. Because these drums contained between a few hundred pounds to a few tons of Ra-226, they probably represented a relatively minor source of radon exposures. Although concentrate sampling operations were reported to have ended in 1971, it is unclear whether this also applied to ore sampling, which was a potential source of radon exposures. In any case, by February 1975, the amount of material stored on site was greatly reduced and the site's primary mission was the NURE program.

The NURE program was not a uranium exploration program. Rather, extensive geologic studies were done to identify and evaluate geologic environments favorable for locating uranium (Albrethsen, 1986). On-site sample preparation and analytical activities were primarily on non-ore materials. After the operational period ended on January 31, 1975, the Ra-226 in surface contamination, and in soils under/around the buildings, remained relatively constant until the remediation of the outdoor areas.

Radon in buildings was studied extensively in the D&D era (1989-2001). There are indoor radon-decay-product measurements for most of the buildings, including 300 daughter measurements

taken in 1985 in some of the former pilot plant buildings. Only Building 34, the former boiler building for the Large Pilot Plant, exceeded 0.02 WL (averaged over 100 hours) (Henwood, 1986, pdf p. 36). This building had been used to store ore and yellowcake and was not routinely occupied (Facility Tour, 1984, pdf p. 2). In 1990, the site implemented and participated in the DOE radon study that included all occupied buildings on site at that time. The study's measurements were representative of the highest radon levels in those portions of the buildings that were fit for occupancy (Radon, 1989-1990, pdf p. 19). An analysis of these data indicates that the median concentrations were less than 2 pCi/l or 0.010 WL. Only three buildings were greater than 4 pCi/l or 0.020 WL: Building 26 (4.5 pCi/l), Building 30B (5.7 pCi/l), and Building 32 (4.9 pCi/l). These buildings were reassessed in 1997-1998 after remediation and all measured less than 0.008 WL (1.6 pCi/l) (Attachment 1 of NIOSH, 2011). The available radon measurements can be used to establish a bounding dose from radon and radon decay products for February 1, 1975 to December 31, 2001. After 2001, the site radon values were reduced to background levels and there were no occupational exposures to radon at the Grand Junction site.

Routine calibration of thoron instruments took place at Grand Junction (George, 1992; Pearson, 1990), indicating that the site was capable of measuring thoron levels; however, no specific thoron measurements have been identified. For the purpose of providing a claimant-favorable estimate of the thoron concentrations to which workers were potentially exposed, thoron levels are assumed to be equivalent to that of radon. This is considered bounding, as the thoron source term (thorium) would be much less than that of the radon source term (uranium/radium). Therefore it is unlikely that the thoron air concentration would exceed the radon air concentration.

7.2.4 Internal Dose Reconstruction Feasibility Conclusion

NIOSH finds it is not feasible to estimate internal dose with sufficient accuracy for all workers on site from February 1, 1975 through December 31, 1985. There is insufficient information to estimate intakes of uranium and thorium (and associated progeny) until January 1, 1986. NIOSH has identified sufficient information and data to support bounding internal dose for the January 1, 1986 through July 31, 2010 period using available methodologies.

Although NIOSH found that it is not possible to completely reconstruct internal radiation doses for the period from February 1, 1975 through December 31, 1985, 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 the Grand Junction Facilities site during the period from February 1, 1975 through December 31, 1985, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate.

7.5 Summary of Feasibility Findings for Petition SEC-00175, Addendum

This report evaluates the feasibility for completing dose reconstructions for employees at the Grand Junction Facilities from February 1, 1975 through July 31, 2010. NIOSH found that the available monitoring records, process descriptions and source term data available are insufficient to estimate the complete radiation dose for the period from February 1, 1975 through December 31, 1985. Doses for later years (January 1, 1986 through July 31, 2010) can be reconstructed.

The feasibility findings presented in the initial SEC-00175 Evaluation Report (Table 7-3) for the period of March 23, 1943 through January 31, 1975, have not changed as a result of the present evaluation and are therefore not reproduced here. Table 7-3a below summarizes the results of the feasibility findings at the Grand Junction Facilities for each exposure source during the time period evaluated in this addendum, from February 1, 1975 through July 31, 2010.

Note: *Table 7-3a is intended to supplement the information in Table 7-3 in the 2011 SEC-00175 Evaluation Report. This table does not replace the existing Table 7-3 in the SEC-00175 Evaluation Report.*

Table 7-3a: Summary of Addendum Feasibility Findings for SEC-00175

Source of Exposure	February 1, 1975 through December 31, 1985		January 1, 1986 through July 31, 2010	
	Reconstruction Feasible	**Reconstruction Not Feasible**	**Reconstruction Feasible**	**Reconstruction Not Feasible**
Internal		**X**	**X**	
- Radon and thoron	X		X	
- Thorium and Uranium and their associated long-lived progeny		X	X	
External	**X**		**X**	
- Gamma	X		X	
- Beta	X		X	
- Neutron	X		X	
- Occupational Medical X-ray	X		X	

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 Grand Junction Facilities during the period from February 1, 1975 through December 31, 1985, 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-00175

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.

