SEC Petition Evaluation Report
Petition SEC-00012-1 and 2

Report Rev # Supplement　　　　Report Submittal Date: 03-30-2005

Petition Administrative Summary			
Petition Under Evaluation			
Petition #	Petition Type	Submittal Date	DOE/AWE Facility Name
SEC-00012	83.13	07-21-2004	Mallinckrodt Chemical Company, Destrehan Street

Initial Class Definition
The entire Uranium Division of Mallinckrodt Chemical Works (1942-1957)

Proposed Class Definition
(1) All Department of Energy (DOE), DOE contractors, or subcontractors, or Atomic Weapons Employer (AWE) employees who worked in the Uranium Division at the Mallinckrodt Destrehan Street facility during the period from 1942 through 1948. (2) All Department of Energy (DOE), DOE contractors, or subcontractors, or Atomic Weapons Employer (AWE) employees who worked in the Uranium Division at the Mallinckrodt Destrehan Street facility during the period from 1949 through 1957.

Related Petition Summary Information			
SEC Petition Tracking #(s)	Petition Type	DOE/AWE Facility Name	Petition Status
NA	NA	NA	NA

Lead Technical Evaluator:	Signature on File *LaVon B. Rutherford*	3/30/05 *Date*
Peer Review Completed By:	Signature on File *James W. Neton*	3/30/05 *Date*
SEC Petition Evaluation Supplement Approved By:	Signature on File *Larry J. Elliott*	__3/30/05__ *Date*

Supplement to Mallinckrodt SEC Petition Evaluation Reports (SEC-00012-1 and 2)

Discussion of Issues Identified During the Advisory Board Deliberation of the Mallinckrodt Evaluation Reports on 2/08-2/09/2005 in St. Louis

Introduction

During the Advisory Board on Radiation and Worker Health's review of the Mallinckrodt SEC Petition Evaluation Reports (SEC-00012-1 and 2), a number of issues were identified that were not specifically addressed in NIOSH's evaluation. This supplement to the Mallinckrodt evaluation reports identifies the issues raised and provides an evaluation of the effect these issues might have on the proposed designation.

Issues

1) Identify how NIOSH is certain that it has access to data and reports identified in the 1972 Mason letter as being potentially lost or destroyed.
2) A number of other items of concern are identified in the 1975 Mont Mason notes that were presented at the Board meeting. NIOSH should address these in their context and discuss whether they prevent NIOSH from reconstructing doses at Mallinckrodt with sufficient accuracy.
3) Provide a summary of the content of the six additional boxes of Mallinckrodt data that have been retrieved and were unevaluated by NIOSH at the time of the St. Louis Board meeting.
4) How will exposures for isotopes other than uranium be calculated if urine samples were counted for uranium only?
5) Can NIOSH estimate potential radiation exposures and doses associated with "blowouts"?

Issue 1

Identify how NIOSH is certain that it has access to data and reports identified in the 1972 Mason letter as being potentially lost or destroyed.

One of the issues raised by the Mallinckrodt petitioner was the potential loss or destruction of records. Specifically, the petitioner referenced a September 5, 1972 letter from Mont Mason to Dr. T. F. Mancuso, which discussed the transfer of records to Oak Ridge for storage. In this letter, Mr. Mason stated his concerns about possible destruction of key records (identified as "shelf list section V2161", which consisted of reports associated with dust studies and other facility surveys) that had been classified and were beyond their scheduled destruction date.

NIOSH had initially believed that the documents on shelf section V2161were the dust box data to which Mason refers in his “Notes and Summary of Visit by M. E. Mason August 1975.” However, NIOSH has since recovered a records transmittal and receipt form from the Federal Records Center that identifies the contents of “the shelf list section V2161.” This transmittal and receipt form identifies 22 separate documents that were received at the Federal Records Center in St. Louis, Missouri on December 28, 1967, in Box Number V-2161. These documents, which are identified by title, consist of dust studies conducted at various Mallinckrodt plants from 1948 to 1953, an annual report from the New York Operations Office (NYOO) Health and Safety Division, and a cumulative exposure estimate of MCW personnel employed between 1942 to 1949.

