Name: _____ SSN: _____

ZIA
DOE Work History

CERID: _____ DOB: _____

#	Coh	Rec Type	Start Date MM/DD/YY	DP Code / Group	DP Name	DV Code / Area	Division Name / Area Name	Job Title	Pay Code	Bldg Loc	Term Reason
1											
2											
3											
4											
5											
6											
7											
8											

* **Record Type:** H = Hire C = Change T = Term R = Rehire NH = Consultant hire NT = Consultant Term
GH = Guest hire GT = Guest term LL = Loan leave LR = Loan return SL = Sick leave SR = Sick return Z = Last known work date (if no Term date known)

Date Last Worked: _____

Source of this information: _____

Abstractor: ___ ___ ___ Date: ___ ___ ___
mm dd yy

Appendix II

Multiple Myeloma Study: Forms for Data Abstraction

Exhibit C

Occupational Health Records

Name:_____ SSN:_____

Occupational Health

CERID

DOB

COHORT

A. Medical X-Rays:

☐ No medical record. ☐ Medical record, but no Xrays recorded.

#	Date MM/DD/YY	Reason	Code Reason	Body Part/ Xray Type	Code Body Part	Comments
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

Occupational Health

CERID

DOB

COHORT

A. Medical X-Rays (continued):

#	Date MM/DD/YY	Reason	Code Reason	Body Part/ Xray Type	Code Body Part	Comments
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						

Occupational Health Records (continued)

CERID ____

COHORT ____

B. Chelation Therapy:

0 = No (no evidence)

1 = Yes

If Yes:

Date Started: ____ (mm dd yy)

Date Stopped: ____ (mm dd yy)

Radionuclide(s): _____ ____

_____ ____

Explain circumstances:

*Note: Use internal radiation monitoring forms to record bioassay results

C. Smoking prior to or during employment:

Ever smoked cigarettes, cigars, pipes: ____

0 = No 1 = Yes 9 = not noted in record

Comments about smoking:

Occupational Health Records (continued)

CERID _____

COHORT _____

D. Health Classification:

1) Preplacement Date: mm dd yy

Classification Code : _____

Comments/Restrictions: _____

_____

2) Termination Date: mm dd yy

Classification Code : _____

Comments/Restrictions: _____

_____

3) Worker ever denied a job for health or physical reasons:

0 = No (no evidence) | 1 = Yes _____

If Yes, explain:

E. History of Cancer:

0 = No (no evidence) | 1 = Yes _____

If Yes:

Diagnosis 1: _____ ICD9: _____

Date noted in OH record: _____ mm dd yy

Diagnosis 1: _____ ICD9: _____

Date noted in OH record: _____ mm dd yy

Occupational Health Records (continued)

CERID ⌊_____⌋

COHORT ⌊_____⌋

F. Ever treated with radiation:

0 = No (no evidence) 1 = Yes ⌊___⌋

Comments:

G. Evidence of Exposure to (or medical surveillance of) Occupational Hazards:

0 = No (no evidence) 1 = Yes ⌊___⌋

If Yes:

Comments	Hazard	Hazard Code	Start Year	Stop Year

* (Use Internal Radiation Monitoring form *(green)* or Biological Monitoring form *(orchid)* to record any radiation, or chemical bioassay results found in medical records.)

Abstractor: ⌊___⌋ Date: ⌊__⌋⌊__⌋⌊__⌋
mm dd yy

Appendix II

Multiple Myeloma Study: Forms for Data Abstraction

Exhibit D

External Radiation Dosimetry Records

Name: _____ _____ SSN: _____ _____

HANF
External Dosimetry Records Year: 19____

CERID: _____ DOB: _____ Cohort: _____ Page 1 of ____

Rec #	Date Sample Read MM/DD/YY	Period Covered MM/DD/YY	MM/DD/YY	Period Type W - week Q - qrtr(#) A - annual	Method Used PC FB TCD TE F O (specify)		Penetrating GamX	FastN	HEBeta	TOTAL	Readings Unknown Neutron	Non-Penetrating SoftX	SlowN	Beta	Alpha	TOTAL
1						Mntr Loc										
						Result/Unit										
2						Mntr Loc										
						Result/Unit										
3						Mntr Loc										
						Result/Unit										
4						Mntr Loc										
						Result/Unit										
5						Mntr Loc										
						Result/Unit										
6						Mntr Loc										
						Result/Unit										
7						Mntr Loc										
						Result/Unit										
8						Mntr Loc										
						Result/Unit										
9						TOTAL Result/Unit										

Source of this information: _____

Location of this information at source: _____

Abstractor: |_|_|_| Date: |_|_|_|_|
mm dd yy

Name: _____ SSN: _____ _____

ORNL
External Dosimetry Records Year: 19____

CERID: _____ DOB: _____ Cohort: _____ Page 1 of ____

Rec #	Date Sample Read MM/DD/YY	Period Covered MM/ DD/ YY	MM/ DD/ YY	Period Type W - week Q - qrtr(#) A - annual	Method Used PC FB TCD TE F O (specify)		Penetrating GamX	FastN	HEBeta	TOTAL	Readings Unknown Neutron	Non-Penetrating SoftX	SlowN	Beta	Alpha	TOTAL
1						Mntr Loc Result/Unit										
2						Mntr Loc Result/Unit										
3						Mntr Loc Result/Unit										
4						Mntr Loc Result/Unit										
5						Mntr Loc Result/Unit										
6						Mntr Loc Result/Unit										
7						Mntr Loc Result/Unit										
8						Mntr Loc Result/Unit										
9						TOTAL Result/Unit										

Source of this information: _____

Location of this information at source: _____

Abstractor: |_|_|_| Date: |_|_|_|
mm dd yy

Name: ___ _____ SSN: _____ _____

SRP
External Dosimetry Records Year: 19____

CERID: _____ DOB: _____ Cohort: _____ Page 1 of ____

Rec #	Date Sample Read MM/DD/YY	Period Covered MM/ DD/ YY	MM/ DD/ YY	Period Type W - week Q - qrtr(#) A - annual	Method Used PC FB TCD TE F O (specify)		Penetrating GamX	FastN	HEBeta	TOTAL	Readings Unknown Neutron	Non-Penetrating SoftX	SlowN	Beta	Alpha	TOTAL
1						Mntr Loc Result/Unit										
2						Mntr Loc Result/Unit										
3						Mntr Loc Result/Unit										
4						Mntr Loc Result/Unit										
5						Mntr Loc Result/Unit										
6						Mntr Loc Result/Unit										
7						Mntr Loc Result/Unit										
8						Mntr Loc Result/Unit										
9						**TOTAL** **Result/Unit**										

Source of this information: _____

Location of this information at source: _____

Abstractor: |___|___|___| Date: |___|___|___| mm dd yy

LANL/ZIA
Annual External Exposures: 1944 -1979

CERID: _____

Rec	Group	Birth Year	Datum Year	Period Type	RESULTS						
					Beta	Gamma Rem (CRem)	Fast Neutron (CRem)	Thermal Neutron (Slow) (CRem)	Tritium (CRem)	WBD (CRem)	
1				A							
2				A							
3				A							
4				A							
5				A							
6				A							
7				A							
8				A							
9				A							

Source of this information: Annual Summary Exposures 1944-1979
PCDA4479.ALF November 30, 1993. User# 050440. Job # 24234

Location of this information at source: LANL/ESH12 HP Policies and Programs. Contact: Yvonne Montoya

Abstractor: |_|_|_|

Date: |_|_|_|_|
mm dd yy

LANL/ZIA
Annual External Exposures: 1980 - 1990

CERID: _____

Rec	Group	Birth Year	BI Badge Issue	BR Badge Return	Datum Year	Period Type	RESULTS NP (Beta)	P (Gamma)	N (Fast Neutron)	T (Tritium)			Dosimeter Type
1						A							
2						A							
3						A							
4						A							
5						A							
6						A							
7						A							
8						A							
9						A							

*Note: NP = Non Penetrating P = Penetrating N = Neutron T = Tritium

Source of this information: Annual Summary Exposures: 1980 - 1990
PCDA8090.ALF November 15, 1993. User# 050440. Job # 82604.

Location of this information at source: LANL/ESH12 HP Policies and Programs. Contact: Yvonne Montoya

Abstractor: _____ Date: _____ (mm dd yy)

Z#: _____ Name: _____ SSN: _____

LANL/ZIA
DetailedExternal Exposures:

CERID: _____ Cohort: _____

DOB: _____

Rec	Area	Monitor Pd mm/dd to mm/dd	Datum Year YY	Lab Bk #	Loc Cd	Results							Remarks
						Beta (rad)	Gamma (R)	Gamma (rem)	Fast Neutron (rem)	Thermal Neutron (Slow) (rem)	Tritium (rem)	WBD (rem)	
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													

Source of this information: White, annual, external radiation dosimetry notebooks.

Location of this information at source: LANL - ESH - 4, Bldg. 2007 Contact: Jeff Hoffman

Appendix II

Multiple Myeloma Study: Forms for Data Abstraction

Exhibit E

Internal Radiation Dosimetry Records

Name: _____ SSN: _____

L/ZIA

Internal Radiation Monitoring Record (Bioassay/Whole Body Count) Page 1 of ____

CERID: _____ DOB: _____ Facility: _____

	Date Sample Taken MM/DD/YY	Date Read MM/DD/YY	Method Used UR - Urine FE - Fecal BL - Blood TS - Tissue BR - Breath O - Other (specify)	Reason R = Routine NR = Non-R	Readings		
					Radionuclide Element Isotope	Solubility R - Rapid S - Slow	Result/Units
1							
2							
3							
4							
6							
7							
8							
9							
10							

Evidence of Chelation Therapy: Start Date: _____ Stop Date: _____ Dose: _____

Additional Information:

Source of this information: _____

Location of this information at source: _____

Abstractor: |_|_|_| Date: |_|_|_|_|
mm dd yy

	Date Sample Taken MM/DD/YY	Date Read MM/DD/YY	Method Used UR - Urine FE - Fecal BL - Blood TS - Tissue BR - Breath O - Other (specify)	Reason R = Routine NR = Non-R	Readings		
					Radionuclide Element Isotope	Solubility R - Rapid S - Slow	Result/Units
11							
12							
13							
14							
15							
16							
18							
19							
20							
21							
22							
23							
24							
25							
26							

Appendix II

Multiple Myeloma Study: Forms for Data Abstraction

Exhibit F

Nonradiation Biological Monitoring Records

where college education in chemistry included special studies in x-ray diffraction that was NOT classified as ionizing radiation exposure at non-study facilities.