NIOSH's evaluation determined that it is not feasible to estimate the complete radiation dose for all workers from February 1, 1975 through December 31, 1985. Modification of the class definition regarding health endangerment and minimum required employment periods, therefore, is required. For the later years in the evaluated class (January 1, 1986 through July 31, 2010), a health endangerment determination is not required because NIOSH has determined that it has an established methodology for estimating dose.

9.0 Class Conclusion for Petition SEC-00175

Based on its full research of the class under evaluation, NIOSH has defined a single class of employees for which NIOSH cannot estimate radiation doses with sufficient accuracy. The NIOSH-proposed class to be added to the SEC includes all employees of the Department of Energy, its predecessor agencies, and its contractors and subcontractors who worked at the Grand Junction Facilities site in Grand Junction, Colorado, during the period from February 1, 1975 through December 31, 1985, for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees in the SEC.

There are sufficient data to reconstruct internal dose for the period from January 1, 1986 through July 31, 2010. There are sufficient data to reconstruct external dose, including occupational medical dose, for the period from February 1, 1975 through July 31, 2010.

NIOSH has reviewed available technical resources and many other references, including the Site Research Database (SRDB), for information relevant to SEC-00175. In addition, NIOSH reviewed its NOCTS dose reconstruction database to identify EEOICPA-related dose reconstructions that might provide information relevant to the petition evaluation.

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 the feasibility or infeasibility of reconstructing dose for the class under evaluation.

10.0 References for this Addendum

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

Air Sampling, Nov-Dec1990, *Airborne Radioparticulate Sampling Data Sheets for November-December 1990*; completed by various health physics technicians; various dates throughout November-December 1990; SRDB Ref ID: 89909

Airborne Radioparticulates, 1994, Airborne Radioparticulate Sampling Data Sheets, Grand Junction Projects Office (GJPO); various dates in 1994; SRDB Ref ID: 89872, PDF pp. 275-341

Albrethsen, 1986, *A Summary History of the Activities of the Grand Junction Office of the AEC, ERDA, and DOE*; Al Albrethsen, Bill Chenoweth, and Frank McGinley; September 1986; SRDB Ref ID: 3325, PDF pp. 14-26

Bioassay, Jan1984-Dec1986, *Urinalysis Sample Logs for January 1984-December 1986*; Bendix Field Engineering Corporation; various dates between January 1984-December 1986; SRDB Ref ID: 98107

Bioassay, Apr1985-Mar1987, *Bioassay Records for April 1985-March 1987*; various vendors; various dates between April 1985-March 1987; SRDB Ref ID: 98096

Building 7 H&S Data, 1991-2001, *Compilation of Building 7 Health and Safety Information and Data*; various contractors at the Grand Junction Projects Office; various dates in 1991-2001; SRDB Ref ID: 89872

Building 7 H&S Data - Phase I, 1972-1999, *Compilation of Building 7 Phase I Health and Safety Information and Data*, various contractors at the Grand Junction Projects Office; various dates in 1972-1999; SRDB Ref ID: 90164

Building 7 H&S Data - Phase II, 1980-2000, *Compilation of Building 7 Phase II Health and Safety Information and Data*, various contractors at the Grand Junction Projects Office; various dates in 1980-2000; SRDB Ref ID: 90155

Building 7A H&S Data, 1991-2001, *Compilation of Building 7A Health and Safety Information and Data*, various contractors at the Grand Junction Projects Office; various dates in 1991-2001; SRDB Ref ID: 90118

Building 7A H&S Data, 2001, *Compilation of Building 7A Health and Safety Information and Data*, various contractors at the Grand Junction Projects Office; various dates in 2001; SRDB Ref ID: 90154

Building 11 H&S Data, 1993-1997, *Compilation of Building 11 Health and Safety Information and Data*, various contractors at the Grand Junction Office (GJO); various dates in 1993-1997; SRDB Ref ID: 89928

Building 12 H&S Data, 1991-2000, *Compilation of Building 12 Health and Safety Information and Data*, various contractors at the Grand Junction Office (GJO); various dates in 1991-2000; SRDB Ref ID: 89926

Building 18 H&S Data, 1991-2001, *Compilation of Building 18 Health and Safety Information and Data*, various contractors at the Grand Junction Office (GJO); various dates in 1991-2001; SRDB Ref ID: 89931