NIOSH has obtained 21 of the 22 documents listed in the transmittal and receipt form for V2161. The only document not located in a search of the ORAU/CER vault was the document titled “Annual Report, FY 1950 – NYOO Health and Safety Division, dated November 13, 1950.”

The table below identifies the documents from the Records Transmittal and Receipt form for V2161 and whether the document is referenced in the Mallinckrodt Technical Basis Document (TBD). If it was not referenced, the table identifies whether the data was captured in the TBD through reference to another document.

Item No.	Document Name	In TBD as Ref.	Not in TBD as Ref., But Data Captured Via Other Ref.	Not in TBD as Ref.; Data May Not Be Captured
1	An estimate of Cumulative Exposures to Radioactive Materials – MCW Plants 4 and 6, July 1942 to October 1949, dated November 20, 1950	X		
2	Dust Study at MCW Plant 4 conducted during September and October 1948, dated February 2, 1949	X		
3	Dust Study of Plant 6 conducted during October and November 1948, dated April 21, 1949	X		
4	Plant 4 Dust Study conducted during October 12 and November 4, 1949 dated March 1, 1950		X	
5	MCW Plant 4 Dust Study Recheck, dated June 1, 1950	X		
6	MCW Plant 4 Occupational Exposure to Radioactive Dust, dated July 26, 1950	X		
7	MCW Plant 6 Dust Study conducted during August 1950, dated August 21, 1950	X		
8	MCW Plant 6E Occupational Exposure to Radioactive Dust, dated November 13, 1950		X	
9	Annual Report, FY 1950 – NYOO Health and Safety Division, dated November 13, 1950			X
10	MCW Results of Dust Study at Plant 6E – November 15, 1950 – February 6, 1951, dated February 26, 1951		X	

11	MCW Plant 7 Occupational Exposure to Radioactive Dust dated December 21, 1951	X		
12	MCW Results of Dust Study at Plant 6 E, dated January 10, 1952			X
13	MCW Plant 6 – Dust Study, dated May 1952		X	
14	MCW Plant 6 – Occupational Exposure to Radioactive Dust, dated May 6, 1952			X
15	MCW Plant 7 - Occupational Exposure to Radioactive Dust, dated December 22, 1952	X		
16	MCW Plant 6E – Occupational Exposure to Radioactive Dust, dated January 5, 1953		X	
17	MCW Plant 7 – Dust Study, dated April, 1953		X	
18	MCW Plant 6 – Ore Room Addition, Occupational Exposure to Radioactive Dust, dated May 22, 1953	X		
19	MCW Plant 4 – Occupational Exposure to Radioactive Dust, dated June 3, 1953		X	
20	MCW Plant 6 - Occupational Exposure to Radioactive Dust, dated June 8, 1953		X	
21	MCW Plant 7 - Occupational Exposure to Radioactive Dust, dated June 15, 1953		X	
22	MCW Plant 6E - Occupational Exposure to Radioactive Dust, dated June 24, 1953		X	

As indicated by the table, three of the 22 documents from V2161 have not been referenced in the TBD and the data was not captured from another reference. The first document is the "Annual Report, FY 1950 – NYOO Health and Safety Division," dated November 13, 1950. As indicated previously NIOSH has been unable to recover this document. The NYOO annual and monthly reports are sometimes helpful in establishing chronology or in documenting the reason behind a particular action, but the environmental health and safety data summarized in these reports usually are provided in more useful and comprehensive form in other documents (e.g., in the plant dust studies).

The second document, "MCW Results of Dust Study at Plant 6 E," is dated January 10, 1952. The data from this document were not previously obtained for use in the TBD. NIOSH has compared the data to data used for the TBD to determine whether their inclusion would increase dose estimates. The exposure data that were used in the TBD were collected after the operation in the plant was in full-scale production and document higher exposure levels than the exposure data from this January 1952 study, which was conducted prior to full-scale production. Thus, using data from the January 1952 document would lower the estimated doses calculated from the data already in the TBD.

The third document not referenced in the TBD is "MCW Plant 6 – Occupational Exposure to Radioactive Dust," dated May 6, 1952. NIOSH has compared the dust exposure data from this study to the January 1952 figures that are in the TBD and found the data in the TBD indicate higher exposures. Thus, use of the new data would not increase the estimated doses calculated from the data already in the TBD.