The primary job of the study subject during their prior work history was identified by reviewing all work activities and jobs listed on the past employment record. The primary job classification was recorded on the lower left corner of the Previous Employment form (page 3 of 3, File: c:\jim\mm\5facform\ per.doc, Date: 9/29/95 or later).

Specific Work History Criteria

1. Military Service (included here because Military Service history is sometimes found in prior work history).

CODING

- NO if previous work history indicates that the subject never served in the military (Army, Navy, Air Force, Marines, Coast Guard), including military service in other countries.
- YES if previous work history indicates that the subject served in the military (Army, Navy, Air Force, Marines, Coast Guard and their academies), including military service in other countries. Enrollment at a U. S. military academy (Army, Navy, Air Force, Coast Guard) is considered military service.
- NOT STATED if any gap greater than two years in work history, or if no previous work history is available.
- Record the service branch: Army, Navy, Air Force, Marines, Coast Guard
- Record the dates when entered and terminated military service (as MMDDYY). If the subject was enrolled at a U. S. military academy, the beginning military service date is the enrollment date. If unable to find the entire service date, then use the following numbers for coding missing dates. Record the missing information in red pen so it can be distinguished later as not completely valid.
  - If the entire date is missing, draw a red line through the field to indicate that information was not found and write "missing".
  - If the month is missing code as "07"
  - If the day is missing code as "15"
  - If the year is missing, draw a red circle around the blank, draw a line to the margin and write "missing"

2. Work on a farm.

CODING

- NO if previous work history indicates that the subject never worked on a farm. If previous work history indicates that the father was a farmer, this is not considered evidence of living/working on a farm.
- YES if previous work history indicates that the subject ever worked on a farm.
- NOT STATED if any gap greater than two years in work history, or if no previous work history is available.

EXAMPLES

1) work in orchards, 2) work for fruit/vegetable growers, 3) fruit picker, 4) rancher, 5) horticulture industry/rose grower, 6) dairy worker, 7) landscape gardener, 8) work at Welch Grape Co., 9) sheepherder, 10) farmer, 11) farm laborer (wheat farm). Jobs **EXCLUDED** in farm work: woolen mill worker, loom mechanic, tobacco packer, assistant baking foreman at NABISCO (worked with flour dust and developed an allergic reaction to the dust), logger, produce buyer for farmers coop, saw mill work, commercial fisherman, chopper at a meat (sausage) plant.

3. Work at other nuclear industry facilities

CODING

- NO if previous work history has no indication that the subject ever worked in the nuclear industry (see attached list of facilities).

- YES if previous work history indicates that the subject ever worked in the nuclear industry. If yes, a three digit facility code is entered (see attached list for facilities and codes). Nuclear facilities include any U. S. Department of Energy (DOE) facilities and sites, any DOE predecessor facilities/sites, or any nuclear power plants including Nuclear Regulatory Commission (NRC) -regulated facilities.
- NOT STATED: if any gap greater than two years in work history after 1933, or if no previous work history is available after 1933. Prior work at nuclear facilities was evaluated back to 1933, the year F. Joliot and I. Curie produced artificial radioactivity by bombarding aluminum with alpha particles (Hoddeson et. al., 1993).

4. Work involving Nuclear Facility occupational radiation exposures

CODING

- NO if previous nuclear facility work history has no indication of a reasonable likelihood of exposure to ionizing radiation.
- YES if previous nuclear facility work history indicates a reasonable likelihood of exposure to ionizing radiation based on job title, work activity and/or industry.
  - Job titles and work activities must specifically reference ionizing radiation (α, β, γ, x-ray, 'cosmic ray'), or include job titles with a reasonable likelihood of exposure to ionizing radiation sources (x-ray technicians).
  - Work locations must specifically reference ionizing radiation or radiation sources and involve work activities with a reasonable likelihood of exposure. Examples include environments involving accelerators (linear, Van-de Graaff), cyclotrons.
- NOT STATED if any gap greater than two years in work history, or if no previous work history is available.
- NOT APPLICABLE if individual never worked in the nuclear industry prior to employment at the index facility.
- NOTE: The research participation/fellows program at ORNL brought in experienced physicists/research scientists from various universities. These individuals could not be identified as having had prior occupational radiation exposures due to the limited information from personnel records and job histories/titles, but these individuals would be more likely to have had prior occupational ionizing radiation exposures than other employees if their area of expertise involved ionizing radiation.

EXAMPLES

Nuclear physics work activities

Jobs at nuclear facilities include: 1) process operator at Y-12, 2) electrical operator at C&CCC (K-25?), 3) operator at Oak Ridge Gaseous Diffusion Plant (ORGDP or K-25), 4) maintenance mechanic at K-25, 5) maintenance mechanic at Tennessee Eastman Company (TEC), 6) engineer at TEC, 7) chemical engineer at K-25, 8) physics research at LASL, Univ. of Chicago and ORNL, 8) work on molten Pu reactor at LASL, 9) university research assistant investigating thorium chemistry (Ames Laboratory), 10) millwright at TEC, 11) laboratory foreman in analytical chemistry at TEC, 12) chemical engineer at TEC, 13) optics section chief at University of Chicago Metallurgical Laboratory, 14) physics technician, Manhattan Project, 15) research associate in electrochemistry at the University of Chicago Met Div.

5. Work involving Non-Nuclear Facility occupational radiation exposures:

CODING

- NO if previous work history has no indication of a reasonable likelihood of exposure to ionizing radiation, excluding nuclear facilities (see attached list of facilities).
- YES if previous work history indicates a reasonable likelihood of exposure to ionizing radiation based on job title, work activity and/or industry (excluding nuclear facilities per attached list).

- Job titles and work activities must specifically reference ionizing radiation (α, β, γ, x-ray, 'cosmic ray'), or involve activities with a reasonable likelihood of exposure to natural sources of ionizing radiation (e.g. mining), or include job titles with a reasonable likelihood of exposure to ionizing radiation sources (dentist/dental assistant).
- Industries or work locations must specifically reference ionizing radiation or radiation sources and involve work activities with a reasonable likelihood of exposure. Examples include environments involving accelerators (linear, Van-de Graaff), cyclotrons.

- NOT STATED if any gap greater than two years in work history, or if no previous work history is available.

EXAMPLES

Mining work activities

1) uranium miner, 2) coal miner, 3) underground miner, 4) hard rock miner, 5) work at Homestake Mining Company (gold mine?), 6) work at a copper mine, 7) mucker (mine), 8) powderman in a quarry, 9) mine mechanic, 10) mine engineer, 11) electrician at an anthracite coal mine, 12) instrumentation supervisor at a uranium mill.

Metallurgical work activities

1) research engineer performing metallography work at a university metallurgical laboratory, 2) metallurgy/x-ray technician at a metallurgical laboratory.

Nuclear physics work activities

1) "cosmic ray" work at a university, 2) cyclotron work at a university nuclear laboratory, 3) university research assistant evaluating radioactivity in various solids, liquids and gases, 4) associate professor of physics and director of a university nuclear physics research laboratory.

Medical work activities

1) x-ray technician (metallurgy or medical?), 2) dental assistant, 3) dentist. Jobs **EXCLUDED** in prior occupational radiation exposures: pathologist (medical x-ray?).

6. **Work with paints and paint solvents** (include prior nuclear facility work and non-nuclear facility work)

CODING

- NO if previous work history has no indication of a reasonable likelihood of exposure to paints or paint solvents (organic).
- YES if previous work history indicates a reasonable likelihood of exposure to paints or paint solvents (organic) based on work activity and/or industry. Work activities or job titles must specifically reference paints, varnishes or similar surface coating materials and involve a reasonable likelihood of exposure. Industries must specifically reference paints, varnishes or similar surface coating materials, and include work activities with a reasonable likelihood of exposure.
- NOT STATED if any gap greater than two years in work history, or if no previous work history is available.

EXAMPLES

1) finish carpenter, 2) sign painter, 3) auto body work, 4) blade worker and assistant foreman finish department at propeller manufacturer, 5) varnish makers helper, 6) apprentice carpenter involving furniture making. Jobs **EXCLUDED** in work with paints/solvents: work at dry cleaners, office manager at a paint manufacturing company, laundry checker, cost clerk at a paint manufacturer.

7. Work with non-ionizing radiation (include prior nuclear facility work and non-nuclear facility work)

CODING

- NO if previous work history has no indication of a reasonable likelihood of exposure to non-ionizing radiation (static magnetic fields, extremely low frequency electromagnetic fields, microwave and radiofrequency radiation).
- YES if previous work history indicates a reasonable likelihood of exposure to non-ionizing radiation (static magnetic fields, extremely low frequency electromagnetic fields (ELF EMF), microwave and radiofrequency radiation). Be sure to specify the type of non-ionizing radiation: static magnetic fields, static electric fields, sub-radiofrequency (30kHz and below) magnetic fields, sub-radiofrequency (30kHz and below) electric fields, radiofrequency radiation, microwave radiation. Identify the job title, industry or equipment that indicates prior NIR exposure.
- NOT STATED if any gap greater than two years in work history, or if no previous work history is available.