Building 20 H&S Data, 1990-2000, *Compilation of Building 20 Health and Safety Information and Data*, various contractors at the Grand Junction Office (GJO); various dates in 1990-2000; SRDB Ref ID: 89938

Building 26 H&S Data, 1980-1998, *Compilation of Building 26 Health and Safety Information and Data*, various contractors at the Grand Junction Office (GJO); various dates in 1980-1998; SRDB Ref ID: 89942

Building 28 H&S Data, 1986-2000, *Compilation of Building 28 Health and Safety Information and Data*, various contractors at the Grand Junction Office (GJO); various dates in 1986-2000; SRDB Ref ID: 89979

Building 29 H&S Data, 1997, *Compilation of Building 29 Health and Safety Information and Data*, various contractors at the Grand Junction Office (GJO); various dates in 1997; SRDB Ref ID: 89966

Building 31/31A H&S Data, 1990-1992, *Compilation of Building 31/31A Health and Safety Information and Data*, various contractors at the Grand Junction Office (GJO); various dates in 1990-1992; SRDB Ref ID: 89991

Building 36 H&S Data, 1992-1996, *Compilation of Building 36 Health and Safety Information and Data*, various contractors at the Grand Junction Office (GJO); various dates in 1992-1996; SRDB Ref ID: 90015

Building 938 H&S Data, 1993-1999, *Compilation of Building 938 Health and Safety Information and Data*; various contractors at the Grand Junction Office (GJO); various dates in 1993-1999; SRDB Ref ID: 90087

Building 3022 H&S Data, 1980-2000, *Compilation of Building 3022 Health and Safety Information and Data*; various contractors at the Grand Junction Office (GJO); various dates in 1980-2000; SRDB Ref ID: 90105

D&D Reports, 1985-1999, *Compilation of Buildings 33 and 35 Decontamination and Decommissioning Documentation*; various contractors at the Grand Junction Projects Office; various dates in 1985-1999; SRDB Ref ID: 93709

D&D Report, 1995, *Final Report of the Decontamination and Decommissioning of the Exterior Land Areas at the Grand Junction Projects Office Facility*, U.S. Department of Energy, Grand Junction Projects Office Remedial Action Project; September 1995; SRDB Ref ID: 88610

Donivan, 1987, *Uranium Reference Materials*, DOE/ID/12584-9; Stephen Donivan and Ronald Chessmore; July 1987; SRDB Ref ID: 140369

Donivan, 1988, *Soil-Based Uranium Disequilibrium and Mixed Uranium-Thorium Series Radionuclide Reference Materials*, UNC/GJ-37(TMC); Stephen Donivan and Ronald Chessmore; December 1988; SRDB Ref ID: 93756

Dosimetry, 1986-2007, *Grand Junction Spreadsheet from INEL Dosimetry Database*; dates from January 1986-December 2007; SRDB Ref ID: 107374

Environmental Monitoring, 1980, *1980 Environmental Monitoring Report for the U.S. Department of Energy Facilities Grand Junction, Colorado, and Monticello, Utah*; prepared by Nic Korte and Ralph Thul, Bendix Field Engineering Corporation; April 1981; SRDB Ref ID: 90862

Environmental Monitoring, 1986, *Environmental Monitoring Report on Department of Energy Facilities at Grand Junction, Colorado, and Monticello, Utah, for Calendar Year 1986*; prepared by Michael Sewell and Larick Spencer, UNC; March 1987; SRDB Ref ID: 90851

Environmental Monitoring, 1987, *Environmental Monitoring Report on the U.S. Department of Energy's Grand Junction Projects Office Facility, Grand Junction, Colorado, for Calendar Year 1987*; U.S. Department of Energy Grand Junction Projects Office; May 1988; SRDB Ref ID: 90847

Environmental Monitoring, 1988, *Environmental Monitoring Report on the U.S. Department of Energy's Grand Junction Projects Office Facility, Grand Junction, Colorado, for Calendar Year 1988*; prepared by UNC Geotech; May 1989; SRDB Ref ID: 90846

Environmental Monitoring, 1989, *Environmental Monitoring Report on the U.S. Department of Energy's Grand Junction Projects Office Facility, Grand Junction, Colorado, for Calendar Year 1989*; prepared by UNC Geotech; May 1990; SRDB Ref ID: 90856

Environmental Monitoring, 1990, *Grand Junction Projects Office Site Environmental Report for Calendar Year 1990*; prepared by Chem-Nuclear Geotech, Inc.; May 1991; SRDB Ref ID: 90845

Environmental Monitoring, 1991, *Grand Junction Projects Office Site Environmental Report for Calendar Year 1991*; prepared by Chem-Nuclear Geotech, Inc.; May 1992; SRDB Ref ID: 90853