Although the data in the TBD are claimant favorable compared to the data in the two studies identified above, the newly obtained data will be fully analyzed and may be included in the next revision of the TBD.

Based on the above information, NIOSH does not find that the records from V2161 have been lost or destroyed. In addition, most of the data from the documents in V2161 were evaluated and used, when appropriate, in rev.1 of the TBD.

Issue 2

A number of other items of concern are identified in the 1975 Mont Mason notes that were presented at the board meeting. NIOSH should address these in their context and discuss whether they prevent NIOSH from reconstructing doses at Mallinckrodt with sufficient accuracy.

During the board meeting, NIOSH presented a document “Notes and Summary of Visit by M. E. Mason” to support the position that key dust study documents had not been destroyed. In the document, a number of issues are identified by Mason with respect to the data for Mallinckrodt.

The Mason notes were generated from a trip Mr. Mason took in 1975. He was gathering data for an epidemiology study he was conducting with Dr. T. F. Mancuso. Ultimately, Mr. Mancuso ran out of funding and his study of the Mallinckrodt population of workers was not completed. However, the important fact to note is that the information in this trip report reflects an evaluation in progress. It does not reflect a completed evaluation of the data. Although the study was never completed, since then the site data have been evaluated and the issues identified by Mr. Mason revisited for other studies and epidemiology reports. In addition, ORAU and NIOSH have reviewed these data for the development of the Mallinckrodt TBD.

Based on NIOSH’s review of the 1975 Mont Mason notes, the context of those notes, and the review of the data, NIOSH does not find any issues that would prevent dose reconstruction.

Issue 3

Provide a summary of the content of the six additional boxes of Mallinckrodt data that have been retrieved and were unevaluated by NIOSH at the time of the St. Louis Board meeting.

There were actually five boxes, not six, because two of the boxes, which contained information from Weldon Springs, were consolidated into one. A summary of the types of information contained in the boxes is provided below. A list of the contents of each folder is provided in Attachment 1.

Box 1 Mallinckrodt
Approximately 75% of the box contents are film badge reports from 1945 to 1958 (distribution: ~25% 1945 – 1950; ~75% 1950 – 1958). The other 25% is air sampling data, breath analyses, contamination survey results, and radon monitoring.

Box 2 Weldon Spring
Approximately 75% of the box contents are film badge reports from 1957 to1961 (distribution is random). The other 25% is bioassay data 1961 – 1965 (sporadic), breathing zone air sampling data 1963 – 1965, contamination survey data1959, and air sampling of Bldg 301.

Box 3 Weldon Spring Film badge reports.

Box 4 Mallinckrodt Dust Studies
The table below indicates the plant or lab and the date for the dust studies found in this box.

Plant 4	Plant 6	Plant 6E	Plant 7	Shotgun Lab	K-65 Lab
11/53	9/53	4/53	7/56	6/53	11/52
5/56	1/53	9/55	3,4/53		
6/50	5/54	7/56	3/53		
9,10/48	3,4,5/52	11/50	6/54		
10,11/49		8-12/51	9/51		
5/50		11/50 -2/51	11/56		
5/50		5/53	11/53		
			5/53		

In addition to the dust studies the box contains annual uranium urine results for 1948 to 1958.

Box 5 Mallinckrodt and Weldon Springs
Approximately 25% of the box contents are 1946 to 1949 film badge records for Mallinckrodt. The other 75% are Weldon Spring Film Badge records. Approximately half of those film badge records cover the time period from 1959 to 1965. The other half is bioassay reports for 1959 to 1965 and “area monitor trends” for 1965.

The initial review of these documents indicates that some of the data duplicate data previously available to NIOSH and were already addressed in the TBD. However, some of the documents provide additional data for dose reconstruction that can be incorporated into the TBD.   The data covering the 1946-1949 period were already incorporated in rev.1 of the TBD. However, the data from the 1953-1958 period are newly obtained. This information, which is, in large part, specific to particular operations (e.g., the results of enclosing particular work stations), will be incorporated into the next revision of the TBD.