EXAMPLES

Electric utility work activities (ELF EMF)

1) helper (electric utility), 2) powerhouse repairman, 3) electrician. 4) telegraph operator, 5) electric utility lineman, 6) telephone lineman, 7) utility tree trimmer, 8) meter reader (electric utility), 9) laborer (electric utility).

Radio/Radar work activities (Microwave/RF)

1) electrician working with microwave/RF, 2) radio/radar repairman, 3) US Navy sonar and radar operator, 4) radio transmitter operator, 5) leadingman electrician installing radio, radar and electrical equipment on US Coast Guard ships, 6) US Army Signal Corps, 7) staff radio operator USAAF, 8) radio/TV technician. Also jobs involving research and development of radar technology at MIT and other universities (~1940) and research in electromagnetic separation of isotopes at Lawrence Berkeley Lab (1940's). Jobs EXCLUDED in prior NIR exposures: radio studio technician.

Other NIR work activities (Static Magnetic Fields, ELF EMF)

1) electric arc welder, 2) electrochemistry and electroplating work with metals/radionuclides, 3) electrical equipment maintenance, 4) research engineer with duties that included work with an electric arc furnace in a metallurgical laboratory, 5) electrician at a coal mine, 6) electrician (general industry),

NIR research work activities (Static Magnetic Fields, ELF EMF, Microwave/RF)

1) development (electrical) engineer involved in the design/development of 400-1000 mc signal generators at an electronic test/radio equipment manufacturer, 2) research assistant operating and maintaining a Van de Graaff accelerator at a university, 3) research physicist in radar scattering, 4) plasma research, 5) cyclotron work at a university nuclear laboratory.

Nuclear facility NIR work activities (Static Magnetic Fields, ELF EMF, Microwave/RF)

1) work with electromagnetic pumps (LASL), 2) electrical operator at K-25, 3) maintenance mechanic at TEC, 4) operator at ORGDP, 5) chemical engineer at K-25, 6) process development (chemical) engineer at TEC (purification of uranium by electromagnetic separation),

Source of this information

Indicate "from whence" this information was abstracted (e.g., medical record or personnel file)

Abstractor and Date: Write your initials and the date it was abstracted (MM/DD/YY).

List of DOE Facility Cohorts, by Facility

CODE[1]	FACILITY	LOCATION
110	AEC Manhattan District, NOS	
10	Ames	Ames, IA
.	Ames Laboratory - Iowa State University	Ames, IA
62	Argonne	Chicago, IL
13	Ashtabula	Ashtabula, OH
14	Bartlesville	OK
16	Bates Linear Accelerator Facility	
18	Battelle-Columbus Laboratories	Columbus, OH
19	Bettis Atomic Power Lab	Pittsburgh, PA
101	Bettis-Naval Reactor Facility	Pittsburgh, PA
20	Brookhaven National Laboratory	Upton, NY
.	Brown University (uranium purification)	
.	Brush Beryllium (uranium production)	
.	Cambridge University	UK
27	Charleston Naval Shipyard	SC
112	Columbia University	
28	Comparative Animal Research Lab	Oak Ridge, TN
151	Department of Energy, Albuquerque Operations (ALO)	
156	Department of Energy, Chicago Operations Office	
157	Department of Energy, Grand Junction Office - Utah	
150	Department of Energy, Headquarters	
158	Department of Energy, Idaho Operations Office	
152	Department of Energy, Los Alamos Area	
160	Department of Energy, Nevada Operations Office	
154	Department of Energy, Oak Ridge Operations (ORO)	
155	Department of Energy, Richland Operations Office - Washington	
159	Department of Energy, San Francisco Operations Office	
153	Department of Energy, Savannah River Operations (SRO)	
.	Du Pont Chemical Co (UO_2 production)[2]	Deepwater Pt., NJ
.	Eastman Kodak Co (UCl_4 production)[2]	Oak Ridge, TN

List of DOE Facility Cohorts, by Facility (Continued)

CODE[1]	FACILITY	LOCATION
.	Eldorado Mining and Refining (concentrating plant)[2]	Port Hope, Ontario, CAN
.	Eldorado Mining and Refining Ltd (ore processing)[2]	Port Hope, Ontario, CAN
.	Electro Metallurgical Co (metal production)[2]	Niagara Falls, NY
.	Electro Metallurgical Co (subsidiary of Union Carbide and Carbon Corp)	Niagara Falls, NY
32	FERMI Accelerator National Lab	IL
1	Fernald Feed Materials Plant	Fernald, OH
33	Franklin McLean Memorial Research Center - Univ Chicago	Chicago, IL
35	Grand Forks Energy Research Inst	ND
34	Groton Naval Shipyard, General Dynamics	CT
102	Hanford (not specified)	Richland, WA
92	Hanford Construction	Richland, WA
91	Hanford Operations	Richland, WA
94	Harshaw Chemical Co	
.	Harshaw Chemical Co (UF6 production)[2]	Cleveland, OH
103	Health and Safety Laboratory	
36	Idaho Chemical Processing	Idaho Falls, ID
37	Idaho National Engineering Laboratory	Idaho Falls, ID
.	Imperial Chemical Industries (chemical separations, Uranium production)	UK
39	Inhalation Toxicology Research	NM
.	Iowa State College (metal production)[2]	Ames, IA
5	K-25	Oak Ridge, TN
40	Kansas City Plant	Kansas City, MO
42	Knolls - Idaho Site	ID
90	Knolls - Kesselring Site	
43	Knolls - Windsor Site	
41	Knolls Atomic Power Lab	NY
44	Lab of Nuclear Medicine - UCLA	Los Angeles, CA
44	Lab of Radiobiology - UCLA	Los Angeles, CA
45	Lab of Radiology - USF-CA	San Francisco, CA
46	Laramie Energy Research Center	San Francisco, CA

List of DOE Facility Cohorts, by Facility (Continued)

CODE[1]	FACILITY	LOCATION
47	Lawrence Berkeley Laboratory	Berkeley, CA
48	Lawrence Livermore - NTS	Livermore, CA
55	Lawrence Livermore Lab	Livermore, CA
.	Lawrence Radiation Laboratory - University of California-Berkeley	Berkeley, CA
.	Linde Air Products (ore processing)[2]	Tonawanda, NY
21	Linde Refinery	
104	Liquid Metal Engineering	
52	Los Alamos National Laboratory	Los Alamos, NM
52	Los Alamos Scientific Laboratory	Los Alamos, NM
3	Mallinckrodt Chemical	St. Louis, MO
3	Mallinckrodt Chemical	Weldon Springs, MO
.	Mallinckrodt Chemical Works (ore, metal and oxide production)[2]	St. Louis, MO
63	Mare Island Naval Shipyard	CA
.	Met Lab - University of Chicago	Chicago, IL
.	Metal Hydrides (metal production)[2]	Beverly, MA
.	Metallurgical Laboratory - University of Chicago	Chicago, IL
61	Middlesex Landfill Site	Middlesex, NJ
64	Morgantown Energy Research Center	Morgantown, WV
2	Mound Laboratory	Miamisburg, OH
65	MSU/DOE Plant Research	East Lansing, MI
.	MW Kellogg Co (design and construction)	
.	National Bureau of Standards (NBS)	
1	National Lead of Ohio	Fernald, OH
66	Naval Reactors Facility	Idaho Falls, ID
106	Naval Reactors Facility - INEL	ID
67	Nevada Test Site	Mercury, NV
106	Nevada Test Site - NTS	Mercury, NV
68	New Brunswick Lab	
69	Newport News Naval Shipyard	VA
69	Newport News Shipyard	Newport News, VA

List of DOE Facility Cohorts, by Facility (Continued)

CODE[1]	FACILITY	LOCATION
70	Norfolk Naval Shipyard	VA
71	Notre Dame Research Lab	South Bend, IN
72	Oak Ridge Associated Universities	Oak Ridge, TN
5	Oak Ridge Gaseous Diffusion Plant	Oak Ridge, TN
7	Oak Ridge National Laboratories	Oak Ridge, TN
.	Oxford University	UK
73	Pacific Northwest Lab - Battelle	Richland, WA
74	Pacific Test Site Div	
9	Paducah Gaseous Diffusion Plant	Paducah, KY
75	Pantex Plant	Amarillo, TX
76	Pearl Harbor Naval Shipyard	HI
77	Pinellas Plant	Clear Water, FL
78	Pittsburgh Energy Research Center	Pittsburgh, PA
79	Portsmouth Gaseous Diffusion Plant	Piketon, OH
80	Portsmouth Naval Shipyard	NH
81	Princeton Plasma Physics Lab	Princeton, NJ
.	Princeton University	Princeton, NJ
107	Puerto Rico Center for Energy and Env Research	Mayaguez, PR
82	Puget Sound Naval Shipyard	WA
.	Radiation Laboratory - University of California-Berkeley	Berkeley, CA
83	Radiobiology Lab - UC-Davis	Davis, CA
84	Radiobiology Lab - Utah	Salt Lake City, UT
53	Rocky Flats Plant	Golden, CO
95	Rust Engineering	Oak Ridge, TN
85	Sandia National Laboratory	Albuquerque, NM
108	Savannah River Ecology Lab	Aiken, SC
22	Savannah River Plant	Aiken, SC
86	Shippingsport Atomic Power Station	Shippingsport, PA
57	Simonds Saw and Steel Co	
87	Stanford Linear Accelerator	CA

List of DOE Facility Cohorts, by Facility (Continued)

CODE[1]	FACILITY	LOCATION
4	Tennessee Eastman Co	Oak Ridge, TN
.	U S Government Warehouse (receive, assay & blend pitchblende)[2]	Middlesex, NJ
.	U S Vanadium Corporation (carnotite mine)[2]	Colorado platcau
.	U S Vanadium Corporation (concentrating plant)[2]	Uravan, CO
.	U S Vanadium Corporation (concentrating plant)[2]	Durango, CO
.	U S Vanadium Corporation[2]	Grand Junction, CO
109	University of Chicago	Chicago, IL
88	University of Rochester Medical Laboratory	Rochester, NY
89	Uranium Resources Laboratory	UT
.	Vanadium Corporation of America (carnotite mine)[2]	Colorado plateau
.	Vanadium Corporation of America (concentrating plant)[2]	Naturita, CO
.	Vitro Manufacturing Co (ore processing)[2]	Cannonsburg, PA
.	Washington University (plutonium processing)	St. Louis, MO
7	X-10	Oak Ridge, TN
6	Y-12	Oak Ridge, TN
97	Zia Company (LANL)	Los Alamos, NM

[1]Code numbers less than 100 are the same as the facility codes used by ORAU/CER; code numbers greater than 100 were assigned by UNC-CH. Locations with missing code numbers were not encountered by UNC-CH in the multiple myeloma study, but were included in the table to provide a complete list of nuclear facilities.

