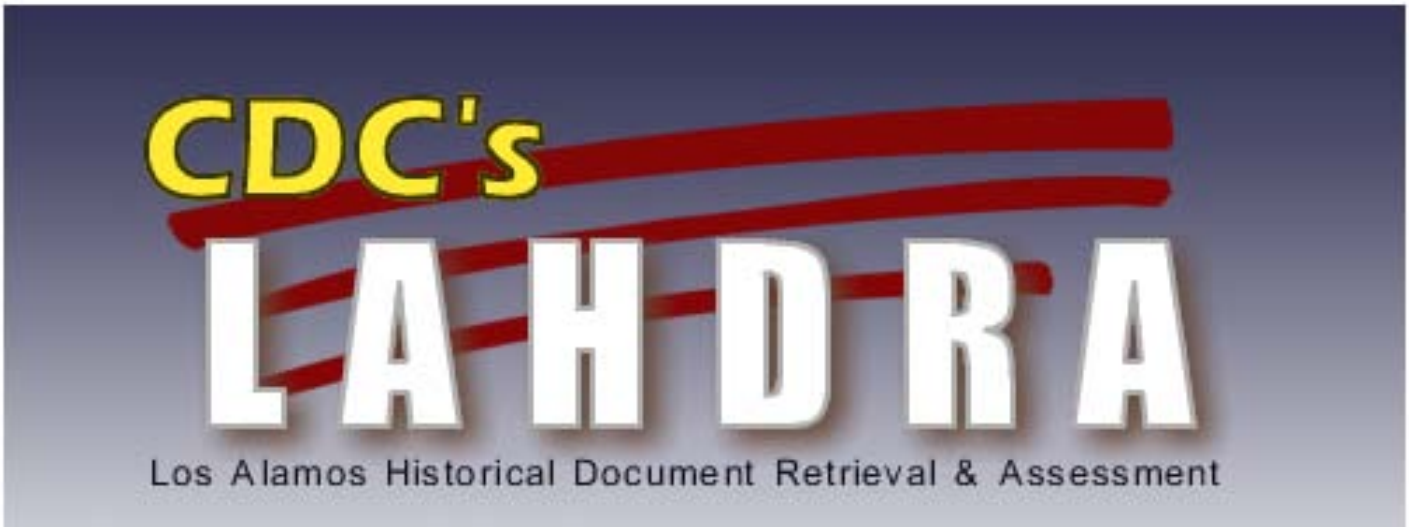

Interim Report of the Los Alamos Historical Document Retrieval and Assessment (LAHDRA) Project

Prepared for the Centers for Disease Control and Prevention (CDC)
National Center for Environmental Health
Division of Environmental Hazards and Health Effects
Radiation Studies Branch

Version 4 • January 2006

Shonka Research Associates
ChemRisk®
ENSR INTERNATIONAL

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Prepared as a team effort by individuals from:
ChemRisk, Inc., Shonka Research Associates, Inc., ENSR Corporation,
and Advanced Technologies & Laboratories International, Inc

Team Leader and Principal Author:

Thomas Widner

Contributing Authors:

Joseph Shonka, Susan Flack, Robert Burns, Jack Buddenbaum,
James O'Brien, Kate Robinson, Jeff Knutsen, Debby Shonka

Other project team members:

Cheryl Allen, Chris Atkinson, Lisa Barfield, Tim Bauer, Regan Burmeister, Joel Cehn, David Dodge, Ellen Donovan, Shannon Gaffney, Jou Hwang, William Joyce, Claudine Kasunic, Jim Key, Chris Kirman, Michael Marcial, William McCaughey, Tom Mongan, Amanda Phelka, Duane Quayle, Michael Simmons, Jeff Vollmer, Jody Williams

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25	Early code name for uranium-235; (from the isotope's atomic number (9**2**) and atomic weight (23**5**)
37	Early code name for neptunium-237 (from the isotope's atomic number (9**3**) and atomic weight (23**7**)
49	Early code name for plutonium-239 (from the isotope's atomic number (9**4**) and atomic weight (23**9**)
410	Early code name for plutonium-240 (from the isotope's atomic number (9**4**) and atomic weight (240); i.e., one higher than 23**9**, hence the **10**)
ACIS	Automated Chemical Inventory System
ADWEM	Associate Laboratory Directorate for Nuclear Weapons Engineering and Manufacturing- formerly ALDNW
AEC	U.S. Atomic Energy Commission (DOE predecessor agency)
AIRNET	A LANL network of ambient air sampling stations
AKA	"also known as"
ALDNW	Former Office of Associate Laboratory Directorate for Nuclear Weapons
ANP	Aircraft Nuclear Propulsion
ARF	Atmospheric Release Fraction
ATSDR	Agency for Toxic Substances and Disease Registry
BR Site	Bruns Railhead Site (in Santa Fe, NM)
BZ	Breathing Zone
CAS	Chemical Abstracts Service, a registry for chemicals
Case	Early code word for curie, especially when referring to polonium shipments ("200 cases of Postum" meant 200 curies of polonium).
CBD	Chronic Beryllium Disease
cc	Cubic Centimeters
CCNS	Concerned Citizens for Nuclear Safety
Cd	Cadmium
CDC	Centers for Disease Control and Prevention
CEARP	Comprehensive Environmental Assessment and Response Program
CEDE	Committed Effective Dose Equivalent, a unit of radiation dose
CFM	Cubic Feet per Minute
CFR	Code of Federal Regulations
Ci	Curie, a unit of radioactivity; 1 Ci = 3.7×10^{10} disintegrations per second.
CIC	Former Computing, Information and Communications (CIC) Division, now the Computing, Communications, and Networking Division (CCN).
CM	Chemistry and Metallurgy
CMB	Former Chemistry/Metallurgy/Baker Division, which later became MST Division
CMR	Chemistry and Metallurgical Research
CMR-12	The radiochemistry group at early LASL
CO_2	Carbon dioxide
DARHT	Dual-Axis Radiographic Hydrodynamics Test
D-Building	Earliest plutonium processing facilities at Los Alamos
DE	Dose Equivalent, a unit of radiation dose
D&D	Decontamination and Decommissioning

DF Site	Detonator Firing Site
DOE	U.S. Department of Energy
DOEAL	Department of Energy Albuquerque Operations Office
DOP	diocthyl phthalate, an aerosol often used to test effluent treatment filters
DP	DP Site[1], or TA-21. The site of plutonium processing at LANL from 1945 until 1978. Was also the site of polonium processing.
DPM	Disintegrations Per Minute, a rate of radioactive decay
DSF	Document Summary Form
DU	Depleted Uranium
DVD	Digital Versatile Disc
DX	Dynamic Experiments Division at LANL
EEOICPA	Energy Employees Occupational Illness Compensation Program Act
EIS	Environmental Impact Statement
EMAD	Engine Maintenance and Disassembly building at NRDS.
EMF	ElectroMagnetic Field
EML	Environmental Measurements Laboratory
ENSR	ENSR Corporation, a provider of ENvironmental SeRvices
ER	Environmental Restoration
ERDA	Energy Research and Development Administration (DOE predecessor agency)
ESA	Engineering Science and Application
ES&H	Environment, Safety, and Health
eV	Electron Volts
FACA	Federal Advisory Committee Act
fCi	Femtocurie, 10^{-15} curie, or 0.000000000000001 Ci
FGI	Foreign Government Information
FQ	Filter Queens- vacuum cleaners adapted at LASL to collect air samples
G/MAP	Gaseous Mixed Activation Products,
GMX	GMX Division (possibly for **G**adgets, **M**unitions, and E**x**plosives)
GMX-1	The Radiography Group at early LANL
GPS	Global Positioning System
GT Site	Anchor Site West
H	H Division or Health Division at LANL
HAI	History Associates Inc.
H-Division	The Health Division at LANL
HE	High Explosive
HEPA	High Efficiency Particulate Air filter
HHS	Dept of Health and Human Services
HMX	High Melting Explosive
HP Site	Hot Point Site
HSE	Health, Safety, and Environment
HSR	Health, Safety, and Radiation Protection group at LANL, formerly ESH
HT	Heat Treatment Building at TA-1
HTML	Hyper Text Markup Language
HTO	Tritiated water, water in which a hydrogen atom is replaced with tritium, ^{3}H

[1] There are several theories about the origin of the "DP Site" name for TA-21. It may stand for D-Prime, since it replaced D Building, "D Plant," "Displaced Persons," "D-Plutonium," or "D-Production" (Martin 1998).