Issue 4

How will exposures for isotopes other than uranium be calculated if urine samples were counted for Uranium only?

Section 6.0 of revision 1 of the Mallinckrodt Technical Basis Document (TBD) identifies assumptions and general instructions for determining intakes during the operating years. These assumptions and general instructions include the methods to be used for calculating the intakes for isotopes other than uranium. The general approach is based on claimant-favorable distributions of isotopes as described in the TBD. A portion of these instructions are included below. For detailed instructions refer to Section 6.0 of Rev. 1 of the TBD.

ASSUMPTIONS AND GENERAL INSTRUCTIONS

A. Urinalyses measured uranium only. For inclusion of other isotopes, the following may be assumed and is considered claimant-favorable.

<u>For source materials in which uranium isotopes were predominant (general case)</u>

By weight, natural uranium is about 99.3% U-238, .732% U-235, and .006% U-234 (Shleien 1992). But by activity, it is about 48.9% U-238, 48.9% U-234, and 2.26% U-235. In the absence of other information, it is not possible to tell the degree of equilibrium between the uranium isotopes and their daughters in a urine sample; hence it may be assumed conservatively that there is 100% equilibrium. Then for each pCi of uranium measured, about 0.49 pCi is U-234, 0.49 pCi is U-238, and 0.02 pCi is U-235. However, generally the U-238 portion can conservatively be assumed to be U-234 as well, so it can be assumed for simplicity that there are 0.98 pCi of U-234 and 0.02 pCi of U-235.

Thus under the assumption that the daughters of the original U-234 are in equilibrium with the U-234 (but of course not the subsumed U-238), there are an additional 0.49 pCi of Th-230 and 0.49 pCi of Ra-226. With the daughters of the U-235 in equilibrium with the U-235 parent, there is an additional 0.02 pCi of Pa-231.

These conservative and claimant-favorable source terms are summarized in the table below and should be used when Table 28 of the TBD is used to determine intake. For simplification of the dose reconstruction process, the low-contributing isotopes may be conservatively ignored or their contributions may be folded into those of other isotopes, when appropriate for the organ type and intake mode.

For each pCi of uranium measured in urine, assume:

Isotope	Quantity, pCi
U-234	0.98
Th-230	0.49
Ra-226	0.49
U-235	0.023
Pa-231	0.023
Ac-227	0.023

For source material in which radium-226 was the predominant isotope

Sources in which radium was the predominant isotope are associated with the job titles and areas listed in Section 6.1 of the TBD. In these areas, it can be assumed that there was approximately 100 times more radium than uranium in the air on a curie basis (see Section 5.3.1). Thus the table above for uranium should still be assumed to apply, but an adjustment must be made for radium content after the uranium pCi intake has been calculated as discussed in Section 6.2 of the TBD.

For source material that was processed to concentrate thorium

For those few workers who processed thorium (Plant 7E, 1955-1957) (see Sections 4.5 and 5.3.2 of the TBD) , it is unclear as to whether the urinalyses measured thorium or still just uranium, although apparently urinalyses were done. There may be indications on individual records. Thus the urinalysis results should be inspected on a case-by-case basis to see if any information regarding thorium measurement methods or content was provided in the record. If not, then the intake data from Table 29F of the TBD should be used instead, as appropriate.

When Table 29F of the TBD is used, for each total pCi of assumed intake (not pCi in the urine), assume:

			CEDE
Th-230	0.990	pCi	8.80E-05
Ra-226	0.0065	pCi	2.32E-06
Th-232	0.00004	pCi	4.43E-04

Note that this table gives the CEDE (which can be assumed to be in arbitrary units) for comparison. Clearly, except possibly for certain organs, the intake can be assumed to be wholly Th-230.

B. Air samples measured gross alpha only. For breakdown into an isotope distribution, the following claimant-favorable values should be assumed when intakes from Tables 29A-29F or concentrations from Tables 19-22 of the TBD are used. Again, for simplification of the dose reconstruction process, the low-contributing isotopes may be conservatively ignored or their contributions may be folded into those of other isotopes, when appropriate for the organ type and intake mode.