[2]Facility identified in Eisenbud, M.: Early Occupational Exposure Experience with Uranium Processing, in US Energy Research and Development Administration , Conference on Occupational Health Experience with Uranium held at Stouffer's National Center Inn, Arlington, VA, April 28-30, 1975. Report No. ERDA-93, US Government Printing Office, Washington, DC (1975) p. 8-24.

Appendix IV

Multiple Myeloma Study: Guidelines for Data Abstraction

Work History

MM Study: Guidelines for Data Abstraction

Work History

VERIFY IDENTITY OF WORKER

1. NAME, SSN and DOB:
   - place check mark by fields on Identification Sheet to indicate that they are in agreement and that record is correct person.
   - if some information does not agree, check in record for other variables (eg, hire date or term date) to decide if correct person. Note: unabstracted original hire dates are from CEDR and will always be "15" for the day; therefore, only month and year are used for verification.
   - if not correct person: Do NOT abstract any data for that individual. Make note on identification sheet of where the validity failed and check with project manager.
   - if correct person: Complete any abbreviated names and correct any wrong information using data from record. If date is missing from the record, draw a line through it on Identification Sheet and write "missing". If part of the date is missing from the record, then using a red pen write the following:

     if the month is missing - 07
     if the day is missing - 15
     if the year is missing - draw red circle around blank, draw line to margin and write "missing"

2. RACE and SEX
   - place check mark by fields on Identification Sheet to indicate that they are in agreement
   - correct any missing or wrong information.
   - you may use a gender-specific first name to verify or correct SEX.

3. ID numbers
   - record any personnel, badge, payroll, or employee #s on the Identification Sheet. Note which type is recorded if possible.

DATA ABSTRACTION

General note: Abstract all data for the worker's employment that was geographically at the facility site, no matter the worker's actual employer/manager/or retirement status. We are interested in all time spent at the physical site while performing a job. Therefore, please make notes on abstraction forms when you suspect the worker was assigned away from the facility but you can't find a Change of Status slip as proof.

NAME & SSN: Record the NAME and SSN in the top right box on the WH abstraction form. This is proof that the CERID is correct person. This information may be redacted before the files leave the facility.

CERID: Record CERID (from Identification Sheet) on top of each WH abstraction form.

DOB: Record correct DOB (from Identification Sheet) on top of first WH abstraction form. This information will help us link all correct records for an individual.

MM Study: Guidelines for Data Abstraction

Work History

FACILITY: Hanford = 91 LANL = 52
ORNL = 7 ZIA = 97
SRP = 22

CONTRACTOR: If the facility used contractors, please note the contractor on the record. Create a running list of contractor names and assign codes. (Hanford and LANL will possibly need contractor coding.)

Record TYPE: Use the following codes for the change in employment status. Also make a note in the record if the worker appeared to be military personnel, and make note if the worker appeared to be working away from the facility (note where worked, date left and date returned).

Code	Description
A	Earliest known employment date (no documentation of hire date).
C	Change date: change in personnal status (job title, department code, etc.)
CL	Change Leave: usually because sent on temporary overseas appt.
CR	Change Return: usually because returning from temporary overseas appt.
GH	Guest Hire: Hired as visiting employee from other business/corporation/govt
GT	Guest Term: Termed as visiting employee. Return to other business, etc.
H	Hire. Documented hire date.
LL	Loan Leave: Employee loaned out to other DOE contractor.
LR	Loan Return: Employee returned from loan-work at other DOE contractor.
ML	Military Leave: Leave on temporary military assignment or duty.
MR	Military Return: Return from temporary military assignment or duty.
NH	Consultant Hire: Hired as consultant at the facility.
NT	Consultant Term: Termed as consultant at the facility.
NZ	Last known consultant employment date.
R	Rehire date after a termination date.
SL	"Sick" Leave: Start of a leave of absence (usually for personal reasons).
SR	"Sick" Return: End of a leave of absence (usually for personal reasons).
T	Term: Documented termination date.
Z	Last known employment date (either no documentation of term date, or extant documentation of working after known term and no documentation of that rehire date).

START DATE: Effective date (MM/DD/YY) of a change in the worker's employment history.

MM Study: Guidelines for Data Abstraction

Work History

To assign Area/Group/Division/Department/Section/Unit, etc.

Be flexible. Make photocopies of record if permitted. Otherwise adapt the abstraction form as necessary to capture the heirarchical structure of the place of work Remember to use our generic Blank Forms if it will be more efficient. Otherwise use blank paper and create tabular forms as necessary to accomodate the data. Abstract liberally to capture as much information as possible.

DPCODE / Group:

Code number for the secondary (smaller) organizational subgroup at the facility.

ORNL subgroups: divisions and departments
LANL subgroups: divisions and groups
ZIA subgroups: divisions and groups
HANF subgroups: departments
SRP subgroups: divisions and departments

DPNAME / Group name:

Group or department name for the respective DP Code/ Group used at the facility for the specific time period in question.

DIVCODE / Area:

Code number for the primary (larger) orgranizational subgroup at the facility.

ORNL subgroups: divisions and departments
LANL subgroups: divisions and groups
ZIA subgroups: divisions and groups
HANF subgroups: Hanford area
SRP subgroups: divisions and departments

DIVNAME / Area name:

Division or area name for the respective DV Code/ Area used at the facility for the specific time period in question.

JOB TITLE:

Record the job title as written in the record. Do **NOT** abbreviate. Leave spaces between words. Be sure to include any title modifiers: (Jr., Sr., apprentice, trainee, helper, etc.)

MM Study: Guidelines for Data Abstraction

Work History

PAY CODE:

H = hourly wage
W = weekly pay
M = monthly salary
T = use when military personnel and no record of paycode

Examine the DP CODE for possible suffix which is actually the paycode (ie, in the case of ORNL an example would be: 3083H. This is DP CODE = 3083, and paycode = H.) If no paycode in record, then determine paycode from rate of pay. Exempt or salaried employees are coded "M". Union or craft workers are coded "H".

BLDG LOCATION:

Identification code or name for the building in which subject worked at that date.

TERM REASON:

Reason for termination:

1 = Reduction in force (eg, RIF, NW, No Work)
2 = Transfer to other DOE facility (if uncertain if DOE, check DOE Facility List)
3 = Medical disability (eg, medical retirement, incapability pension, total disability)
4 = Discharged (usually for personnel or disciplinary reasons)
5 = Voluntary retirement (eg, early retirement). Code this even if coincidental with RIF.
6 = Personal reasons (except to accept other employment, that would be #12)
7 = Non-student temporary assignment
8 = Deceased
9 = Unknown
10 = Student temporary assignment
11 = Consultant period terminated (eg, if TYPE is coded as "NT")
12 = Accepting other employment (not other DOE)
13 = Military draft
14 = Military transfer away from the facility

DATE LAST WORKED: (bottom left of first page of Work History abstraction form)

Record this date if available. NOTE: This date may be significantly different from the date of termination (eg, medical reasons).

RECORDS AT CER: (bottom right of first page of Work History abstraction form)

Check "YES" if this work history was abstracted or verified at ORAU/CER.
Check "NO" if none of this work history was abstracted or verified at ORAU/CER.
Check "NA" if ORAU/CER was not housing any records for this facility.

RECORDS AT FACILITY:

Check "YES" if this work history was abstracted or verified at the DOE facility.
Check "NO" if none of this CERID work history was abstracted or verified at the DOE facility.

Appendix V

Multiple Myeloma Study: Guidelines for Data Abstraction

Occupational Health

MM Study: Guidelines for Data Abstraction

Occupational Health History

VERIFY IDENTITY OF WORKER

Name Record Last Name, First Name in upper right box. Verify namein chart with name on Identification Sheet.

SSN Record SSN in upper right box. Verify SSN in chart with SSN on Identification Sheet. If they differ, record corrections onto Identification Sheet.

CERID Record subject's CERID as found on the Identification Sheet.
(Note: CERID is a unique individual identifier assigned by ORAU/CER to every DOE worker in the master roster file. CERID is not facility specific.)

Date of Birth Record date of birth (DOB) as found on the Identification Sheet. (MM/DD/YY)

- Use two digits for Month, Day, and Year (i.e., 03/01/47)
- If the subject was born in the 1800's, then write out entire year (e.g., 03/01/1890)
- Verify the DOB on the Identification Sheet with the DOB in the personnel file to insure that the dates are the same. If the dates are different make a note of it both on the data collection sheet and on the Identification Sheet.
- If part of DOB is missing on the Identification Sheet check the file to find the rest of the date. Record this on Identification Sheet.
- If unable to find the entire date then use the following numbers for the missing portion. **(Note: Please use a RED pen when filling in this missing information so it can be distinguished later as not completely valid.):**
  - If entire date is missing, draw a red line through the field, to indicate that information was not found, and write "missing."
  - If month is missing code - **07**
  - If day is missing code - **15**
  - If year is missing - write "missing" in the place indicated for date

Before proceeding, review the record carefully to determine if there is other information available (i.e., date of hire, race, sex) to verify that we have the correct record for our study subject.