HSPT	Human Studies Project Team
HYPO	Water Boiler Reactor in its high-power configuration
IAEA	International Atomic Energy Association
ICRP	International Commission on Radiological Protection
ICRU	International Commission on Radiation Units and Measurements
IH	Industrial Hygiene
IM-5	The Records Management Group within the LANL Information Management Division
INEEL	Idaho National Engineering and Environmental Laboratory
IP	Internet Protocol
IPM	Images per minute
JHSPH	Johns Hopkins School of Public Health
kW	kilowatt, one thousand watts of power
LA–	A prefix in many Los Alamos technical report designators
LAHDRA	Los Alamos Historical Document Retrieval and Assessment project
LALP	A type of LANL publication, from Los Alamos Laboratory publication
LAMS	A type of Los Alamos technical report, from Los Alamos Manuscript
LAMPF	Los Alamos Meson Physics Facility
LAMPRE	Los Alamos Molten Plutonium Reactor Experiment
LANL	Los Alamos National Laboratory (January 1981 to present)
LANSCE	Los Alamos Neutron Science Center- formerly LAMPF
LA-PR	A type of Los Alamos technical report, from Los Alamos Progress Report
LAPRE	Los Alamos Power Reactor Experiment
LAPRE I	First Los Alamos Power Reactor Experiment
LAPRE II	Second Los Alamos Power Reactor Experiment
LASL	Los Alamos Scientific Laboratory (January 1947 to December 1980; name changed to Los Alamos National Laboratory in January 1981)
LA- UR	A type of Los Alamos technical report, from Los Alamos Unlimited Release
LCLS	LANL's Legal Counsel Litigation Support Database
LMFBR	Liquid Metal Fast Breeder Reactor
LOAEL	Lowest Observed Adverse Effect Level
LOPO	Water Boiler Reactor in its low-power configuration
LSSS	Limiting Safety System Setting
mA-hr	Millampere-hours, a measure of work load for accelerators like at LANSCE
MAP	Mixed Activation Products
MDL	Minimum Detection Level
MED	Manhattan Engineer District
MeV	Million Electron Volts
MFP	Mixed Fission Products
mL	milliliter, one thousandth of a liter
mm	millimeter, one thousandth of a meter
MDA	Minimum Detectable Activity
MOU	Memorandum of Understanding
MPC	Maximum Permissible Concentration
MST	Materials Science and Technology Division
MTR	Materials Test Reactor
MW	Megawatt, one million watts of power

NASA	National Aeronautics and Space Administration
NBS	National Bureau of Standards (predecessor to NIST)
NCEH	National Center for Environmental Health, part of CDC
NCRP	National Council on Radiation Protection and Measurements
NEPA	Nuclear Energy for the Propulsion of Aircraft (a USAF project)
NERVA	Nuclear Engine for Rocket Vehicle Application
NESHAPS	National Emissions Standards for Hazardous Air Pollutants
NIOSH	National Institute for Occupational Safety and Health
NMED	New Mexico Environmental Department
NMT	Nuclear Materials Technology
NOAEL	No Observed Adverse Effect level
NO_x	Oxides of nitrogen
NRC	U.S. Nuclear Regulatory Commission
NRDS	Nuclear Rocket Development Station (at NTS)
NSA	Nuclear Science Abstracts
NTK	Need-to-know
NTS	Nevada Test Site
OCR	Optical Character Recognition
ORNL	Oak Ridge National Laboratory
ORF	Overall Release Fraction
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
OSR	Off-Site Releases Database
OSTI	Office of Scientific and Technical Information
OUO	Official Use Only
OWR	Omega West Reactor
OWREX	Omega West Reactor Experiment
PARKA	A Phoebus 1 reactor set up as a critical assembly
PBX	Plastic Bonded Explosive
PCB	Polychlorinated Biphenyls
PDF	Portable Document Format
PEL	Permissible Exposure Limit
PETN	pentaerythritol tetranitrate, an explosive
PHERMEX	Pulsed High-Energy Radiation Machine Emitting X-rays
PI	Priority Index
Postum	Early code word for polonium, a material used at Los Alamos.
PPM	Pages Per Minute

PROJECTS

Project Apple	Rocky Flats Plant
Project Camel	The first full-scale test firing of the "Fat Man" type bomb (minus the plutonium) at the China Lake Naval Ordnance Sta. in CA.
Project Orange	Pantex Plant
Project Royal	*unknown*
Project Sugar	Burlington Army Ordnance Plant in Iowa
Project Tee	*unknown*

PRG	Preliminary Remediation Goals
PRS	Potential Release Sites
PSR	Proton Storage Ring
P/VAP	Particulate Various Activation Products
Q	The top level of security clearance granted by DOE

R	Roentgen, a unit of radiation exposure
RAEHP	Rio Arriba Environmental Health Partnership
RaLa	Radioactive Lanthanum
RCRA	Resource Conservation and Recovery Act
RDX	Rapid detonating explosive
rem	A unit of radiation dose equivalent, from Roentgen Equivalent Man
RF	Respirable Fraction
RfC	Reference Concentration
RFETS	Rocky Flats Environmental Technology Site
RFI	RCRA Facility Investigation
RMAD	Reactor Maintenance, Assembly, and Disassembly building at NRDS.
RMC	Records Management Center
RPF	Records Processing Facility
RRES	Risk Reduction and Environmental Stewardship
RSAC	Radiological Safety Analysis Computer program
RSB	CDC's Radiation Studies Branch
S Site	TA-16; S is from Sawmill Site, after a former sawmill in the area.
S-7	LANL's Classification Office
SAP	Special Access Program
SCI	Sensitive Compartmented Information
SED	Special Engineering Detachment, in the Manhattan District era
SL-1	A 3-MW experimental reactor in Idaho, Stationary Low-Power Plant No. 1, that was destroyed in 1961 when a control rod was removed manually.
SM	South Mesa
SNM	Special Nuclear Material
SNPO	Space Nuclear Propulsion Office, a joint office between the AEC and NASA.
Soda Pulp	Early code name for bismuth, which was irradiated to make polonium.
SRA	Shonka Research Associates, Inc.
SRS	Savannah River Site
SUPO	Water Boiler Reactor in its highest (Super) power configuration
SWMU	Solid Waste Management Unit
TA	Technical Area; a section of land at Los Alamos, with TA number from 0 to 74, that has been the site of identified operations or activities
TATB	1,3,5-triamino-2,4,6-trinitrobenzene, an explosive
TD Site	Trap Door Site
TFF	Target Fabrication Facility
TLD	ThermoLuminescent Dosimeter
TNT	Trinitrotoluene, an explosive
TR	Transfer Record
TRU	Transuranic, that is elements having atomic numbers greater than 92
TSTA	Tritium Systems Test Assembly
TU	Tuballoy, an early code name for depleted uranium (from the British Tube Alloys project, a code name for their atomic bomb program)
UC	University of California, operator of the Los Alamos facility since its founding
UCNI	Unclassified Controlled Nuclear Information
UHTREX	Ultra High-Temperature Reactor Experiment
UK	United Kingdom
UNM	University of New Mexico
USAEC	United States Atomic Energy Commission
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

VHS	Video Home System, a video cassette format patented by JVC
Vitamin B	Early code name for the isotope boron-10, a material used at Los Alamos.
VJ Day	The day of Allied victory over Japan in WW II
VRS	Virtual ReScan technology
VTR	Vault Type Room
WB	whole body
WEM	Weapons Engineering and Manufacturing
WETF	Weapons Engineering Tritium Facility (at TA-16)
WFO	Work for Others
WIPP	Waste Isolation Pilot Plant
WNR	Weapons Neutron Research Facility
WP	Weapons Physics
WX	Weapons Group WX
Y	Site Y, the code name for Los Alamos Laboratory under the MED from April 1943 to December 1946.
Z	Z Division (named for Jerrold R. Zacharias, a physicist from MIT's Radiation Laboratory), an ordnance design, testing, and assembly group formed at LASL in July of 1945. Moved to the old Oxnard Air Field, east of Kirtland Air Base, just outside of Albuquerque between fall of 1945 and January of 1947 and became informally known as Sandia Base.

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Reference:

Martin 1998. Martin, C. *Los Alamos Place Na*mes. Los Alamos Historical Society, Los Alamos, New Mexico.