Environmental Monitoring, 1992, *Grand Junction Projects Office Site Environmental Report for Calendar Year 1992*; prepared by RUST Geotech Inc.; May 1993; SRDB Ref ID: 90860

Environmental Monitoring, 1993, *Grand Junction Projects Office Site Environmental Report for Calendar Year 1993*; prepared by RUST Geotech Inc.; May 1994; SRDB Ref ID: 90857

Facility Tour, 1984, *GJAO – SFMP Facility Tour – June 29, 1984*, Grand Junction Area Office; June 29, 1984; SRDB Ref ID: 71090

Forbes, 1997, *Confirmatory Radiological Survey of the Grand Junction Projects Office Remedial Action Project Exterior Portions, 1989-1995*; G. H. Forbes and P. V. Egidi of Oak Ridge National Laboratory; April 1997; SRDB Ref ID: 76720

George, 1992, *Evaluation of Thoron-Daughter Instruments*, DOE/ID/12584-110; J. L. George; September 1992; SRDB Ref ID: 93715

GJ Contractors, undated, *Other Contractors at the U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado: Uranium Concentrate Sampling*; Grand Junction Operations Office; undated; SRDB Ref ID: 3325, pdf p. 4

GJ MAP, 1996, Grand Junction Projects Office Management Action Process (MAP), prepared for the U.S. Department of Energy by Rust Geotech; April 1996; SRDB 88611, pdf p. 21

Health and Safety Checklists, 1990-1991, *Collection of Health and Safety Checklists*, UNC Geotech and Grand Junction Projects Office; various dates in 1990-1991; SRDB Ref ID: 89900

Heffelfinger, 1981, *Environmental Protection, Safety, and Health Protection Program for DOE Operations*, DOE 5480.1 Chg 6; William S. Heffelfinger; August 13, 1981; SRDB Ref ID: 11593

Henwood, 1986, *Radiologic Characterization of the Department of Energy Grand Junction Projects Office Facility*; Paul Henwood and Callie Ridolfi; January 1986; SRDB Ref ID: 6640

Leino, 1994, *Field Calibration Facilities for Environmental Measurement of Radium, Thorium, and Potassium*, DOE/ID/12584-179; R. Leino, D. C. George, B. N. Key, L. Knight, and W. D. Steele; June 1994; SRDB Ref ID: 93424

Mathews, 1978, *DOE-Grand Junction Logging Model Data Synopsis*, GJBX-76(78); Mark A. Mathews, Carl J. Kolzumi, and Hilton B. Evans; May 1978; SRDB Ref ID: 97466

NIOSH, 2011, *SEC Petition Evaluation Report for Petition SEC-00175, Grand Junction Operations Office*; National Institute for Occupational Safety and Health (NIOSH); January 11, 2011; SRDB Ref ID: 141458

OCAS-PR-004, *Internal Procedures for the Evaluation of Special Exposure Cohort Petitions*, Rev. 0; National Institute for Occupational Safety and Health (NIOSH); Cincinnati, Ohio; September 23, 2004; SRDB Ref ID: 32022

Pearson, 1990, *Calibration of Alpha-Track Monitors for Measurement of Thoron*, DOE/ID/12584-61; Mark D. Pearson; March 1990; SRDB Ref ID: 93747

Personal Communication, 2010b, *Personal Communication with a Former Grand Junction Employee*; Telephone Interview by ORAU Team; October 19, 2010; SRDB Ref ID: 90653

Personal Communication, 2010c, *Personal Communication with a Former Grand Junction Employee*; Telephone Interview by ORAU Team; October 14, 2010; SRDB Ref ID: 90654

Personal Communication, 2010d, *Personal Communication with a Former Grand Junction Employee*; Telephone Interview by ORAU Team; October 19, 2010; SRDB Ref ID: 90655

Personal Communication, 2010h, *Personal Communication with a Former Grand Junction Employee*; Telephone Interview by ORAU Team; December 2, 2010; SRDB Ref ID: 90999

Personal Communication, 2014e, *Personal Communication with a Former Grand Junction Employee*; Telephone Interview by ORAU Team; December 18, 2014, 11:00 AM EST; SRDB Ref ID: 139114

Personal Communication, 2014g, *Personal Communication with a Former Grand Junction Employee*; Telephone Interview by ORAU Team; December 10, 2014, 11:00 AM EST; SRDB Ref ID: 139116

Personal Communication, 2014h, *Personal Communication with a Former Grand Junction Employee*; Telephone Interview by ORAU Team; October 24, 2014, 9:00 AM MST; SRDB Ref ID: 139128