For source materials in which uranium isotopes were predominant (general case)

The source terms in the table below should be used when Tables 29A-29E or Tables 19-22 of the TBD are used to determine intake.

For each 1,000 dpm of gross alpha measured in air, assume:

Isotope	Quantity, dpm
U-234	489
Th-230	244
Ra-226	244
U-235	11
Pa-231	11
Ac-227	11

For each pCi of inhalation intake, assume:

Isotope	Quantity, pCi
U-234	0.489
Th-230	0.244
Ra-226	0.244
U-235	0.011
Pa-231	0.011
Ac-227	0.011

For source material in which radium-226 was the predominant isotope

For sources in which radium was the predominant isotope, it can be assumed that there was approximately 100 times more radium than uranium in the air on a curie basis (see Section 5.3.1 of the TBD). The following should be assumed for cases in which worker titles or functions correspond to areas where K-65 residue is present. This can be determined from the Table in Section 6.2, Item 3.

For each 1,000 dpm of gross alpha measured in air, assume:

Isotope	Quantity, dpm
U-234	9.6
Th-230	4.8
Ra-226	985
U-235	0.2
Pa-231	0.2
Ac-227	0.3

For each pCi of inhalation intake, assume:

Isotope	Quantity, pCi
U-234	.0096

Th-230	.0048
Ra-226	.984
U-235	.00020
Pa-231	.00020
Ac-227	.00030

For source material that was processed to concentrate thorium

The following should be assumed for cases in which workers processed residue to concentrate thorium (Plant 7E, 1955-1957) (see Sections 4.5 and 5.3.2 of the TBD) and the dpm figures from Table 29F of the TBD are used.

For each 1,000 dpm of gross alpha measured in air, assume:

Isotope	**Quantity, dpm**
Th-230	993
Ra-226	6.5
Th-232	.04

For each pCi of inhalation intake, assume:

Isotope	**Quantity, pCi**
Th-230	.990
Ra-226	.0065
Th-232	.000040

Note that it may be possible, for a given organ, to consider Th-230 alone.

As identified in the opening paragraph of this issue, Section 6.0 of the TBD contains the details for determining intakes for isotopes other than Uranium.

Issue 5

Can NIOSH estimate potential radiation exposures and doses associated with "blowouts"?

BACKGROUND

The term "blowout," as used in the production of uranium, is an event that occurs during the reduction of uranium tetrafluoride (UF_4) to uranium metal. To accomplish the reduction, UF_4 (also known as green salt) is blended with magnesium metal and poured into a container known at Mallinckrodt as a "bomb". The bomb was lined with a refractory material, such as magnesium fluoride, to isolate the reactants from the walls of the container. To initiate the exothermic reaction, the operators "fire" the mixture by capping and sealing the cylinder and heating the contents in a gas furnace. The reaction causes the fluorine to combine with the magnesium to form magnesium fluoride with the molten uranium forming a "derby" in the bottom of the pot. This uranium metal derby is then separated from the magnesium fluoride after the bomb has cooled.

A blowout occurs when a hole is burned through the side of the bomb causing some of the heated contents to escape. The force for the escaping material is the result of a build up of pressure in the heated container. Depending on timing, the airborne material generated during a blowout could include various combinations of magnesium fluoride, magnesium metal, uranium metal and uranium tetrafluoride.

DOSE RECONSTRUCTION

The most significant source of exposure to a worker who was present at a blowout is from inhalation of airborne uranium. Since the uranium used in the process has already been chemically purified, internal exposure to uranium progeny, such as radium and radon is not a consideration. The magnitude of an inhalation exposure is limited to the amount of uranium particulate that can be sustained in a cloud of dust and the amount of air a worker could breathe during such an incident.

The existence of a routine urinalysis program after 1948 allows NIOSH to put an upper limit on any doses associated with blowouts or other incidents involving internal exposures. If NIOSH assumes all uranium excreted by workers on a routine monitoring program is the result of a blowout that occurred immediately after the workers submitted their previous sample, the resultant dose calculation will provide a maximum plausible estimate of the exposure incurred by a worker. The dose, in all likelihood, would be an overestimate because the urine samples would include uranium inhaled from other routine operations conducted in the plant.