Metric (SI) Prefixes

Factor	Prefix	Symbol	Factor	Prefix	Symbol
10^{18}	exa	E	10^{-1}	Deci	d
10^{15}	peta	P	10^{-2}	Centi	c
10^{12}	tera	T	10^{-3}	Milli	m
10^{9}	giga	G	10^{-6}	Micro	μ
10^{6}	mega	M	10^{-9}	Nano	n
10^{3}	kilo	k	10^{-12}	Pico	p
10^{2}	hecto	h	10^{-15}	Femto	f
10^{1}	deka	da	10^{-18}	Atto	a

Summary of New and Old Radiological Units

Quantity	Name	Symbol	In other units
radioactivity	becquerel	Bq	1 disintegrations per second (dps)
(*old)*	curie	Ci	3.7×10^{10} Bq
absorbed dose	gray	Gy	joule/kilogram (J/kg)
(*old)*	rad	rad	10^{-2} Gy
dose equivalent	sievert	Sv	J/kg
(*old)*	rem	rem	10^{-2} Sv
exposure	coulomb per kilogram		C/kg
(old)	roentgen	R	2.58×10^{-4} C/kg

Chemical Concentrations

1.0 mg/L = 0.001 g/L = 1,000 µg/L = 1,000,000 ng/L

1.0 µg/L = 0.001 mg/L = 1,000 ng/L

1.0 ng/L = 0.001 µg/L = 0.000001 mg/L

1.0 percent = 1.0 g/100g = 10 $^{o}/_{oo}$ (parts per thousand) = 10 g/kg = 10,000 mg/kg

1.0 g/kg = 0.10 percent = 1,000 mg/kg

1.0 mg/kg = 0.0010 g/kg = 0.00010 percent = 1,000 µg/kg

1.0 µg/kg = 0.001 mg/kg = 1,000 ng/kg

Table of the Elements

Z #*	Name	Symbol	Z #	Name	Symbol
89	Actinium	Ac	101	Mendelevium	Md
13	Aluminum	Al	80	Mercury	Hg
95	Americium	Am	42	Molybdenum	Mo
51	Antimony	Sb	60	Neodymium	Nd
18	Argon	Ar	10	Neon	Ne
33	Arsenic	As	93	Neptunium	Np
85	Astatine	At	28	Nickel	Ni
56	Barium	Ba	41	Niobium	Nb
97	Berkelium	Bk	7	Nitrogen	N
4	Beryllium	Be	102	Nobelium	No
83	Bismuth	Bi	76	Osmium	Os
107	Bohrium	Bh	8	Oxygen	O
5	Boron	B	46	Palladium	Pd
35	Bromine	Br	15	Phosphorus	P
48	Cadmium	Cd	78	Platinum	Pt
20	Calcium	Ca	94	Plutonium	Pu
98	Californium	Cf	84	Polonium	Po
6	Carbon	C	19	Potassium	K
58	Cerium	Ce	59	Praseodymium	Pr
55	Cesium	Cs	61	Promethium	Pm
17	Chlorine	Cl	91	Protactinium	Pa
24	Chromium	Cr	88	Radium	Ra
27	Cobalt	Co	86	Radon	Rn
29	Copper	Cu	75	Rhenium	Re
96	Curium	Cm	45	Rhodium	Rh
05	Dubnium	Db	37	Rubidium	Rb
66	Dysprosium	Dy	44	Ruthenium	Ru
99	Einsteinium	Es	104	Rutherfordium	Rf
68	Erbium	Er	62	Samarium	Sm
63	Europium	Eu	21	Scandium	Sc
100	Fermium	Fm	106	Seaborgium	Sg
9	Fluorine	F	34	Selenium	Se
87	Francium	Fr	14	Silicon	Si
64	Gadolinium	Gd	47	Silver	Ag
31	Gallium	Ga	11	Sodium	Na
32	Germanium	Ge	38	Strontium	Sr
79	Gold	Au	16	Sulfur	S
72	Hafnium	Hf	73	Tantalum	Ta
108	Hassium	Hs	43	Technetium	Tc
2	Helium	He	52	Tellurium	Te
67	Holmium	Ho	65	Terbium	Tb
1	Hydrogen	H	81	Thallium	Tl
49	Indium	In	90	Thorium	Th
53	Iodine	I	69	Thulium	Tm
77	Iridium	Ir	50	Tin	Sn
26	Iron	Fe	22	Titanium	Ti
36	Krypton	Kr	74	Tungsten	W
57	Lanthanum	La	92	Uranium	U
103	Lawrencium	Lr	23	Vanadium	V
82	Lead	Pb	54	Xenon	Xe
3	Lithium	Li	70	Ytterbium	Yb
71	Lutetium	Lu	39	Yttrium	Y
12	Magnesium	Mg	30	Zinc	Zn
25	Manganese	Mn	40	Zirconium	Zr

*The Z Number, or Atomic Number, of an element is the number of protons in its atomic nucleus.

Executive Summary

The Los Alamos Historical Document Retrieval and Assessment (LAHDRA) project began in early 1999. It is being conducted by the Centers for Disease Control and Prevention (CDC), with much of the work of the project conducted by contractors to CDC, namely ChemRisk Inc., Shonka Research Associates Inc., ENSR Corporation, and Advanced Technologies and Laboratories International, Inc. The primary purpose of the LAHDRA project is to identify the information that is available concerning past releases of radionuclides and chemicals from the government complex at Los Alamos, New Mexico. "Project Y" was born as part of the Manhattan Project to create the first atomic weapons. LANL's responsibilities expanded after the wartime years, to include thermonuclear weapon design, high explosives and ordnance development and testing, weapons safety, nuclear reactor research, waste disposal or incineration, chemistry, criticality experimentation, tritium handling, biophysics, and radiobiology.

This Interim Report represents a summary of information that has been obtained by the LAHDRA project team regarding:

- historical operations at Los Alamos,
- the materials that were used,
- the materials that were likely released off site,
- development of residential areas in Los Alamos, and
- the relative importance of identified releases in terms of potential health risks.

The information in this report was obtained from records reviewed at Los Alamos by the project team, some books and reports that are publicly available, and some interviews with past and current Los Alamos workers. While millions of documents have been reviewed at Los Alamos, the information gathering is not complete.

Products of the LAHDRA Project

The products of the LAHDRA project include:

- this report and periodic updates to it;
- a database that contains bibliographic information and summaries of the content of relevant documents that were located by the project team;
- sets of copies of the most relevant documents, to be made available by DOE in a reading room in Albuquerque;
- a collection of electronic document images, as Portable Document Format (PDF) files, of all documents for which paper copies or electronic files were obtained; and
- a chronology of incidents and off-normal events identified in review of reports prepared by Los Alamos' Health Division.

A Microsoft® Access database was created to store the information reviewed and collected during this project. There are 4,055 files in the LAHDRA database. A user-friendly front-end was developed for use by the project analysts for reviewing the information collected. The database includes a form created for entering the information from the document summary forms (DSFs) filled out by document analysts in the field, and also a form to perform searches on all the information that has been entered. In the search form, users can search the data from every field on the DSF.

As the number of paper copies grew and scanning technology matured, it was decided that a better way to preserve and present the reference material being collected by the LAHDRA team would be as scanned images. Ultimately, all of the information was scanned in as PDF

files and an Adobe Acrobat full text search capability was developed. Adobe® Acrobat® Capture® 3.0 software was used with the scanner to convert paper documents into searchable Adobe Portable Document Format (PDF) files. That software applies optical character recognition (OCR), page and content recognition, and cleanup tools to convert the paper-based information into electronic documents of optimal quality. Indexing of documents was achieved using Adobe Acrobat 6.0 Professional's Catalog tool. The indexing allows efficient searching across all of the PDF files in the collection. Users of the database can choose to see the results of the search either in a report format or in HTML format. HTML format provides users with hyperlinks to open the documents associated with the DSF in scanned searchable images in PDF format.

Systematic Document Reviews Conducted

As originally specified, the LAHDRA project was divided into six phases that were planned to be completed sequentially. Each phase was meant to target a specific group of records, as outlined below:

Phase 1: The LANL Records Management Center
Phase 2: The LANL Archives
Phase 3: The Technical Report Library
Phase 4: Records at the Technical Areas
Phase 5: Records pertaining to "Work for Others"
Phase 6: Documents located at other sites

Because of restrictions that were placed on the number of analysts that could work in a given repository at any time, the decision was made to abandon the sequential approach and work in multiple repositories concurrently. The initial and principal focus of the effort was the LANL Central Records Management Center. The LANL Records Center is a 15,000 square foot building located at 180 6th Street in Los Alamos. The function of the Records Center is to receive and catalog records from the various LANL groups and divisions, to place and maintain these records in retrievable storage, and disposition them in accordance with DOE retention and disposition guidelines and other associated requirements (such as the moratorium on destruction of records deemed pertinent to epidemiological studies). Note that the LANL Archives is also housed in Building TA-21-1001, however, this collection is stored, maintained, and managed separately from the Central Records Center's holdings. Systematic review of the contents of the LANL Records Center that were accessioned prior to December 31, 1999 was completed in early June 2005, with all of the selected material received from LANL by the end of that month.