Do not abstract information from a medical record unless you are sure the record belongs to the worker in the study.

Missing Medical Record: If a medical record is not found, fill in the identifying information on the abstraction form and check (✓) the box "No Medical Record."

DATA ABSTRACTION

Cohort Record number of the cohort group. Choose from the following list:

Hanford	91	LANL	52
ORNL	7	ZIA	97
SRP	22	Subjects who worked at both LANL and ZIA	99

Occupational Health History

Part A. Medical X-rays (Tabular form):

Date of X-ray — Record the date of the x-ray. (MM/DD/YY)

- Use two digits for Month, Day and Year (i.e., 03/01/47)
- Date of X-ray can be found on the X-ray reports in the medical chart. Some of the medical charts have flow sheets that list the X-rays.
- If unable to find the entire date then use the following numbers for the missing portion. **(Note: Please use a RED pen when filling in this missing information so it can be distinguished later as not completely valid.):**
  - If entire date is missing, draw a red line through the field, to indicate that information was not found, and write "missing."
  - If month is missing code - **07**
  - If day is missing code - **15**
  - If year is missing- write "missing" in the place indicated for date

Reason — Use codes from the table below to code reason for the X-ray.

ORNL Codes

Code	X-ray Reason	Indications for use
A	Annual	
X	Periodic	"Periodic" is a designation that is sometimes used for an X-ray (e.g., chest X-ray) that is done as part of a medical surveillance program, as in the case of beryllium workers.
P	Preplacement or Re-hire	X-ray done at the beginning of each hire or re-hire at the facility
T	Termination	X-ray done at the end of each employment period
D	Diagnostic	The X-ray report probably will not state that the purpose of the X-ray was "Diagnostic." Diagnostic indicates that the physician was obtaining an X-ray to determine possible injury or illness (i.e., fracture or pneumonia). Therefore, for any report that does not indicate any of the other reasons listed for the X-ray, then indicate on the abstraction sheet that it was Diagnostic.

HANFORD Codes

Code	X-ray Reason	Indications for use
A	Annual	
I	Interim	
M	Periodic	This "Periodic" exam was coded differently than ORNL. The annual type of exam at Hanford was called either a "Periodic" or an "Interim" exam. The The difference between Periodic and Interim was not provided.
P	Preplacement or Re-hire	X-ray done at the beginning of each hire or re-hire at the facility
T	Termination	X-ray done at the end of each employment period
D	Diagnostic	The X-ray report probably will not state that the purpose of the X-ray was "Diagnostic." Diagnostic indicates that the physician was obtaining an X-ray to determine possible injury or illness (i.e., fracture or pneumonia). Therefore, for any report that does not indicate any of the other reasons listed for the X-ray, then indicate on the abstraction sheet that it was Diagnostic.

LANL and ZIA Codes

Code	X-ray Reason	Indications for use
A	Annual	
K	Routine	
H	Animal Handler	One subject at LANL/ZIA had this type of exam.
P	Preplacement or Re-hire	X-ray done at the beginning of each hire or re-hire at the facility
T	Termination	X-ray done at the end of each employment period
D	Diagnostic	The X-ray report probably will not state that the purpose of the X-ray was "Diagnostic." Diagnostic

		indicates that the physician was obtaining an X-ray to determine possible injury or illness (i.e., fracture or pneumonia). Therefore, for any report that does not indicate any of the other reasons listed for the X-ray, then indicate on the abstraction sheet that it was Diagnostic.
U	Unknown	Reason for X-ray was not stated in the medical record

SRP Codes

Code	X-ray Reason	Indications for use
A	Annual	
D	Diagnostic	The X-ray report probably will not state that the purpose of the X-ray was "Diagnostic." Diagnostic indicates that the physician was obtaining an X-ray to determine possible injury or illness (i.e., fracture or pneumonia). Therefore, for any report that does not indicate any of the other reasons listed for the X-ray, then indicate on the abstraction sheet that it was Diagnostic.
J	Pension	Pension exams were provided for employees after they retired, and were included in the employee's occupational health medical file.
P	Preplacement or Re-hire	X-ray done at the beginning of each hire or re-hire at the facility
T	Termination	X-ray done at the end of each employment period

Body Part/X-ray Type Use Body Part codes from the table below:

- It is important to note that an AP (anterior posterior view, also written "PA") and a LAT (lateral view) X-ray are counted and recorded on the abstraction sheet as two separate X-rays. Indicate in the comment section of the X-ray abstraction form if PA or LAT.
- If X-ray is done for both right and left body part then it is counted and written on the abstraction sheet as two separate X-rays. Indicate in the comment section of the X-ray abstraction sheet if the X-ray is right or left.

Code #	Body Part	Code #	Body Part
1	Chest (14 x 17)	18	Skull Series
2	Skull, Head, Sinus	19	Small Bowel Series
3	Shoulder, Scapula	20	Mastoid
4	Ribs, Abdomen	21	Uterosalpingography
5	Hand, Finger, Wrist	22	4 x 5 chest
6	Arm, Elbow	23	Cystoscopy, Retrograde Pyleography
7	Leg, Femur, Knee	24	Lung Scan
8	Hip, Pelvis	25	Mammography
9	Foot, Toe, Heel, Ankle	26	Chest Fluoroscopy
10	GI Series, Upper GI, Barium Swallow, GI Fluoroscopy	27	Sigmoidoscopy
11	Spine, Back (lumbar, cervical, thoracic)	28	Skeletal Survey (see notes below)
12	Neck, Throat	29	Colon Fluoroscopy
13	IVP	30	Other (see notes below)
14	Gall Bladder Series	31	70 mm Chest
15	KUB	32	35 mm Chest
16	Barium Enema	33	Chest 14x14 (LANL/ZIA)
17	Dental Series		

#28: Case in point consisted of 9 to 11 films including skull, thoracic spine, lumbar spine, humerus, and femur to detect cancer metastisis.

#30: Other category consists of: 70 mm chest film, 35 mm chest film, and roentegerin??? chest film

NOTE: An AP (also written PA) and a LAT x-ray are counted and recorded as two separate x-rays. Indicate in the comment section whether PA or LAT. Also if x-rays are taken for both right and left body parts, count and record as two separate x-rays. Indicate in the comment section whether right or left.

Comments — This section should be used to indicate if a X-ray is PA / LAT, or left / right. Comments can also be included for diagnosis of musculoskeletal problems such as spondylolisthesis, herniated disc, sciatica or multiple myeloma.

Part B. Chelation Therapy:

Code whether subject received chelation therapy. It will be documented on the progress notes in the medical chart.

Date Start/Stop — Record the date (MM/DD/YY).

- Use two digits for Month, Day and Year (i.e., 03/01/47)
- Date of X-ray can be found on the X-ray reports in the medical chart. Some of the medical charts have flow sheets that list the X-rays.
- If unable to find the entire date then use the following numbers for the missing portion. **(Note: Please use a RED pen when filling in this missing information so it can be distinguished later as not completely valid.):**
  - If entire date is missing, draw a red line through the field, to indicate that information was not found, and write "missing."
  - If month is missing code - **07**
  - If day is missing code - **15**
  - If year is missing - draw red circle around blank, draw line to margin and write "missing"

Radionuclide — Record the type of radiation that the subject was exposed to.

- Explain Circumstances: Use internal radiation monitoring forms to record any bioassays taken to chart the course of the chelation therapy.

Part C. Smoking prior to or during employment

0 = No — Documentation exists that the subject never smoked.

1 = Yes — Documentation exists that the subject smoked, even if for only one year, or "just a little"

2 = Documentation shows that subject did not smoke for a period of time (Record the number of non-smoking years)

9 = Not Stated — No documentation in the record regarding smoking history

Part D. Health Classification

There are two categories in the Health Classification section to complete:

1) **preplacement** - which includes the subject's first preplacement exam

   - If there is only one health classification listed in the chart then indicate this as the preplacement.

2) **termination** - which includes the subject's last termination exam.

Note: If there are health classifications listed but the dates don't match the actual preplacement and termination dates, then indicate the classifications closest to these dates.

Date — Record the date (MM/DD/YY).

- Use two digits for Month, Day and Year (i.e., 03/01/47)
- Date of X-ray can be found on the X-ray reports in the medical chart. Some of the medical charts have flow sheets that list the X-rays.
- If unable to find the entire date then use the following numbers for the missing portion. **(Note: Please use a RED pen when filling in this missing information so it can be distinguished later as not completely valid.):**
  - If entire date is missing, draw a red line through the field, to indicate that information was not found, and write "missing."
  - If month is missing code - **07**
  - If day is missing code - **15**
  - If year is missing - draw red circle around blank, draw line to margin and write "missing"

Occupational Health History

Classification Code — Use codes from the table below:

Comments/Restrictions — Use codes from the table below:

Health Classification Codes	Restriction Codes
The following are health classifications for **ORNL:** 01 = H1: Physically qualified for any position 02 = H2: Physically qualified for any position, but has minor defects 03 = H3: Physically qualified for special employment only, with following restrictions 04 = H4: Physically unqualified for position applied for 05 = H5: Temporary employee The following are health classifications for **Hanford:** 01 = Approved for job title for work in all locations 03 = Approved with work restrictions 06 = Not approved pending further exam 07 = Not approved pending change in condition	1. Must wear truss 2. Must wear safety spectacles 3. No back bending 4. No climbing stairs or ladder 5. No heavy lifting 6. No inside work 7. No outside work 8. No sudden temperature changes 9. No work around hazardous machinery 10. No work around moving objects 11. No work around toxic materials 12. No work in cold quarters 13. No work in high places 14. No work in hot quarters 15. No work in noisy quarters 16. No work in wet quarters 17. No work involving great nervous tension 18. No work other than sedentary 19. No work with dust exposure 20. Not to be in work requiring acute hearing 21. Not to be in work requiring acute vision 22. Not to be in shift work 23. Not to work alone 24. Not to work with other employees 25. Not to wear respirator or face mask