Procedure, 1990, Internal Radiation Dosimetry Program, ES&H Procedure 3.8, UNC Geotech, October 3, 1990; SRDB Ref ID: 90529

Radon, 1989-1990, *Results of the U.S. Department of Energy Indoor Radon Study, Volume 1*; prepared by UNC Geotech; results compiled August 1990; SRDB Ref ID: 13191

Rothman, 1986, *Summary of MPC-Time Weighted Exposure for the First Quarter*, correspondence to A. N. Tschaeche; B. Rothman; April 1, 1986; SRDB Ref ID: 98100

Ruhoff, 1943, *Frequency of Physical and Laboratory Examinations*, correspondence to Area Engineer, Colorado Area; J. Ruhoff; November 9, 1943; SRDB Ref ID: 4504

Steele, 1987, *Construction and Characterization of the TL/TH Thorium Calibration Pads*, DOE/ID/12584-3; W. Douglass Steele; September 1987; SRDB Ref ID: 93754

UNC Geotech, 1990, *Technical Basis for Bioassay Sampling for Sample Preparation Plant and Grand Junction Vicinity Property Workers*; UNC Geotech; March 1990; SRDB Ref ID: 100231

Vanderheiden, 1993, *Grand Junction Projects Office Site Decontamination and/or Decommissioning Project Plan*, with cover letter; Tom Vanderheiden; February 23, 1993; SRDB Ref ID: 93686

Ward, 1978, *Procedures and Regulations for Airport Calibration Pads Walker Field, Grand Junction, Colorado*, GJBX-38(78); Dan L. Ward and David C. Stromswold; August 1978; SRDB Ref ID: 93152

WASTREN, 2001a, *Closeout Report of the Decontamination and Decommissioning of the Sample Plant (Phase III) of Building 7 at the Grand Junction Office Facility*, GJO-2001-252-FOS; WASTREN, Inc.; September 2001; SRDB Ref ID: 89880

WASTREN, 2001b, *Decontamination and Decommissioning of the Grand Junction Office Facility—Certification Docket Summary Report (activities through fiscal year 2001)*, GJO-2001-254-FOS; WASTREN, Inc.; September 2001; SRDB Ref ID: 90206

This page intentionally left blank

Attachment 2: Data Capture Synopsis

Table A2-1: Summary of Holdings in the SRDB for Grand Junction Facilities			
Data Capture Information	**Data Capture Description**	**Completed**	**Uploaded into SRDB**
Primary Site/Company Name: Grand Junction Facilities (GJF), formerly Grand Junction Operations Office; (GJO), (GJOO) 1943 - Present DOE Alternate Site Names: U.S. Vanadium (Stratcor), 1943-1946, Robert Elliot American Smelting and Refining Co. (ASARCO) 1948-1955, Tom Aldridge Ledoux and Company 1948, Charley Avalon American Cyanamid (Wyeth) 1953-1954, Denise Lenza National Lead Co. (NL Industries) 1954-1958, Paul Bass Lucius Pitkin, Inc. 1956-1971, James McLaughlin Bendix Field Engineering Corporation 1975-1986 UNC Technical Services 1986-1987 UNC Geotech, Inc. 1987-1990 Chem-Nuclear Geotech, Inc. 1990-1993 RUST Geotech, Inc. 1993-1996 MACTEC Environmental Restoration Services 1996-2002 WASTREN, Inc. 1996-2002 S.M. Stoller Corporation 2002-Present Physical Size and Population of the Site: The site encompasses 54 acres. In 1964 there were 226 workers on site, 24 of whom were monitored for radiation exposure. In 1998 307 workers were monitored for radiation exposure.	Material received from GJO or downloaded from the GJO website is summarized in the DOE Legacy Management - Grand Junction Office and Internet - DOE Legacy Management Considered Sites sections below. NL Industries has informed the Project that a formal court order or records subpoena will be required before any GJO records that may exist can be released or disclosed. The other company's records were either destroyed or submitted to GJO.	11/30/2009	0
State Contacted: Steve Tarlton, Phil Egidi	Colorado does not hold relevant records.	11/11/2009	0
Battelle Memorial Institute, King Avenue	Normal and product material inventories.	04/14/2011	1
Brookhaven National Laboratory	A Department of Energy report from 2000 that states that GJO does not conduct ambient particulate or tritium air monitoring.	03/01/2006	1
Colorado Mesa University, Tomlinson Library	Monthly progress reports, topical uranium extraction reports, the history of	10/15/2012	51