During the first calendar quarter of 2005, LAHDRA analysts began reviewing printouts of LANL Archives collections and the folders that exist within each collection, identifying (based on review of folder titles) folders to be reviewed by the project team. The project team began the review of records at the LANL Archives in early June of 2005, and this review continues as of the issuance of this report.

From 1942 to 1992, the LANL Reports Collection was a filing point for reports issued by LANL and by other Department of Energy sites. There are three types of records in the Report Collection vault, which is located below the LANL Research Library in the Oppenheimer Study Center building at TA-3: classified reports in paper format, unclassified reports in paper format, and reports on microfiche. Approximately 3,000 classified report titles issued by LANL as LA- or LAMS- reports are located in the Report Collection. In the second half of the project, the project team was denied access to the following categories of classified information in document repositories at LANL:

- Nuclear weapons design information,
- Information falling under Sigma levels 14 and 15,
- Sensitive Compartmented Information (SCI),
- Special Access Programs (SAPs),
- Foreign Government Information (FGI), and
- Unclassified Sensitive Vendor Proprietary Information.

Access to classified reports issued by any of the following entities with publication dates after 1962 was denied beginning March 2001: LANL, Lawrence Livermore National Laboratory, Sandia National Laboratory, the Defense Nuclear Agency and its predecessor and successor agencies, and DOE Albuquerque Area Office. During 2005, C.M. Wood of CDC reviewed the Los Alamos technical reports that fell within this restriction by title and selected 18 for review. These classified technical reports were reviewed by a LAHDRA document analyst, and several were selected as relevant, summarized, and added to the project information database.

Approximately 55-60% of the classified LANL-issued technical reports had been reviewed prior to March 2001. Approximately 1,144 classified LANL reports issued after 1962 have not been reviewed by the project team because of the March 2001 decision by LANL to withhold them. LAHDRA document analysts were allowed to review the titles of these withheld reports, but that approach proved to be ineffective and problematic due to the vagueness of many titles. All of the classified "LA-" and "LAMS"-series reports issued before 1963 that were present at the Report Collection were reviewed by the LAHDRA team. Access to classified reports issued by entities other than LANL has been denied to LAHDRA analysts since November 2001. The project team had reviewed approximately 35-40% of the classified reports issued by entities other than LANL (up to letter "L" in the alphabetically-shelved documents) prior to the withdrawal of access. The remaining reports in this group were reviewed during 2005 by a LAHDRA analyst working in tandem with a LANL person trained to recognize deniable category information.

Approximately 10,000 unclassified report titles issued by LANL as LA- or LAMS- reports are located in the Report Collection vault. Images of approximately 25,000 unclassified LA-, LA-MS-, LA-UR, and LA-PR reports are available as PDF files in the LANL electronic library catalog. Prior to the heightening of security measures that followed the terrorist attacks of September 11, 2001, the unclassified "LA" reports were publicly available on the LANL Web site. The project team reviewed 100% of the unclassified "LA" reports that were formerly available without restriction on the Internet.

There are also approximately 90,000 unclassified reports in the Report Collection vault that were issued by DOE sites other than LANL, academic institutions, private corporations that conducted research on behalf of DOE, and other defense-related agencies. The project team reviewed 70 to 75% of the non-LANL unclassified reports shelved in the Report Collection vault (up to letter "P" in the alphabetically shelved documents) before work was halted in 2004, and the remainder will be reviewed during 2006. There are also approximately 1.5 million documents on microfiche at the LANL Reports Collection. A search of two relevant databases indicated that LANL is the authoring institution for approximately 11,000 NSA reports and 53,000 DOE Energy reports, or about 10% of each database's contents. The project team is currently reviewing the reports on microfiche.

The ES&H Records Center has been in operation since 1998. Its purpose is to receive records from the various ES&H Groups, catalogue and consolidate those records, and to eventually forward them on to the LANL Central Records Center. Many of the records stored at the ES&H Records Center are recent, i.e., from the 1990s. A total of 1,187 boxes were reviewed in the ES&H Records Center. Of these, 227 were deemed to contain material relevant to the project and thus had DSFs completed for them.

Reviews completed during this project also included holdings of the Weapons Engineering and Manufacturing (WEM) and Weapons Physics (WP) divisions. These LANL divisions are organized under the Directorate's Office of the Associate Laboratory Directorate for Nuclear Weapons Engineering and Manufacturing (ADWEM). The Office of ADWEM was formerly known as Office of Associate Laboratory Directorate for Nuclear Weapons (ALDNW). There are 36 additional divisions or program offices under ADWEM that have not yet been reviewed. The WEM/WP VTR contained approximately 18,876 classified documents and 1126 classified photographs. Thirty-six classified safes within the ADWEM main offices were also reviewed for potentially relevant information. The safes contained 7,056 documents marked "RESTRICTED DATA". No titles were identified as potentially relevant to the LAHDRA project. Based on a review of a list of classified vaults and repositories at LANL, it is estimated that 21 vaults, 107 Vault-type rooms (VTRs), 5 alarmed rooms, and 1,600 repositories (file cabinets, 2-5 drawers each, with combination locks) are present. Not all of the vaults or VTRs contain only records– some contain weapon parts and/or special nuclear material.

Review of documents located at the Los Alamos Neutron Science Center (LANSCE Division, formerly LAMPF) is 80 percent complete at the time of this report. Reviews of available documents at LANSCE focused on office files within the Main Administration Building 1 located at TA-53 and the Radiological Air Monitoring Records Archive. Of these documents, 2,500 were considered potentially relevant and underwent detailed review. Copies of 36 documents were requested and summarized for the LAHDRA project database. Highlights of these records are the Shift Supervisor Logbooks that contain daily beam current and beam-hour information dating back to 1971.

Forty-five boxes of documents (3,375 documents) located at the Radiological Air Monitoring Records Archive (Building 3R) were reviewed. Copies of 97 documents were requested and summarized for the LAHDRA project database. This archive is a very useful source of relevant information for the LAHDRA project and for any future studies of off-site releases from TA-53.

During the LAHDRA project, team members made several attempts to gain access to the contents of the Legal Counsel Litigation Support Database (LCLS), sometimes called the Legal Database. While the database itself was not made available, in late 2003/early 2004 the LAHDRA team received and reviewed a hardcopy listing of the documents contained in that database. The list includes document number, title, author, addressee and copy recipient, date, status, and page count. The LCLS database consists of the following document categories: H-Division, Human Studies Project Team, Central Records Management, "Other" documents, and Records Processing Facility documents. During 2005, LAHDRA analysts reviewed the hardcopy indices of the LCLS database and selected documents for review. Images of these documents were made available to LAHDRA analysts by Legal Counsel staff, and they were reviewed between May and September of 2005. Documents selected as relevant were printed and released to the project team.

Challenges and Accomplishments in Information Gathering at Los Alamos

Access to classified documents at Los Alamos has been more difficult than LAHDRA team members have experienced at any of the other DOE sites that have been subjects of dose reconstruction investigations. The discussion of the main document access challenges experienced on the LAHDRA project that is presented in this Interim Report includes the following topics:

- The Cerro Grande Fire
- Security Stand-Downs and the Fallout of Security Incidents
- Need-to-Know Letter Received

- Security Plan Promised
- First Special Security Plan Issued
- Calls for Review by Title Alone
- Second Special Security Plan Issued
- Practices Changed in the Report Collection
- First Appeal to DOE Issued
- UK Documents Not All Made Available for Review
- Second Appeal Letter Issued to LANL
- Contract with Classification Reviewers Expires
- CDC Requests that Work be Brought to Close under Existing Contract
- Prerequisites for Continued Work at Los Alamos Outlined by CDC
- Tasks Authorized to Bring Work to Clean Breakpoints
- Reports Collection Resources Raised as an Issue
- CDC Returns to Complete Review of "UK Records"
- Response to Appeal Letter Received
- Classification Review Backlog Quantified
- Review of Documents in Backlog Begins
- LANL Resources Limit LAHDRA Team Activities
- Funding under First LAHDRA Contract id Expended
- Progress during Early 2004
- LANL Shutdown Begins in Response to Security Incident
- CDC Public Meeting, LAHDRA Interim Report Issued
- New Contract Awarded, but Site Access Not Immediately Possible
- Meeting Kicks Off Resumption of Information Gathering at LANL
- Review of Records Center Holdings Closed Out
- Contents of Litigation Support Database Reviewed
- Review of LANL Archives Contents Begins
- Review of Documents in the Report Collection Resumes

Prioritization of Airborne Releases

During the period of LANL's existence, many operations involving radionuclides have been performed at LANL, and effluents of various kinds have been released. As the initial step towards prioritization of historical airborne releases from LANL, Priority Index (PI) values were calculated by computing the air volume required to dilute the annual activity released to be equal to the worst-case non-occupational Maximum Permissible Concentration (MPC) per federal regulations. This priority index is intended to be a guideline to determine if a nuclide set requires further iterations of calculation and refinement, or if it warrants lower priority relative to other nuclides. For example: a PI of 10^6 indicates that 10^6 mL of air would be required to dilute the released material to a concentration equal to the MPC. A Microsoft Access® Off-Site Releases (OSR) Database was created to tabulate effluent information and to link it to existing LANL documents that have been assembled by the LAHDRA project team.