Exposures to blowouts from 1942 to 1948 can be estimated by using urine data available after 1948. Since the amount of material released, exposure time, and type of radioactive material involved with a blowout would be similar during the entire operating period, 1942 to 1957, the urine data after 1948 can be used to develop an exposure model for blowouts occurring during the 1942 to1948 time period. NIOSH can review the urine data available for individuals with a high probability of being exposed to blowouts. From this urine data NIOSH can determine a worst case exposure scenario or, if sufficient urine data are available, a claimant favorable distribution could be established.

To refine these values, NIOSH could also review the information provide by Mallinckrodt workers during their interviews. When such incidents were identified, NIOSH could specifically review the Energy Employee's bioassay records for incident samples.

Attachment 1
List of Documents found in the Mallinckrodt Boxes

DOCUMENT NUMBER	SITE / FACILITY OF DATA CAPTURE	SITE	DOCUMENT TITLE / SUBJECT	DATE UPLOADED
030002631	ORO Vault	MCW	Film Badge Report/Data 1946-1947	2/11/2005
030002632	ORO Vault	MCW	Conversion to the "Rad" Unit June 1956	2/11/2005
030002633	ORO Vault	MCW	Film Badge Summary December 1960	2/11/2005
030002634	ORO Vault	MCW	Changes to the Film Badge Program August 1956	2/11/2005
030002635	ORO Vault	MCW	List of Personnel and Social Security Numbers 1944-1947	2/11/2005
030002636	ORO Vault	MCW	Air Sampling Data 1956-1957	2/11/2005
030002637	ORO Vault	MCW	Health Hazard Report 1946	2/11/2005
030002638	ORO Vault	MCW	Area and Personnel Film Badge Results 1956	2/11/2005
030002639	ORO Vault	MCW	Radon and Air Sample Data 1947-1948	2/11/2005
030002640	ORO Vault	MCW	Film Badge Report 1954	2/11/2005
030002643	ORO Vault	MCW	Breath Sample Report 1945-1947	2/11/2005
030002644	ORO Vault	MCW	Film Badge Data 1946	2/11/2005
030002645	ORO Vault	MCW	Film Badge Data 1945	2/11/2005
030002646	ORO Vault	MCW	Film Badge Data 1958	2/11/2005
030002647	ORO Vault	MCW	Film Badge Monitoring Program 1948-1956	2/11/2005
030002648	ORO Vault	MCW	Radiation Survey of Reduction Pilot Plant April 1952	2/11/2005
030002649	ORO Vault	MCW	Plant 4 Need for Shielding April 1952	2/11/2005
030002650	ORO Vault	MCW	Radiation Study of the Shotgun Laboratory Operations April 1956	2/11/2005
030002651	ORO Vault	MCW	Uranium Discharged to Atmosphere February 1956	2/11/2005
030002652	ORO Vault	MCW	Breath Analysis August 1947	2/11/2005
030002653	ORO Vault	MCW	Radiation Hazards in Shotgun Laboratory July 1956	2/11/2005
030002654	ORO Vault	MCW	Beta Radiation in Metal Plant February 1949	2/11/2005
030002655	ORO Vault	MCW	Interpretation of Contamination Survey Readings May 1949	2/11/2005
030002656	ORO Vault	MCW	Beta Radiation and Contamination at Plant 4 August 1948	2/11/2005
030002657	ORO Vault	MCW	Film Badge Data for 1958	2/11/2005
030002658	ORO Vault	MCW	Radon Monitoring Data 1952-1954	2/11/2005