Table A2-1: Summary of Holdings in the SRDB for Grand Junction Facilities			
Data Capture Information	**Data Capture Description**	**Completed**	**Uploaded into SRDB**
	the Colorado plateau uranium industry, pilot plant progress reports, and a pilot ion exchange equipment report.		
Department of Labor / Paragon	A summary history of uranium mills, the Surgeon General's recommendations regarding building homes on uranium mill tailings, and an Atomic Energy Commission report on contamination removal.	01/23/2012	11
DOE Environmental Measurements Laboratory Library	Mill tailings project reports, dust sample reports, and a report on controlling employee exposures in underground uranium mines.	03/09/2005	5
DOE Germantown	The DOE Legacy Management process for responding to EEOICPA claims.	03/07/2011	1
DOE Legacy Management - Grand Junction Office	A listing of all contractors at GJO, summary histories of GJO, a summary history of domestic uranium procurement, Contract No. AT(05-1)-266 documents, material inventories, reports on the treatment of carnotite ores, annual UMTRA site inspections, UMTRA reports, remediation work plans, the S.M. Stoller Office of Legacy Management contract, reports on the treatment of ore concentrates, reports on standards preparation, 1953 trip reports, a mixed waste report, final decontamination and decommissioning reports, the Manhattan Engineer District diagram of materials shipments, environmental reports, airborne effluent control at uranium mills, a 1980 radiometric site survey, a 1997 confirmation of exterior remediation activities, radon reports, a summary of process knowledge interviews, mill tailings studies and reports, the 1959 mill products sampling process and flow sheet, building decontamination and decommissioning reports with supporting and historical radiological survey data, and bioassay data from 1967 and the 1990s.	01/29/2015	469
DOE Legacy Management - Morgantown	A 1972 unclassified Fernald letter log with GJO correspondence, a Fernald report which mentions Colorado ores, and verification of GJO as the location of an ore concentrate stockpile.	09/19/2011	408
DOE Legacy Management - MoundView (Fernald Holdings, includes Fernald Legal Database)	A 1953 Health and Safety Division report which references instruments in use at GJO, raw materials development report for 1954-1959, a report which documents the analysis of GJO U_3O_8 at the New Brunswick Laboratory, data on ore concentrate shipments from GJO to Fernald in the 1970s, limited uranium urinalysis from the 1950s and 1960, ore concentrate treatment methods at Fernald, Mallinckrodt Chemical Co., and Weldon Spring, interlaboratory comparisons of ore concentrate assays, an ore concentrate management plan, ore sampling flow diagrams under Lucius Pitkin, ore concentrate specifications committee meeting minutes, an epidemiologic study of mill worker mortality, ore concentrate inventories	05/13/2010	51

Table A2-1: Summary of Holdings in the SRDB for Grand Junction Facilities			
Data Capture Information	**Data Capture Description**	**Completed**	**Uploaded into SRDB**
	and projections, a 1953 New York Operations Office report with the summary of distribution of film badge readings, and documentation of a security breach during a concentrate shipment.		
DOE National Nuclear Security Administration (NNSA)	National Environmental Policy Act (NEPA) categorical exemptions for GJO projects and National Uranium Resource Evaluation (NURE) contracted activities.	01/17/2012	6
DOE Oak Ridge Operations Office Records Holding Task Group (ORO-RHTG)	Uranium production reports.	06/25/2013	21
DOE Office of Scientific and Technical Information (OSTI)	Environmental restoration site maps and sampling and testing procedures for special products.	09/16/2010	2
Federal Records Center, Kansas City	Film badge records for 1957-1960, Uranium Mill Tailings Remedial Action Project (UMTRAP) Project Health and Safety Plan, and an Argonne report describing radon flux tests at Grand Junction.	10/15/2008	6
Federal Records Center, San Bruno	A 1988 Lawrence Berkeley National Laboratory environmental sampling and analysis plan which identifies GJO as the low level radioanalytical laboratory to be used.	08/03/2012	1
Hanford	1948 uranium inventories and the authority to declassify raw materials program documents.	03/20/2013	2
Idaho National Laboratory	Dosimetry reports, bioassay reports, exposure summaries, area monitoring reports, and neutron survey data.	06/06/2012	29
Interlibrary Loan	A 1958 uranium ore processing report and the proceedings of the 1993 incineration conference.	05/29/2012	2
Internet - Defense Technical Information Center (DTIC)	A 1996 report on the decontamination, survey, and statistical release method for vehicles.	08/26/2014	1
Internet - DOE Environmental Management	Linking Legacies Chapter 3: Wastes.	10/28/2007	1
Internet - DOE Comprehensive Epidemiologic Data Resource (CEDR)	No relevant data identified.	11/02/2009	0
Internet - DOE Hanford Declassified Document Retrieval System (DDRS)	No relevant data identified.	11/02/2009	0
Internet - DOE Legacy Management Considered Sites	A raw materials research report covering 1954-1959; mill tailings sites inspections, assessments, and remedial action plans, and long-term stewardship issues and updates.	08/01/2012	14
Internet - DOE National Nuclear Security Administration (NNSA) - Nevada Site Office	No relevant data identified.	11/02/2009	0
Internet - DOE OpenNet	A 1971 site visit report, a 1949 progress report, and Linking Legacies Appendix B: The Eight Major Processes of the Nuclear Weapons Complex.	11/02/2009	3