Plutonium data obtained are from 1948-1996. Release estimates are not available for D Building, or at least none have been located. D Building started operation in late 1943/early 1944, so it is important to note that for the years 1944-1948, no data could be found on air emissions. In addition, the releases from DP Site reported by LANL for 1948, 1949, and 1950 are based on simple estimates first made by Jordan and Black (1958). The priority index for plutonium over the years of LANL operations ranges from 10^{14} to 10^{19}. The years in the pre-1976 era have a sample line loss correction factor of 2.0 and a filter burial correction factor of 1.6 applied by the LAHDRA team.

The uranium data found range from 1949-1996. Some of these data are uranium inventory data from uses in experiments involving explosive tests and some data are from stack monitoring. For the explosion data, the mass was multiplied times a specific activity for the nuclide group (for instance, depleted uranium, or natural uranium). Uranium data from stack sampling also had the sample line loss and filter burial correction factors applied by the LAHDRA team to all data prior to 1976. In addition, Atmospheric Release Fractions (ARF) and Respirable Factions (RF) were then multiplied to get a range of Overall Release Fractions (ORF). The ORF-corrected values represent the amount of the radionuclide that got into the air and contains respirable-size particles. The overall range for the priority index for uranium was from approximately 10^{19} to approximately 10^{15}. In general, in the post-1973 era, the uranium priority indices appear to indicate greater significance than plutonium. In the pre-1973 era, plutonium is of greater significance.

Airborne effluent data for tritium that were found range from 1967-1996, although tritium was used and released on-site at LANL before 1967. No correction factors were applied to tritium data by the LAHDRA team. The priority indices for tritium range from 10^{15} to 10^{17}. In the post-1973 era, tritium was more significant than uranium or plutonium, but less significant than mixed activation products (MAP). More data are required for pre-1967 tritium releases at LANL. LAHDRA staff have found and entered Document Summary Forms (DSFs) for additional documents containing tritium release data in the LAHDRA database; however, these data hove not yet been released by LANL.

Radioactive Lanthanum (RaLa) has been subjected to a dose reconstruction by LANL personnel, including source term evaluation. All of the RaLa data are from explosive tests. No correction factors were applied to the activity data by the LAHDRA team. The time period is from 1944 –1962, with no testing with RaLa accomplished in 1951. The priority indices ranged from 10^{14} to 10^{16}. Since it was desired to estimate the actual RaLa releases to air, the same ORF used for uranium (0.001) was applied to RaLa data. RaLa is apparently not a high priority radionuclide compared to plutonium or uranium.

Mixed Fission Products (MFP) data begin in 1961 and are continuous until 1996. Their variability is quite high, with a maximum priority index of approximately 10^{15} and a minimum of 10^{10}. It is believed that the main source of MFP radionuclides was the Omega reactor. In some years, like 1969, 1972, 1973, and 1994, the MFP activity was reportedly much higher than normal. The reasons for these elevated values have not yet been explored.

Mixed Activation Products (MAP) make up the the largest portion of the airborne radioactive releases after 1973. Reactors and large accelerators produce MAP radionuclides. At Los Alamos, this would mean the majority of the MAP would come from TA-53 and the Los Alamos Meson Physics Facility (LAMPF), now called Los Alamos Neutron Science Center (LANSCE). Although LAMPF started operations in 1971, no pre-1976 data were found for MAP. The maximum priority index for MAP was 10^{18} and the minimum was 10^{16}.

The current results indicate that, based on LANL compilations of releases, plutonium and uranium would be of primary concern up until the early 1980s. From then until the present, the MAPs would be of primary concern. However, in some cases, limited or no data were found in LANL compilations of releases for important nuclides such as plutonium (early D Building data), polonium, pre-1967 tritium, all nuclides pre-1950, and non-point source emissions.

Prioritization of Liquid-Borne Radionuclide Releases

Since 1944, many operations involving radionuclides have been performed at LANL, and liquid-borne wastes of various kinds have been released. Priority Indices for liquid-borne radionuclides were calculated for: total plutonium, ^{238}Pu, ^{239}Pu, ^{89}Sr, ^{90}Sr, tritium, gross alpha, and gross beta radioactivity. LANL also reported the following radionuclides at various times over the years; effluent data were tabulated but priority indices are not presented herein for Ba/La-140 (radioactive lanthanum), ^{227}Ac, ^{241}Am ^{7}Be, ^{134}Cs, ^{137}Cs, ^{57}Co, ^{60}Co, ^{54}Mn, ^{22}Na, ^{83}Rb, ^{84}Rb, ^{75}Se, ^{85}Sr, and ^{88}Y.

Priority Index (PI) was calculated by computing the volume of liquid that would be required to dilute the annual activity released to be equal to the worst-case non-occupational Maximum Permissible Concentration (MPC) per federal regulations. This priority index is intended to be a guideline to determine if a nuclide set requires further iterations of calculation and refinement, or if it warrants lower priority relative to other nuclides. For example, a PI of 10^6 indicates that 10^6 mL of liquid (water) would be required to dilute the released material to a concentration equal to the MPC.

Plutonium liquid effluent data throughout the years have been reported as Pu, ^{238}Pu, or ^{239}Pu. The priority indices for plutonium range from approximately 10^{10} to around 10^{14}. Priority index values for strontium range from 10^9 to 10^{12} and PI values for tritium range from 10^8 to 10^{11}. It is important to note, however. that reported liquid releases of tritium date back to the 1940s, while the LANL compilations for tritium releases to the atmosphere were not identified for years prior to 1967. Appendix D further discusses operations involving tritium and the potential magnitude of releases before 1967.

Effluent values for other reported radionuclides are included in this report. PI values calculated for these radionuclides ranged from 10^7 to 10^{11}, except for one ^{227}Ac value at 10^{14} and several ^{241}Am values of 10^{12}. There were a number of these radionuclides present, but none in concentrations that would yield a greater approaching that for plutonium. The information for these “other” radionuclides is included for completeness.

The current results indicate that, based on this study of liquid-borne effluent data reported by LANL, plutonium would be of highest concern for liquid-borne radionuclides.

Measurements of Plutonium in Soil as Indicators of Historical Releases

Although LASL began operations in 1943, LANL compilations of historical releases include no effluent measurements from before 1951. In 1951, releases were likely substantially reduced over those of the 1940s. Effluent monitoring was of lower quality (as compared to more modern measurements) until the mid-1950s. During these early years, LASL was the lead site for production of U.S. nuclear weapon components, as the Hanford Plutonium Finishing Plant began operations in 1949, and Rocky Flats started operations in late 1952.

Since the 1970s, measurements of plutonium concentrations in soil have been performed by LANL for the purpose of evaluating potential doses to members of the public. Because of the lack of effluent measurements from 1943 to approximately 1950, the LAHDRA team has applied several methods to gain information about the potential magnitude of historical plutonium releases. Measurements of plutonium in soil around LANL are potentially useful indicators of past releases. Members of the project team have performed several iterations of calculations to estimate the total integrated airborne plutonium release that would be consistent with the environmental record of plutonium found in soil samples in the Los Alamos area.

The Radiological Safety Analysis Computer program (RSAC version 6.2) was run with Los Alamos meteorological data to calculate ^{239}Pu deposition at various distances in each direction from a unit release (1 curie) of ^{239}Pu over 50 years. The calculated deposition at each distance was converted to a soil concentration based on the annular area involved and the soil density and sampling depth reported by LANL. The ratio of each measured soil concentration to the concentration calculated for that same area from the RSAC modeling of a unit release yielded a factor that corrects the unit source in RSAC to give agreement between the soil data and the RSAC results. For example, a ratio of 15 would indicate that 15 curies of plutonium was released rather than 1 curie.