Worker ever denied a job for health or physical reasons

1 = Yes — If Yes, then explain the circumstances (include dates if possible)

0 = No — No evidence of employment denial in occupation health record

Part E. History of Cancer Code as follows:

0 = No — No evidence of cancer in the occupational health record

1 = Yes — Documentation exists of cancer history

- Document the diagnosis and the ICD9 code
- Record the date that cancer was noted in the occupational health record

ICD9	Type of Cancer
162.1	Lung
173.1	Skin cancer of the right eye
173.2	Skin cancer of the ear
173.3	Skin cancer of the nose or the nasal bridge
173.8	Inguinal region
173.9	Skin Cancer, site unspecified
185	Prostate
186	Seminoma of the Testicles
188	Bladder or malignant polyps in bladder
202.2	Lumphoma
203	Multiple Myeloma
205.1	Chronic myeloid leukemia

Part F. Ever treated with radiation:

0 = No — No evidence of radiation treatment in the occupational health record

1 = Yes — Documentation exists of radiation treatment, except for Multiple Myeloma

- Record any details in the comments section

Part G. Evidence of exposure to (or medical surveillance of) occupational hazards)

0 = No — No evidence hazard exposure in the occupational health record

1 = Yes — Documentation exists of hazard exposure

- Record any details of the exposure in the tabular format

Appendix VI

Multiple Myeloma Study: Guidelines for Assessment of Chemical and Physical Agent Exposures

MM Study: Guidelines for Assessment of Chemical and Physical Agent Exposures

I. General Procedures

Site visits were conducted at each facility to obtain copies of relevant documents for assigning exposure potential. Industrial hygiene personnel at each study site were contacted to identify information resources that may be used to evaluate historical exposures to the agents of interest. Additional information resources were identified and retrieved from US Department of Energy Reading Rooms at each study site and from US government document collections at depository libraries. Relevant information was abstracted and entered into site-specific electronic databases covering: 1) agent inventory information, 2) industrial hygiene information, 3) building and location information, and 4) organization information.

The exposure potential for each agent was classified as positive or negative based on a review of the individual's work history, and relevant industrial hygiene, agent inventory and related information. Confidence in the exposure assignment was classified as high, moderate or low based on the quality, strength and specificity of the available information used in making the exposure assignment. The assessment involved the following steps: 1) pertinent work history information was reviewed and recorded on exposure assessment coding sheets (CERID, Division or Department number and name, job titles, dates and building numbers), 2) radiation monitoring reports were reviewed for evidence of internal and external monitoring, 3) occupational health coding sheets were reviewed for evidence of exposures to the study agents included in the worker's occupational health records at the site, 4) industrial hygiene, building and inventory databases were reviewed for evidence of exposure to the study agents for the departments, buildings or job titles indicated in the work history, 5) job descriptions from personnel records (when available) were reviewed for evidence of potential exposures to the study agents, 6) facility summary documents prepared by the study industrial hygienist were reviewed for evidence of potential exposures to the agents of interest, 7) published information resources (books, technical papers, facility news articles, and other resources) were reviewed for evidence of potential exposures to the study agents, 8) industrial hygiene databases were queried using search strings related to the study subject (job title, department or division, building, work activity). Standardized guidelines for assigning exposures were developed for specific job titles, departments and/or locations when the potential for exposure was likely to be consistent within a job, or associated with a specific department or location at the study site based on the available information resources. These standardized guidelines are summarized below by study site.

Exposures for each study subject were evaluated for the period of employment at the study site(s) using a qualitative rating based on the exposure potential and the confidence in the exposure assignment. The exposure and confidence ratings were used to classify individuals into three groups for subsequent analysis: 1) an exposed group consisting of individuals with potential exposure to the agent of interest and a moderate or high level of confidence, 2) an unexposed group consisting of individuals not exposed to the agent of interest and a moderate or high level of confidence, and 3) an uncertain exposure group consisting of exposed and unexposed individuals with a low level of confidence in the exposure estimate. Each study subject was assigned a single exposure and confidence rating for their work history. Changes in exposure potential that may have occurred over time were not considered in assigning the exposure or confidence ratings due to incomplete information for the time periods of interest.

II. Confidence Ratings

The criteria used to assign exposure potential and confidence is provided below and summarized in the attached table.

<u>High confidence (positive exposure)</u> - Agent was identified in inventory for building, department or process, linked by work history to an individual; potential for exposure confirmed by monitoring results or health records (e.g. Zia electricians repairing Ajax electrical converters containing mercury); description of the job title and department is sufficient to determine that the agent is normally associated with the job title and department (e.g. Hanford millwright exposures to halogenated hydrocarbons and any metal); biological monitoring results for the

agent of interest, its metabolite or characteristic reversible biochemical change induced by the agent were identified for the study subject; participation of the study subject in a biological monitoring or medical surveillance program specifically designed for the agent of interest.

Moderate confidence (positive exposure) - Agent identified in inventory for building or process, linked by work history to an individual; potential for exposure based on knowledge of the process, operation, job or work location (e.g. metal exposures to an associate scientist in metallurgy department); industrial hygiene monitoring results or occupational health records confirming exposures were not available; description of either the job title or department is sufficient to determine that the agent is normally associated with the job title or department (e.g. wood dust exposures in carpenters, asbestos exposures in machinists and foundrymen); biological monitoring results for the agent of interest, its metabolite or characteristic reversible biochemical change induced by the agent, or participation in a biological monitoring or medical surveillance program specifically designed for the agent of interest, by individuals from the same department, work location or job title.

Low confidence (positive exposure) - Agent not identified in inventory for building or process; or work history was not able to link an individual to a building or department; potential for exposure based on knowledge of the process, operation, job or work location; industrial hygiene monitoring results or occupational health records confirming exposures were not available; description of both the job title and department is insufficient to determine that the agent is normally associated with the job title and department. Confidence was also assigned Low if the agent was identified in the department or building of the individual, but the job title would not normally be associated with exposure to the agent (e.g. clerk typist exposures to metals and halogenated hydrocarbons in explosives group GMX-4) or if evidence from other jobs in the building or department indicate potential exposures (e.g. exposures of janitors to halogenated solvents and metals based on descriptions of spill cleanup, or janitors identified for participation in a beryllium medical surveillance programs from other buildings).

High confidence (negative exposure) - Agent was not identified in inventory for building, department or process, linked by work history to an individual; no potential for exposure confirmed by monitoring results or health records; description of the job title and department is sufficient to determine that the agent is not normally associated with the job title and department.

Moderate confidence (negative exposure) - Agent was not identified in inventory for building or process, linked by work history to an individual; no potential for exposure based on knowledge of the process, operation, job or work location; description of either the job title or department is sufficient to determine that the agent is not normally associated with the job title or department.

Low confidence (negative exposure) - Agent was not identified in the inventory for building or process; work history was not able to link an individual to a building or department; no potential for exposure based on knowledge of the process, operation, job or work location; description of both the job title and department is insufficient to determine that the agent is not normally associated with the job title and department.

III. Agent Information

Asbestos

- Agents: Includes all types, may be identified as "Transite", "Marinite", "Thermobestos" or "Superex" boards, structural panels, pipes or blocks.
- Typical tasks involving potential exposures to asbestos include pipefitting, insulating, sheetmetal work, carpentry, roofing, cement work and tasks associated with metal work described above.
- Typical job titles involving work with these agents include specialized trades that handle or use asbestos products (e.g. pipefitter, steamfitter, carpenter, welder, machinist, metal worker, millwright, mechanic, roofer, cement worker, bricklayer). Potential asbestos exposures in unskilled jobs (e.g. laborer) include handling, installation and use of asbestos products or the demolition of structures

containing asbestos, and in skilled trades and technical jobs include work in areas that may contain asbestos (e.g. telecommunications technician, electrician, instrument and control technician).
- Other indications of exposure include any indication of medical surveillance (lung function, chest x-rays, sputum examination).

Aromatic hydrocarbons

- Agents: benzene; toluene; xylene; phenol; naphthalene; trinitrotoluene; aromatic hydrocarbons NOS, including products containing aromatic hydrocarbons (scintillation liquids, fuels or polynucleated aromatic hydrocarbons derived from coal gasification processes); high explosives (containing trinitrotoluene, anthracene, naphthalene).
- Typical operations and tasks involving exposure to aromatic hydrocarbons include degreasing, dipping, spraying, brushing, coating, etching, machining, painting.
- Typical job titles involving work with these agents include operators (coal gasification process), metal workers (machinists, millwrights, welders), mechanics (auto/truck) and technicians (health physics). Other job titles with potential exposures include unskilled jobs involving handling and use of these agents or work in areas containing these agents (e.g. laborer), professional and technical jobs involving work in areas that may contain the agent (e.g. chemist, analyst, technician, scientist or engineer).
- Other indications of exposure include any indication of biological monitoring of the agent or metabolites (trinitrotoluene, phenol, nitrophenol) in blood, urine or exhaled air; or participation in a medical surveillance program.

Engine Exhaust

- Agents: carbon monoxide, polycyclic aromatic hydrocarbons, nitrogen oxides.
- Typical processes, operations and tasks involved in exposure to engine exhaust include maintenance and repair of engines, vehicles and heavy equipment; operation of heavy equipment;
- Typical job titles involving work with these agents include auto and truck mechanics; engine mechanics; heavy vehicle operators; bus drivers; delivery drivers and carriers; firefighter; jobs involving travel as a routine part of the job (patrol and security);
- Other indications of exposure include any indication of biological monitoring of metabolites (carboxyhemoglobin) in blood; participation in a medical surveillance program.