Table A2-1: Summary of Holdings in the SRDB for Grand Junction Facilities			
Data Capture Information	**Data Capture Description**	**Completed**	**Uploaded into SRDB**
Internet - DOE OpenNet / NIOSH	The 1960 annual report to Congress.	01/11/2008	1
Internet - DOE OSTI Energy Citations	Nuclear waste management reports, the overview of decommissioning activities, leaching of uranium from ores, and environmental audits and reports.	11/30/2013	14
Internet - DOE OSTI Information Bridge	Stannard's Radioactivity and Health, final decontamination and decommissioning reports, the long term surveillance plan for the Cheney Disposal Site, complex-wide radiological waste data, final report on the decontamination and decommissioning of exterior land areas, waste generation and pollution prevention reports, final decontamination and decommissioning reports for GJO facilities, Uranium Mill Tailings Remedial Action (UMTRA) reports, groundwater protection reports, ore processing reports, a radon barrier system report, and uranium industry annuals.	07/30/2013	104
Internet - DOE OSTI SciTech Connect	A survey of sources of thorium-230, the summary of GJO well logging model data, and the construction of the potassium-uranium-thorium (KUT) test pits.	06/10/2011	3
Internet - Energy Employees Claimant Assistance Project (EECAP)	Groundwater and surface water sampling, the radiological release reports for GJO buildings, the long-term surveillance and maintenance plan, and a GJO fact sheet.	12/13/2013	13
Internet - Google	Environmental reports, groundwater reports, final decontamination and decommissioning reports, S.M. Stoller's contract for management of GJO, Projects Office Management Action Process, site environmental summary, the quantity of legacy material present at the site, overviews of mill tailings remediation, complex-wide waste management, stewardship, GJO REMS data, mixed waste profiles, ALARA analysis of hazardous waste disposal alternatives, mill tailings management plans, radon barrier analyses, annual NURE reports, and environmental restoration plans.	01/13/2015	117
Internet - Health Physics Journal	No relevant data identified.	11/04/2010	0
Internet - Journal of Occupational and Environmental Health	No relevant data identified.	11/04/2010	0
Internet - National Academies Press (NAP)	No relevant data identified.	11/04/2009	0
Internet - NIOSH	The designation of a class of GJO employees in the Special Exposure Cohort and the United Nuclear Corporation SEC Petition Evaluation Report.	09/14/2011	2
Internet - NRC Agencywide Document Access and Management (ADAMS)	UMTRA surveillance and maintenance, inspection, mapping, engineering drawings, corrective action, and site remediation reports, Grand Junction Steel property cleanup, Freedom of Information Act (FOIA) requests and	03/26/2013	191

Table A2-1: Summary of Holdings in the SRDB for Grand Junction Facilities			
Data Capture Information	**Data Capture Description**	**Completed**	**Uploaded into SRDB**
	summaries, and radon barrier reports.		
Internet - Oak Ridge National Laboratory (ORNL)	Design of an extraction plant, a 1956 feed material processing status report, a 1974 Health Physics Division report, a 1957 uranium recovery report, and the ORNL fiftieth anniversary history.	01/07/2013	5
Internet - U.S. Environmental Protection Agency (EPA)	A 1979 preliminary assessment of radon emanations from mill tailings piles.	09/09/2005	1
Internet - Washington State University (U.S. Transuranium and Uranium Registries)	No relevant data identified.	11/02/2009	0
Kansas City Plant (KCP)	A KCP environmental restoration paper co-authored by GJO personnel.	09/19/2013	1
Mesa County Libraries, Grand Junction, CO	Newspaper reports on GJO site management, property transfers, and workforce changes.	01/06/2011	26
Mound Museum	Bismuth project reports.	02/13/2008	3
National Archives and Records Administration (NARA) -Atlanta	Manhattan Engineer District production, accountability, medical reports, and analysis of the first four lots produced at GJO.	06/19/2008	20
National Archives and Records Administration (NARA) -College Park	A 1974 study of inactive mill tailings piles, Madison Square Area material balance reports, a 1947 monthly status report, and special materials accountability reports.	09/11/2013	5
National Institute for Occupational Safety and Health (NIOSH)	Semiannual reports of the Atomic Energy Commission, a 1978 DOE survey memo and a 1971 New York Times article on houses built on mill tailings, 1956 AEC radiation safety activities, and Volumes I and II of the History of the AEC.	08/27/2014	11
Nevada Test Site (NTS)	The NTS Final Environmental Impact Statement which identifies GJO as a shipper of radioactive waste to NTS.	10/01/2003	1
New York State Archives	A waste disposal report documenting the presence of GJO ore at Lake Ontario Ordnance Works (LOOW).	03/19/2012	1
Nuclear Regulatory Commission (NRC) Public Document Room	Uranium mills environmental monitoring reports, and source material licenses and licensing documentation.	10/26/2012	18
Oak Ridge Associated Universities (ORAU)	1985 through 2009 annual exposure totals spreadsheet.	11/02/2010	1
ORAU Team	The tenth and eleventh annual radiation exposure reports and 21 documented process knowledge interviews.	12/18/2014	23
Pacific Northwest National Laboratory	A Nuclear Regulatory Commission guidance document for performing occupational radiation monitoring at uranium mills.	04/02/2006	1
SAIC	Summary radiation exposure reports for 1960, 1961, 1964, 1969, 1972, and 1973.	09/02/2004	6
Sandia National Laboratories, New Mexico (SNL/NM)	Weekly exposure reports for 1977-1979 and radioactive shipments from SNL/NM.	10/20/2010	2
S. Cohen & Associates (SC&A)	Film badge reports and the classification review and release of	04/07/2011	3