For this prioritization assessment, results of 697 soil sample analyses near LANL were evaluated. A total uncertainty for each soil sample was calculated, and only those measurements with uncertainty in the plutonium-to-cesium ratio less than 25% were used. This resulted in a data set with 119 members. The plutonium-to-cesium ratio was studied, and the Pu/Cs ratio was used to select a 37-sample subset of the 119 samples previously selected for low uncertainty. These samples lie within 5.5 kilometers of either DP Site or D Building, the main locations of early plutonium processing. The results from use of these 37 samples were less dependent on the assumed background from fallout, since the values for plutonium were higher and the background is a smaller percentage of the value.

The results indicate that, if the release was attributed to the DP Site, an average of 60 curies and a median of 12 curies were obtained with a geometric standard deviation (factor of uncertainty) of 9. Based on application of “log-normal” distribution statistics to the data (log-normal distributions look like “bell-shaped curves” that are stretched toward larger values), the above values mean that we expect (at the 95% confidence level), the answer to be between 60 ÷ (2x9) = 3 curies and 60 x (2 x 9) = 1080 curies. We expect the true release total to be between the average divided by two-times the geometric standard deviation and the average multiplied by two-times the geometric standard deviation. The median value of 12 indicates that half of the release totals estimated from soil data fell below 12 curies, and half fell above 12 curies.

If the site releases were attributed solely to the D Building, an average of 101 curies and a median of 46 curies were obtained with a corresponding geometric standard deviation (factor of uncertainty) of 5. The smaller uncertainty for D Building suggests that large and previously undocumented releases from D Building likely occurred.

During 2005, the LAHDRA project team and LANL scientists began a collaborative effort to resolve differences in calculations of early plutonium releases. A meeting was held in August 2005 at which LAHDRA team members and LANL scientists aired their differences and created some action items towards improving estimates of plutonium releases. At this meeting, the LAHDRA team described newly-located stack monitoring data from DP West from the point that it became operational. In the course of this collaboration, an error was found that reduced the Project Team estimates by an order of magnitude (4.6 Ci from D Building and 1.1 Ci from DP Site). It has been agreed that the LANL estimate of 1.2 Ci released needs to be modified with “filter burial” and “sample line loss” factors, which will bring the LANL estimate to almost 5 Ci. The CAP88 and RSAC data results for similar input parameters appear to be reasonably close in value. New data (drawings of DP Site, etc.) are being used to determine appropriate values for other modeling parameters. Other LANL employees are also being interviewed to gain new insights, and another dispersion model (AERMOD) may be used to gain further insight, as it uses complex terrain modeling. It is expected that the model described in this report will be re-run during 2006 with the new data from RSAC and CAP 88 to yield updated release estimates.

Analysis of Measurements of Plutonium in Body Tissues of Los Alamos Residents

The human tissue analysis program was a 35-year effort by LANL to study the levels of plutonium in workers and in the general population of the United States. The general population was exposed to plutonium from atmospheric testing of nuclear weapons. Populations located near plutonium facilities, such as the D Building and DP Site in Los Alamos, were also exposed to plutonium released during operations. Compilations of the data have been published periodically, and the Los Alamos Science magazine summarized the program in the November 23, 1995 issue that was devoted to a discussion of the Human Radiation Experiments.

The LAHDRA team is attempting to prioritize off-site releases from LANL. Some of the data from the 1940s are not available as effluent (stack) measurements, but rather as room air concentrations. Even these data may not be available for all time periods. In addition, both D Building and DP Site facilities were operated at least in part at positive building pressures. This would tend to increase non-point source (non-stack) emissions as compared to modern plutonium processing buildings. The human tissue analysis program data, even if the data did not show any added plutonium in tissue over that expected from global fallout, might provide an alternative means to place an upper bound on the potential plutonium source term from LANL.

The LAHDRA team performed an analysis of human tissue sample data using data from a 1979 Health Physics journal paper. A public records search was conducted for information on persons in the HP journal article from Los Alamos. The ratio of deposited plutonium in the lung vs. that in the vertebrae was calculated for each individual. The standard deviation of Pu Ratio was plotted for the populations of Los Alamos and Denver, and several conclusions were drawn about the individual cases in Los Alamos and potential exposures.

There were 97 non-LANL-worker resident autopsy cases for Los Alamos and White Rock. Of these, 24 were easily identified from cemetery records with at least three of the attributes positively matched (Los Alamos non-worker resident, sex, age and year of death). Most also had some notice in the Los Alamos Monitor, which added to the information, at times including a cause of death that could be matched. In addition to the 24 uniquely matched cases, an individual could not be uniquely established for two of the autopsy cases. For these two cases, one of two cemetery records could match the data. These duplicate assignments are also carried in the data set for a total of 28 addresses (that is, 26 total people with 28 address sequences where 2 of the addresses are just possibilities). Although the suspected persons have been matched to case numbers from the 1979 *Health Physics* article, the names have been redacted in this work to protect privacy.

The calculation demonstrates that excess plutonium is present in non-worker residents of Los Alamos over what would be expected from global fallout from nuclear weapons testing. It also establishes and tests a method for uncovering the history of residence locations for autopsy cases. This history establishes the range and bearing from LANL release points along with the years of occupancy at each residence. This method could be used to reduce the uncertainty in retrospective dose reconstructions and possibly permit use of the autopsy data for bounding LANL releases.

Prioritization of Chemical Releases

Operations at LANL have involved many non-radioactive materials, including metals, inorganic chemicals, and organic chemicals including solvents. For the sake of simplicity in this report, we will refer to these materials as “chemicals”. Prior to the 1970s, uses of chemicals and their ultimate fate were poorly tracked and documented compared to radionuclides. One particularly challenging portion of the LAHDRA project, for this reason,

has been the collection of information concerning historical uses of chemicals, identification of those that were most likely released off site, and determination of which chemicals have been most important in terms of potential off-site health hazards. The sources of information about chemical usage at LANL that have been most useful to the LAHDRA team include a modern-day chemical inventory, historical chemical inventories, and various types of LANL site documents.

Preliminary review of a modern-day chemical inventory database indicated that 37 chemicals were each present onsite at 250 or more individual locations and therefore represented the largest onsite quantities. Twelve of the thirteen chemicals present onsite in the highest quantities do not have USEPA recommended toxicity values for potential cancer and non-cancer systemic health effects, although some can be irritants or corrosives at high concentrations. These 37 high quantity chemicals were ranked in order of decreasing estimated on-site quantities. Of the 37 high quantity chemicals, the 13 with USEPA recommended toxicity values were also order of generic toxicity, "1" being more toxic than "13". Generic toxicity includes both cancer and non-cancer chronic health effects with no bias toward any route of potential exposure (e.g., inhalation, ingestion, and dermal contact) or to any potential environmental exposure medium (e.g., air, soil, water, food products) since little is known about how the chemicals were used and the potential for off-site release.

Attempts to locate earlier chemical inventories have not been successful. Based on historical documents that were reviewed, however, a list of chemicals documented as having been used at LANL at some point in time was prepared. Other tabulations that were prepared based on historical records include:

- a compilation of quantities of chemicals used or released historically from LANL
- reported estimates of quantities of high explosives used from 1944 through 1945
- an effluent summary for group GMX-7 that includes several explosives dispersed at TA-40 as gaseous detonation products during the period July – September 1971
- estimates of toxic materials dispersed by GMX Division shots for April and May 1971

USEPA Region 9 Preliminary Remediation Goals (PRGs) are target cleanup levels based on conservative assumptions regarding direct exposure to soil through ingestion, dermal contact and inhalation, and direct inhalation of vapors and particulates. PRGs are based on cancer as an endpoint if available cancer potency factors ("slope factors") result in a more conservative (lower) PRG than would result based solely on evaluation of non-cancer health effects. As a first step towards prioritization of potential chemical releases, PRGs for chemicals used and possibly released historically from LANL were used by the LAHDRA team to rank the potential of various chemicals to result in adverse health effects to off-site populations. The lower a PRG, the higher the potential for off-site health effects if the compound were released beyond the site boundary– this preliminary ranking does not address actual quantities released or whether real exposures occurred; however, these factors will be considered as the prioritization process advances.