030002659	ORO Vault	MCW	Film Badge Program 1950-1956	2/11/2005
030002660	ORO Vault	MCW	Film Badge Results 1946-1950	2/11/2005
030002661	ORO Vault	MCW	Radon and Gamma Levels in Plant 6 December 1956	2/11/2005
030002662	ORO Vault	MCW	Radon Results 1955-1956	2/11/2005
030002663	ORO Vault	MCW	Dosimetry Data Cumulative to 1955	2/11/2005
030002664	ORO Vault	MCW	Film Badge Results 1956-1957	2/11/2005
030002665	ORO Vault	MCW	Film Badge Data 1956	2/11/2005
030002666	ORO Vault	MCW	Film Badge Results 1955-1956	2/11/2005
030002667	ORO Vault	MCW	Film Badge Summaries 1954-1955	2/11/2005
030002668	ORO Vault	MCW	Film Badge Results 1957	2/11/2005
030002714	ORO Vault	MCW	Individual Occupational Exposure Plant 6E September 1950	2/16/2005
030002715	ORO Vault	MCW	Annual Uranium Urine mg/l August 1948-1958	2/16/2005
030002716	ORO Vault	MCW	Dust Study Plant 6E May 4-15, 1953	2/16/2005
030002717	ORO Vault	MCW	Dust Study Plant 6 December 12, 1950	2/16/2005
030002718	ORO Vault	MCW	Dust Study Plant 7 November 9-13, 1956	2/16/2005
030002719	ORO Vault	MCW	Dust Study Plant 7 July 17-20, 1956	2/16/2005
030002720	ORO Vault	MCW	Dust Study Plant 7 March 14-18, 1955	2/16/2005
030002721	ORO Vault	MCW	Dust & Urine Exposure Calculations 1942-October 1, 1949	2/16/2005
030002722	ORO Vault	MCW	Dust Study Plant 7 June 28, 1954	2/16/2005
030002723	ORO Vault	MCW	Dust Study Plant 4 May 17-18, 1956	2/16/2005
030002724	ORO Vault	MCW	Dust Studies Plant 7 September 26-28, 1951	2/16/2005
030002725	ORO Vault	MCW	Dust Study Plant 4 June 5-9, 1950	2/16/2005
030002726	ORO Vault	MCW	Dust Studies Plant 6E September 27, 1955	2/16/2005
030002727	ORO Vault	MCW	Dust Studies Plant 6 September 28, 1953	2/16/2005
030002728	ORO Vault	MCW	Occupational Exposure to Airborne Contaminants - Plant 6E July 17-19, 1956	2/16/2005
030002729	ORO Vault	MCW	Occupational Exposure to Radioactive Dust - Plant 6E September 5-8 & 26-29, 1950	2/16/2005
030002730	ORO Vault	MCW	Occupational Exposure to Airborne Contaminants - Plant 7 November 16-18, 1953	2/16/2005
030002731	ORO Vault	MCW	Dust Study Plant 7 Week of May 11, 1953	2/16/2005
030002732	ORO Vault	MCW	Dust Study Plant 6E April 6, 1953	2/16/2005
030002733	ORO Vault	MCW	Dust & Urine Exposure Calculations Plant 4 1942-October 1, 1949	2/16/2005

030002734	ORO Vault	MCW	Dust Study Plant 6 January 12-16, 1953	2/16/2005
030002735	ORO Vault	MCW	Occupational Exposure to Airborne Contaminants May 24-27, 1954	2/16/2005
030002736	ORO Vault	MCW	Dust Study March, April, May 1952	2/16/2005
030002737	ORO Vault	MCW	Dust Studies Plant 6E 1955	2/16/2005
030002738	ORO Vault	MCW	Counting Room Procedures Beta Counter	2/16/2005
030002739	ORO Vault	MCW	Exposure > 15,000 rep/year 1947-1948	2/16/2005
030002740	ORO Vault	MCW	Film Badge Reports Plant 6 1947	2/16/2005
030002741	ORO Vault	MCW	Film Badge Data	2/16/2005
030002742	ORO Vault	MCW	Visitor Film Badge 1949-1950	2/16/2005
030002743	ORO Vault	MCW	Determination of Pu in Urine	2/16/2005
030002744	ORO Vault	MCW	Bioassay Urine Processing	2/16/2005
030002745	ORO Vault	MCW	Film Badge Dosimetry Plant 4 1948	2/16/2005
030002746	ORO Vault	MCW	Film Badge Dosimetry Plant 6 1948	2/16/2005
030002747	ORO Vault	MCW	Film Badge Dosimetry Plant 6 1949	2/16/2005

Prepared by: LaVon Rutherford 3/10/2005

Reviewed by: James W. Neton 3/14/2005

Approved by: Larry J. Elliott 3/14/2005