Table A2-1: Summary of Holdings in the SRDB for Grand Junction Facilities			
Data Capture Information	**Data Capture Description**	**Completed**	**Uploaded into SRDB**
	Mallinckrodt and United Nuclear documents held by GJO.		
SC&A / Idaho National Laboratory	A 1986 memo which states that the GJOO has nine CERCLA units.	06/24/2010	1
SC&A / Pinellas Plant	A 1993 annual report on waste generation and waste minimization progress.	06/24/2010	1
Southern Illinois University	AEC construction cost differentials and the Argonne Palos Forest Preserve environmental monitoring program administered by DOE Legacy Management at GJO.	10/21/2008	2
Unknown	Urine sample data, air sampling data, results of 1991 indoor radon study, film badge reports, site characterization surveys, New York Operations Office correspondence and reports, radon measurements, and a request for special J slugs.	10/04/2004	57
Total			**1,720**

Table A2-2: Database Searches for Grand Junction Facilities			
Database/Source	**Keywords**	**Hits**	**Uploaded into SRDB**
NOTE: Database search terms employed for each of the databases listed below are available in the Excel file called "Copy of Grand Junction Facilities Rev 02 (83.13) 02-09-15."			
Defense Technical Information Center (DTIC) https://www.dtic.mil/ COMPLETED 08/26/2014	See Note above	2,621	1
DOE CEDR http://cedr.lbl.gov/ COMPLETED 11/02/2009	See Note above	0	0
DOE Hanford DDRS http://www2.hanford.gov/declass/ COMPLETED 11/02/2009	See Note above	0	0
DOE NNSA - Nevada Site Office www.nv.doe.gov/main/search.htm COMPLETED 11/02/2009	See Note above	0	0
DOE OpenNet	See Note above	36	8

Table A2-2: Database Searches for Grand Junction Facilities			
Database/Source	**Keywords**	**Hits**	**Uploaded into SRDB**
http://www.osti.gov/opennet/advancedsearch.jsp COMPLETED 11/02/2009			
DOE OSTI Energy Citations http://www.osti.gov/energycitations/ COMPLETED 10/31/2009	See Note above	909	1
DOE OSTI Information Bridge http://www.osti.gov/bridge/advancedsearch.jsp COMPLETED 10/30/2009	See Note above	422	72
Energy Employees Claimant Assistance Project (EECAP) http://www.eecap.org COMPLETED 12/13/2013	See Note above	NA	15
Google http://www.google.com COMPLETED 11/10/2009	See Note above	924,702	25
HP Journal http://journals.lww.com/health-physics/pages/default.aspx COMPLETED 11/04/2010	See Note above	53	0
Journal of Occupational and Environmental Health http://www.ijoeh.com/index.php/ijoeh COMPLETED 11/04/2010	See Note above	1	0
National Academies Press http://www.nap.edu/ COMPLETED 11/04/2009	See Note above	211	0
NRC ADAMS Reading Room http://www.nrc.gov/reading-rm/adams/web-based.html COMPLETED 09/01/2010	See Note above	1,211	51
U.S. Transuranium & Uranium Registries http://www.ustur.wsu.edu/ COMPLETED 11/02/2009	See Note above	0	0