PRGs for soil were used to rank chemicals usually present in the environment as particulates, and PRGs for air were used to rank volatile chemicals. Both soil and air PRGs were considered for explosives. Toxicity factors are not available for some chemicals used at LANL, and estimates of quantities used have been identified through systematic document review for only a subset of those chemicals with published toxicity factors. Estimates of quantities of a material used on an annual basis are in some cases available. "Annual use" is typically the highest known annual usage of a compound from available data, and in some cases may be based on a single year for which data are available.

Reported values are often presented as quantities used, issued, lost, or released, and it is not always clear how the quantities were determined.

A ranking of Los Alamos chemicals based on PRGs for soil is presented, as is a ranking based on PRGs for air. A final table presents a ranking based on a factor equal to the annual usage (in kg) divided by the cancer potency slope factor or multiplied by the non-cancer reference dose (mg/kg-d). The analysis reflected in these tables suggests that historical releases of explosives and volatile organic chemicals from LANL operations have the greatest potential for producing off-site health effects.

Development of Housing Areas in Los Alamos

Evaluation of off-site exposures from activities at Los Alamos technical areas will require documentation of the development of nearby residential areas over time. While it was initially thought that the 31 houses commandeered from the Los Alamos Ranch School and Anchor Ranch would provide sufficient housing for the projected staff of 30 scientists and their families, it soon became clear that the scope of the challenge to provide housing for Los Alamos residents had been severely underestimated. The scarcity of housing in Los Alamos was problematic during World War II and for years to follow. Hiring at the Lab was at times severely restricted because there was nowhere for new employees to live. This pressure to provide housing and the limited availability of suitable land in the region of finger-like mesas and canyons led to the development of housing that in some cases was much closer to operational areas than has become customary for government facilities that undertake processing of nuclear materials and high explosives and/or operation of devices such as reactors or high-energy particle accelerators.

Based on reviews of historical documents performed to date, a nine locations have been identified as being among the sites where historical operations took place that appear to warrant evaluation in terms of potential off-site releases or health effects. The LAHDRA project team is collecting maps, photographs, and historical documents that describe the history of development of each Los Alamos housing area. For each of the nine locations of interest, the following parameters are being evaluated to support evaluation of the potential for public health effects:

- The distance from the area to housing areas that were in place during the period that associated operations were active,
- The direction from the location to each housing area, and
- The prevalence of winds from the location toward each the housing area.

Appendices to this Interim Report

The information outlined below is contained in appendices to this Interim Report. These appendices are intended to present additional details to support the summaries and assessments contained in the body of the report and to describe the public involvement program that was active throughout the project.

- Appendix A: Key Operational Area– Plutonium Processing
- Appendix B: Key Operational Areas– Uranium, Fission Products, Radium, Polonium, and Barium/Lanthanum
- Appendix C: Key Operational Areas– Reactors
- Appendix D: Key Operational Areas– Tritium

- Appendix E: Key Operational Areas– Beryllium
- Appendix F: Key Operational Areas– High Explosives
- Appendix G: Key Operational Areas– Accelerator Operations
- Appendix H: Key Operational Areas– the LANL Health Division
- Appendix I: Key Operational Areas– Environmental Monitoring
- Appendix J: Listing of Airborne Release Points
- Appendix K: Rules for Specifying Dates and Names in Database Records when Incomplete Information is Available
- Appendix L: Partial Chronology of Accidents and Incidents
- Appendix M: Summaries of Public Meetings Held by the LAHDRA Project Team

Chapter 1: Introduction to the LAHDRA Project

The Los Alamos Historical Document Retrieval and Assessment (LAHDRA) project began in early 1999. It is being conducted by the Centers for Disease Control and Prevention (CDC), National Center for Environmental Health. Much of the work of the project was conducted by contractors to CDC, namely ChemRisk Inc., Shonka Research Associates Inc., ENSR Corporation, and Advanced Technologies and Laboratories International, Inc.

The primary purpose of the LAHDRA project is to identify the information that is available concerning past releases of radionuclides and chemicals from the government complex at Los Alamos, New Mexico. Sited in northern New Mexico and owned by the Department of Energy, the Los Alamos facilities have been managed by the University of California since 1943, when "Project Y" was born as part of the Manhattan Project to create the first atomic weapons. Project Y became known as Los Alamos Laboratory, and its name changed to Los Alamos Scientific Laboratory in 1947 and then to Los Alamos National Laboratory in 1981. For sake of simplicity in this document, we will refer to LANL for all time periods. LANL's responsibilities have expanded since the wartime years, to include thermonuclear weapon design, high explosives and ordnance development and testing, weapons safety, nuclear reactor research, waste disposal or incineration, chemistry, criticality experimentation, tritium handling, biophysics, and radiobiology.

LANL operations have not proceeded without health hazards or environmental impacts. Approximately 30 people have been killed in incidents including criticality experiments and accidents with high explosives. Significant quantities of plutonium, uranium, and a wide variety of other toxic substances have been processed and released to the environment in quantities that in some cases are not well known. The project team is investigating the materials used throughout LANL's history of operations to identify and prioritize releases in terms of their apparent relative importance from the standpoint of potential off-site health effects. Based on the project's findings, CDC will work with stakeholders to determine if more-detailed assessments of past releases are warranted. Should additional investigations be warranted, they might be in the form of screening-level evaluations, or could progress to detailed dose reconstruction for those releases of highest priority.

In more specific terms, CDC's model of dose reconstruction involves a process that can be broken up into as many as five phases:

- Retrieval and Assessment of Data
- Initial Source Term Development and Pathway Analysis
- Screening Dose and Exposure Calculations
- Development of Methods for Assessing Environmental Doses
- Calculation of Environmental Exposures, Doses, and Risks

CDC has completed various stages of this process at INEEL, Savannah River, and Los Alamos. Various stages of the process may overlap in time, and stages may be performed iteratively. All stages may not be necessary at all sites. Each stage involves CDC staff, contractors, and the public. The CDC project at Los Alamos is in the initial, information-gathering phase. The process of information gathering and assessment is partially complete.

The Products of the LAHDRA Project

The products of the LAHDRA project include:

- This Interim Report
- A database that contains bibliographic information and summaries of the content of relevant documents that were located by the project team.
- Sets of copies of the most relevant documents, to be made available by DOE in a reading room in Albuquerque.
- A collection of electronic document images, as Portable Document Format (PDF) files, of all documents for which paper copies or electronic files were obtained.
- A chronology of incidents and off-normal events identified in review of reports prepared by Los Alamos' Health Division.

The Project Information Database

A Microsoft® Access database was created to store the information reviewed and collected during this project. The CDC defined the basic database structure and values of many of the fields at the onset of the project. Throughout the project, a few additional fields were added to the database based on analyst and staff comments, the changes being mostly for administrative use. The latest revision of the database was V3-9-0032. A user-friendly front-end was developed for use by the project analysts for reviewing the information collected. The database includes a form created for entering the information from the document summary forms (DSFs) filled out by document analysts in the field, and also a form to perform searches on all the information that has been entered. In the search form, users can search on every field on the DSF. Users can choose to see the results of the search either in a report format or in HTML format. HTML format provides users with hyperlinks to open the documents associated with the DSF in a scanned searchable image format called portable document format (PDF).

As each DSF was entered into the project database, it was assigned a unique sequential Repository Number. This designation was used to track the information throughout the remainder of the project. Many of the reference citations in this report include repository numbers, often abbreviated "Repos. No." Note that a repository number may represent a number of related, individual documents.

The project database has been made available to the public by placing it in three regional libraries: the Zimmerman Library at the University of New Mexico in Albuquerque, the Mesa Public Library in Los Alamos, and the Northern New Mexico Community College library in Española. Users may search the bibliographic information captured on the document summary forms and perform full-text searches of the documents which have been scanned to PDF.

Figure 1-1: One of several sets of copies of documents selected by the LAHDRA team

Copies of Documents Obtained by the Project Team

The project repository contains paper copies of documents selected as relevant by the project team and released by LANL. This repository currently contains over 235,270 pages of documents. These documents are arranged sequentially by Repository Number. A duplicate set of the project's document repository is maintained at the Zimmerman Library at the University of New Mexico in Albuquerque. This location was selected by the U.S. Department of Energy as the official Public Reading Room for this Project.

The Zimmerman Library is located on the University of New Mexico's (UNM's) main campus. The library's Government Information Department is a regional depository for government documents. Documents can be requested at the information desk, and photocopies can be made at a nominal cost using copy machines in the immediate area.