Halogenated solvents

- Agents: carbon tetrachloride (Freon 10, Halon 104, carbon tet or mixtures such as "Vaporene" containing CCl_4); perchloroethylene ("Perk", "Perc", tetrachloroethylene or mixtures such as "Blankrola" containing the agent) ; trichloroethylene ("Triclene", "Perm-A-Chlor"); methyl chloroform (1,1,1-trichloroethane, "Vythene"); 1,1,2,2-tetrachloroethane; methylene chloride; chlorinated solvents, NOS (not otherwise specified, including mixtures of halogenated solvents such as "Safety Solvent" and "Safety Sol")
- Typical operations and tasks involving exposure to halogenated solvents include degreasing, dipping, spraying, brushing, coating, etching, machining, painting.
- Typical job titles involving work with these agents include operator (degreaser, process), painter, machinist, mechanic, welder, millwright. Other job titles with potential exposures include unskilled jobs involving handling and use of these agents or work in areas containing these agents (e.g. laborer); professional and technical jobs involving work in areas that may contain the agent (e.g. chemist, analyst, technician, scientist or engineer).
- Other indications of exposure include any indication of biological monitoring of the agent or its metabolites (trichloroacetic acid) in blood, urine or exhaled air; participation in a medical surveillance program.

Metals

- Agents: beryllium and beryllium oxide; lead, including alloys with antimony, cadmium, tin, zinc; other specific metals and alkali metals including aluminum, antimony, arsenic, bismuth, cadmium, copper, mercury, nickel, tin, uranium, zinc; other metals, NOS used in the nuclear industry, such as zirconium; welding fumes, NOS (composed of gases and fumes from metals, flux materials, metal surface coatings or contaminants)
- Typical operations or tasks involving potential emissions of metals include abrasive blasting, grinding, milling, machining, forming, forging, rolling, coining, sizing, pressing, sintering, welding and handling of powdered metal materials.
- Typical jobs involving work with these agents include machinist, millwright, welder, lead burner, metallurgist. Other job titles include unskilled jobs involving handling and use of these materials or work in areas containing these materials (e.g. laborer), skilled trades involving work in areas that may contain the agent (e.g. steamfitter, pipefitter and boilermaker) or professional (e.g. technician, scientist or engineer).
- Other indications of exposure include "metal fume fever" from occupational health records; any indication of biological monitoring of blood and/or urine or participation in a surveillance programs (e.g. lead, beryllium, uranium).

Non-Ionizing Radiation

- Agents: microwave, radiofrequency (RF induction heaters, "Magneform" heat sealers, "Plasmatron"), extremely low frequency electromagnetic fields, static magnetic fields.
- Typical processes, operations and tasks involved in exposure to nonionizing radiation include heat sealing; electromagnetic separation of isotopes; semiconductor fabrication (including plasma etching and spraying operations); work with accelerators and fusion reactors (linear and Van de Graaff accelerators, cyclotrons, calutrons, DCX); plasma production and heating systems; telecommunications and relay systems; electric power generation, transmission and distribution; electroplating and electrodeposition of metals.
- Typical job titles involving work with these agents include skilled trades (electricians, line workers, cable splicers, powerplant operators, locomotive conductor and brakeman), technicians (research, electrical, electronics, instrument and control, relay, telecommunications), physicists, scientists and engineers (electrical, electronics, solid state, nuclear). Other job titles with potential exposures include unskilled jobs involving work in areas containing these agents (e.g. laborer, maintenance, janitor), and skilled jobs involving work with energized equipment (and professional and technical jobs involving work in areas that may contain the agent (e.g. analysts).
- Other indications of exposure include any job restrictions or concerns in workers with a cardiac pacemaker or prosthesis of metallic construction; interference with or problems during the use of a hearing aid.

IV. Detailed Notes

Exposure assignments were coded for each CERID. Two different coding sheets were used for recording exposure assignments. The first sheet (Version #1) provided coding by date and job title for aromatic hydrocarbons and benzene, halogenated hydrocarbons and carbon tetrachloride, metals (Be, Cd, Pb, Hg, Ni, U, welding fumes, other metals), engine exhaust and carbon monoxide, non-ionizing radiation (RF/microwave, ELF EMF and static magnetic fields) and other agents (asbestos, cutting oils, wood- and coal-dust, animal dander, dyes and inks, methyl ethyl ketone, paints, pesticides, vinyl chloride). The second coding sheet (Version #2) is a condensed version of the first but provides a single exposure assessment by CERID. The Version #2 coding sheet does not separate exposure assignments by date and job title, and only includes exposures assignments for aromatic hydrocarbons, halogenated hydrocarbons, metals (Be, Cd, Pb, Hg, Ni, U, welding fumes, other metals), non-ionizing radiation, and asbestos. Exposure assignments for LANL, ZIA and SRS were made using Version #1

coding sheet, with the results transcribed to Version #2 coding sheet. Exposure assignments for ORNL and Hanford were only made using Version #2 coding sheet.

Records indicating exposures to ionizing radiation or participation in a biological monitoring program for radionuclides (e.g. urinalysis, nose swipes) may provide information regarding potential for exposures to other chemical and physical agents of interest. Therefore, internal and external radiation exposures were recorded on the coding sheets based on the evidence of monitoring results. Exposures were either assigned 0H for individuals without monitoring data, or 1H for individuals with monitoring data. Parentheses were placed around assignments which were suspect.

An initial coding assignment was completed after reviewing the industrial hygiene databases and related information resources. If the results did not appear to represent exposures of the individual, then an alternate assignment was made with the original assignment placed in parentheses. Notes indicating critical information used in assigning exposures were placed on the margins of the coding sheet.

Los Alamos National Laboratory/Zia

Assignments at LANL/Zia were based on: 1) an industrial hygiene database created by UNC-CH from published literature, technical reports, internal documents, monthly, quarterly and annual reports of the industrial hygiene group at LANL, and related resources, 2) department files containing descriptive information obtained from published references and unpublished sources (Hoddeson et al., 1993; Hawkins et al., 1983). Specific observations follow:

- Electrician exposures to Hg at LANL/Zia assigned **1H** since the job title was identified in monitoring results at LANL during repair of Ajax (electrical) converter by ZIA electricians.
- Janitors at LANL were assigned exposures to multiple agents based on industrial hygiene information indicating janitor work activities included cleanup of production and processing areas and spill cleanup. These activities included handling of metals in production areas, use of halogenated hydrocarbon solvents during cleanup activities and the participation of janitors in medical surveillance programs for workers exposed to beryllium.
- CMR-5 worker exposures were assigned based on information from Chapter 24 of Project Y book (Hawkins et al., 1983), where CMR-5 was involved in the development of Pu reactor for P Division. Equipment and operations indicated work with electromagnetic mercury pumps and flowmeter, canning (Al?) of reactor slugs, lead shielding of reactor pot, uranium tamper blocks electroplated with silver, aluminum envelope enclosing reactor pot. CMR-5 became CMF-5. Exposure assignments (1H) given for CMR-5/CMF-5 workers for Pb, Hg, U, Pu, welding fumes, Al, Ag, ELF EMF and static magnetic fields.

Oak Ridge National Laboratory

Assignments at ORNL were based on: 1) an industrial hygiene database created by UNC-CH from published literature, technical reports, internal documents, monthly, quarterly and annual reports of the industrial hygiene group at ORNL, and related resources, 2) electronic databases obtained from ORNL industrial hygiene group, 3) department files containing descriptive information obtained from ORNL and from published references and unpublished sources. Specific observations follow:

- Project Sherwood involved fusion research at ORNL during the late 1950s. The research program included the creation and containment of a plasma within a magnetic field. Specific experiments associated with Project Sherwood included a direct current experiment (DCX), a magnetic fusion device using a deuterium plasma. Equipment associated with this research included multiple non-ionizing radiation sources (ELF EMF, static magnetic fields) such as electromagnets obtained from Y-12 calutrons, cyclotrons and other particle accelerators. Individuals associated with Project Sherwood were assigned non-ionizing radiation exposures for RF/microwave, ELF EMF, and static magnetic fields of **1H**.
- Fusion research programs conducted by the ORNL Physics Division, Chemistry Division and Thermonuclear Division maintained a variety of direct current, high-voltage accelerators and related equipment beginning in 1946. The facility purchased a Betatron accelerator in 1946, a Van de Graaff electron accelerator in 1948, a

Cockroft-Walton particle accelerator around 1948, a 5 megavolt Van de Graaff accelerator in 1949. The devices were housed at the high voltage laboratory building at Y-12. A 15 megavolt tandem Van de Graaff accelerator was added around 1962. Other fusion research devices were constructed and added to the site including a second direct current experiment and steady-state fusion device (ELMO Bumpy Torus) and tokamak fusion device (ORMAK) constructed in the late 1960s and early 1970s; and a fusion reactor (stellerator advanced toroidal facility) and radiofrequency facility for heating fusion plasmas constructed in the late 1980s. A large magnetic coil facility was constructed in the 1980s to test superconducting magnets used in fusion research (International Fusion Superconducting Magnet Test Facility). Individuals working in divisions and departments associated with fusion energy research (3060, 4460, 3410) were assigned exposures (1L, 1M or 1H) to RF/microwave, ELF EMF and static magnetic fields.

- Particle research was conducted by the ORNL Electronuclear Division using various cyclotrons and related equipment. During the late 1940s and early 1950s three cyclotrons were built by Y-12 research staff to study properties of compound nuclei and heavy particle reactions. Additional cyclotrons constructed at the site included the isochronous (variable energy) cyclotron in 1962 and an electron linear accelerator at the Hollifield heavy ion research facility completed in 1980. Individuals working in divisions and departments associated with particle research (4320, 4435, H200L) were assigned exposures (1L, 1M, or 1H) to RF/microwave, ELF EMF and static magnetic fields.
- Several work histories described participation in the "Finger Ridge" study. Potential exposures to uranium (1H or 1M) were indicated based on information provided in work histories and bioassay monitoring results.

Hanford

The following observations were noted in completion of the Hanford exposure assessment. Hanford appears to have monitored many workers for internal radiation (primarily for Pu), but this does not appear to indicate exposure, just routine policy if an individual worked in specific areas (e.g. 200 Separations). Inventory and exposure data for chemical and physical agents is generally lacking. Assignments relied more on the text description of operations in c:\gjmihlan\mm\hanford\hanford.doc and from descriptions of buildings, areas and operations contained in Hanford publications (HANF.HP.207). Specific observations follow:

- A staff engineer at PUREX plant was assigned to 202A and 2750E from 1977-1984, but was not monitored for internal radiation. Internal exposure data was expected for this individual given the job title, work location and process operation. Note: The PUREX operation ran through 1972, then restarted in 1983 for final processing of N-reactor irradiated fuel.
- Work in **T-Plant Building (221-T)** was assigned the following exposures: 1) aromatics (0M), 2) halogenated hydrocarbons (1L), 3) metals U, Cd, Be, Pb, Hg, Ni and other metals Al and Zr (1L); welding fumes (0M); 4) non-ionizing radiation RF/microwave, ELF EMF and static magnetic fields (0M), and 5) asbestos (0M). Halogenated hydrocarbons used as equipment degreasing agent.
- Work in **REDOX Plant (202-S)** was assigned the following exposures: 1) aromatics (0M) and halogenated hydrocarbons (1H or 1L), 2) U, Pb, Be, Cd, Hg, Ni, other metals (1L), 3) welding fumes (0M), 5) non-ionizing radiation (0M), and 6) asbestos (0M). Halogenated hydrocarbons used as equipment degreasing agent.
- Work in **PUREX Plant (202-A)** was assigned the following exposures: 1) aromatics (0M) and halogenated hydrocarbons (1H or 1L), 2) metals U, Pb, Be, Cd, Hg, Ni, other metals Al, Zr (1L); welding fumes (0M), 3) non-ionizing radiation (0M), and 4) asbestos (0M). Halogenated hydrocarbons used as equipment degreasing agent.
- Work in **Plutonium Finishing Building (234-5Z)** and **Plutonium Metallurgy Building (231-Z)** were assigned the following exposures: 1) aromatics (0M), 2) halogenated hydrocarbons (1H), 3) metals U (0M); Be, Ni, Pb, other metals, (1H); Cd, Hg (1L); welding fumes (0M), 4) non-ionizing radiation RF/microwave (0M); ELF EMF and static magnetic fields (1L), and 5) asbestos (1M).
- Work in **Fuels Manufacturing Building (313)** was assigned the following exposures: 1) aromatics (1H), 2) halogenated hydrocarbons (1H), 3) metals U, Ni, Pb, welding fumes and other metals Al, Sn, bronze (1H); Cd, Be, Hg (0M); 4) non-ionizing radiation RF/microwave (0M); ELF EMF (1M) and static magnetic fields (0M), and 5) asbestos (1M). Cd exposures are assigned 1H if in 1950s-1960s.

- Work in **Pile Technology Building (326)** was assigned the following exposures: 1) aromatics (0L), 2) halogenated hydrocarbons (1H), 3) metals U, Be, Hg, Pb and other metals Al (1H); Cd, Ni and welding fumes (0L); 4) non-ionizing radiation RF/microwave (0M); ELF EMF and static magnetic fields (1M), and 5) asbestos (1L). NIR exposures based on non-destructive testing.
- Work in **UO_3 Plant (224-U Bulk Reduction Plant, U-Plant, TBP-Plant, Metal Recovery Plant)** was assigned the following exposures: 1) aromatics (0M), 2) halogenated hydrocarbons (0M), 3) metals U (1H); Be, Cd, Pb, Hg, Ni, welding fumes, other metals (0M), 4) non-ionizing radiation RF/microwave (0M); ELF EMF (1H) and static magnetic fields (0M), and 5) asbestos (OM).

Savannah River Site

Assignments at the Savannah River Site were based on: 1) an industrial hygiene database created by UNC-CH from published literature, technical reports, internal documents, monthly, quarterly and annual reports of the industrial hygiene group at LANL, and related resources, 2) department files containing descriptive information obtained from published references and unpublished sources (Savannah River Plant News articles). Specific observations follow:

- Work in **Metallurgy (235-F)** was assigned the following exposures: 1) aromatics and halogenated hydrocarbons (0M), 2) metals Be, Cd, Hg, Ni, and welding fumes (0M); Hg (1M); other metals (Al) and U (1H) based on the extrusion of U, Np, Pu fuel elements, assuming Pb was used as a lubricant as in other fuel extrusion processes, 3) RF/microwave radiation and static magnetic fields (0M); ELF EMF (1M) from electrically powered extrusion equipment, and 4) asbestos (1M).
- Work in **Separations (221-F)** was assigned the following exposures: 1) aromatics (1L), 2) halogenated hydrocarbons (1H), 3) metals Cd, Pb, welding fumes and other metals (0L); Hg (0M); Be and Ni (1L); U (1H) from UO_3 process, 4) RF/microwave, ELF EMF and static magnetic fields (0M), and 5) asbestos (0M). Operations/equipment in the facility include a UO_3 process.
- Work in **Separations (221-H)** was assigned the following exposures: 1) aromatics (1L), 2) halogenated hydrocarbons (1H), 3) metals Cd, Pb, and other metals (0L); Be, Ni and welding fumes (1L); U (1M); Hg (1H), 4) RF/microwave, ELF EMF and static magnetic fields (0M), and 5) asbestos (0M). Operations/equipment in the facility include mercury processing/recovery.
- Work in **Uranium Element Fabrication (313-M)** was assigned the following exposures: 1) aromatics (1L), 2) halogenated hydrocarbons (1H), 3) metals welding fumes (0L); Be, Cd, Hg (0M); Pb, Ni, U and other metals as Al (1H); 4) RF/microwave (0L); ELF EMF and static magnetic fields (1L), and 5) asbestos (1L). Operations/equipment in the facility include extrusion presses using a Pb-containing lubricant.
- Work in **Metal Preparation (320-M)** was assigned the following exposures: 1) aromatics (1L), 2) halogenated hydrocarbons (1H), 3) metals Be, Cd, Hg, Ni (0L); Pb, U, welding fumes and other metals (stainless steel and tool steel) (1H), 4) RF/microwave, ELF EMF and static magnetic fields (1L), and 5) asbestos (1L). Operations/equipment in the facility include extrusion presses using a Pb-containing lubricant, cutoff machines for U metal fabrication and grinders for tool steel and stainless steel.
- Work in **TNX-CMX Semiworks (678-G)** was assigned the following exposures: 1) aromatics (1H), 2) halogenated hydrocarbons (0L), 3) metals Be, Cd, Pb, Hg, welding fumes (0M); Ni, U (1L); other metals (Al, Li, Zn) (1H); 4) RF/microwave (1L); ELF EMF and static magnetic fields (1H), and 5) asbestos (1L). Early operations in this building involved the study of chemical processing problems and test production-scale equipment using non-radioactive materials or natural uranium (TNX-CMX). The facility was later used for research and development of waste solidification processes. Occupancy during waste solidification operations were assigned NIR exposures listed above. Occupancy during CNX-TNX process would result in NIR exposure ratings of 1L or 0M.
- Work in **Traffic and Transportation Automotive Shop (716-A)** was assigned the following exposures: 1) aromatics (1L), 2) halogenated hydrocarbons (1H), 3) metals Be, Cd, Hg, Ni, U (0M); welding fumes (1L); Pb and other metals (1H); 4) RF/microwave, ELF EMF and static magnetic fields (0M), and 5) asbestos (1H). Operations/equipment in the facility include a radiator repair shop handling Pb.
- Work in **Fluorophotometry Laboratory (772-F)** was assigned the following exposures: 1) aromatics (1L), 2) halogenated hydrocarbons (1L), 3) metals Be, Cd, Pb, Hg, Ni, U, welding fumes and other metals (1L), 4)

RF/microwave, ELF EMF and static magnetic fields (1L), and 5) asbestos (1H). Operations/equipment in the facility include mercury recovery.

- Work in **Main Laboratory (773-A)** was assigned the following exposures: 1) aromatics (1L), 2) halogenated hydrocarbons (1H), 3) metals Be, Cd, Ni (0L); Pb, Hg, U, welding fumes (1L); other metals (Al, Li, Zn) (1H), 4) RF/microwave (1H); ELF EMF and static magnetic fields (1L), and 5) asbestos (1L). If the job is associated with fuel and target fabrication, then U exposures are assigned (1H). Operations/equipment in the facility include mercury recovery, Li-Al slug welding. Welding shop workers from this building participated in a biological monitoring program for Pb.

V. References

Hawkins, D, EC Truslow, RC Smith: The History of Modern Physics 1800-1950, Volume II, Project Y, the Los Alamos Project. Tomash Publishers and the American Institute of Physics (1983).

Hoddeson, L, PW Henriksen, RA Meade, C Westfall: Critical Assembly: A Technical History of Los Alamos during the Oppenheimer Years, 1943-1945. Cambridge University Press, New York, NY (1993).

MM Study: Guidelines for Assessment of Chemical and Physical Agent Exposures

Summary of criteria used in assigning exposure potential and confidence.

Exposure	Confidence	Bldg, Dept or Job → Worker	Agent → Bldg/Dept	IH data → Bldg/Dept	Agent → Job/Dept	Biological monitoring program → Worker	Biological monitoring program → Others	Process, operation, location → Agent	Other occup. health → Worker
Positive	High	+	+	+	+	+	+	+	+
Positive	Moderate	+	-	NA	+	-	+	+	+
Positive	Low	+	-	NA	-	NA	NA	+	-
Negative	High	+	-	NA	-	NA	NA	-	-
Negative	Moderate	+	-	NA	-	NA	NA	-	NA
Negative	Low	-	NA	NA	-	NA	NA	-	NA

- indicates the criteria is negative; + indicates the criteria is positive; NA indicates the criteria is not applicable; → indicates a link between components