Figure 1-2: Dan Barkley of UNM discusses project records at Zimmerman Library in Albuquerque with CDC project staff

Directions to the Public Reading Room at the University of New Mexico:

Head east from the Central Avenue exit from I-25. Continuing east on Central Avenue, pass through the signal at University Avenue. UNM will be on the left. The third light after University Avenue will be Stanford Drive. Take a left on Stanford Drive to enter the UNM campus. Take another left at the "T." On the right will be Visitor Parking. After parking, head north and slightly west across campus. Zimmerman Library is just northwest of the Student Union Building. The Government Information Department is located in the basement of the library.

Contact: Dan Barkley, phone: (505) 277-7180, fax: (505) 277-6019; barkley@unm.edu

Document Images

As the number of paper copies grew and scanning technology matured, it was decided that a better way to preserve and present the reference material being collected by the LAHDRA team would be as scanned images. Ultimately, all of the information was scanned in as PDF files and an Adobe Acrobat full text search capability was developed.

Figure 1-3 depicts the progression of a document from preparation of a handwritten DSF through input into the Access database with a link to the document image file.

The documents are scanned using a high-speed, high-capacity scanner running at 50 pages per minute in simplex mode or 45 pages per minute in duplex mode. Images may be scanned to a maximum resolution of 600 dpi, however, a resolution of 200 dpi is typically used. This resolution provides a good compromise between image quality and file size.

The scanning software used includes a proprietary "VirtualReScan" (VRS) feature, which allows mixed batches of documents to be scanned without adjustments. VRS technology automatically detects, de-skews, crops and brightens images as needed regardless of document shape, size and color.

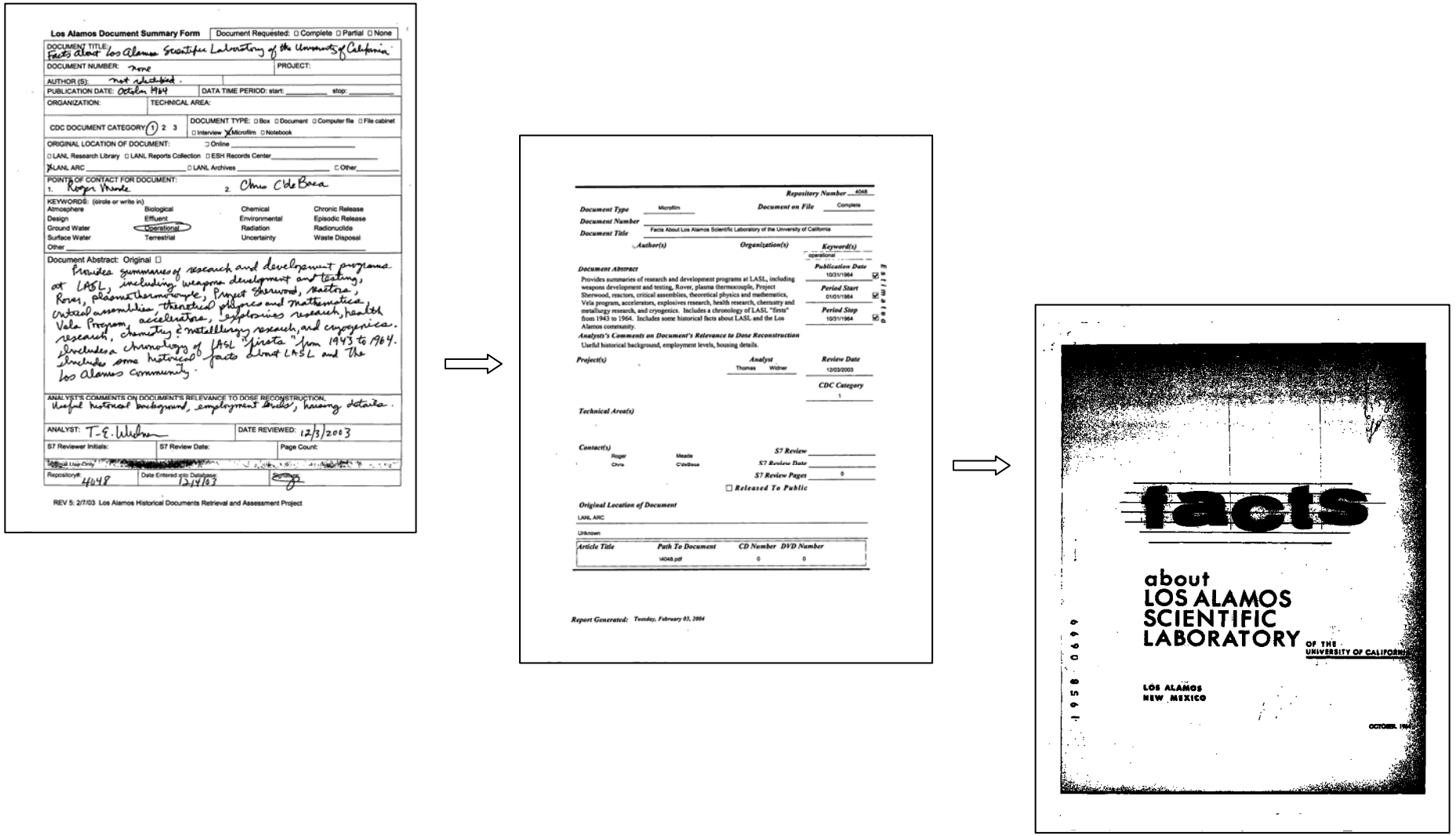

Figure 1-3: Original DSF, Access Database DSF, Original Document PDF

After the documents are scanned to optimized, interim image files, Adobe® Acrobat® Capture® is used to convert the images to searchable PDF files. The Capture® software applies optical character recognition (OCR), advanced page and content recognition, and powerful cleanup tools to convert the paper-based information into electronic documents of optimal quality.

Once documents are scanned to searchable PDF files, they are indexed using Adobe® Acrobat® Professional's Catalog tool. The Catalog tool generates an index definition file, which provides for efficient full-text searching across all of the PDF files in the index.

Currently all documents in the project repository have been scanned to PDF files. The project database and the PDFs can be stored on two DVDs for installation on a host computer. A "Readme" file is included with each software installation with instructions on how to install the database and how to perform these searches. The full-text search capability across all of the documents retrieved to date provides a powerful augmentation to the bibliographic search capabilities of the Access database. However, due to the poor quality of some of the documents retrieved, the OCR process can miss individual words or passages of text. Thus it is important both the bibliographic and full-text search capabilities be used to find information of interest. Some manual verification and correction of the OCR process has been performed, but this effort is limited by budget constraints.

Chronology of Incidents and Off-Normal Events

Progress reports issues by the Los Alamos Health Division (H Division) are particularly useful sources of information about operations, releases, episodic events, and accidents involving radionuclides and other toxic materials. The LAHDRA team has made a concerted effort to obtain as many H-Division progress reports as possible. The project information database currently contains summary data for hundreds of H-Division progress reports. At present, these reports cover a date range from 1947 to 1963, with some additional reports issued in the early 1980s. Most of the reports cover a one month period, though there are also annual reports and, in later years, quarterly reports. The monthly reports were discontinued in September of 1964 in favor of quarterly reports.

A chronology of episodic or off-normal events described in these reports will be a valuable resource for depicting historical release pathways, particularly in describing mechanisms for fugitive emissions and other unmonitored pathways that might otherwise go unaccounted for. And for hazardous chemicals, the anecdotal information contained in many H-Division reports makes up a large part of what we know about historical usage and actual or potential releases.

The review of H-Division reports was begun by the LAHDRA project team during 2004, but was not completed before project work was suspended. Now that work has resumed, this effort has continued as an element of the prioritization process as document search and retrieval progresses. The latest available version of a chronology of episodic or off-normal events, based on reports that have been reviewed as of the date of release of this report, is presented in Appendix L. Each event is described briefly, and Repository Number and page number references are provided.

The H-Division progress reports were compiled by the Division Leader and contained information submitted by the leaders of the individual groups that made up the Health Division at a given time. While the material they provide is largely of a summary nature, the reports are nonetheless detailed and provide an array of information. Collectively, the

reports provide a chronology of laboratory operations with an emphasis on experience with hazardous materials. They cover the breadth of what are now known as health physics and industrial hygiene, and provide information in a number of areas of interest to the LAHDRA Project, including:

- materials (contaminants) of concern (radionuclides, chemicals, and explosives)
- instrumentation issues
- monitoring/sampling of waste streams/effluents
- monitoring of special (short-duration) programs and experiments
- unmonitored releases and fugitive emissions
- environmental monitoring
- episodic events and incidents involving spread of materials to private property or members of the public
- facility operations (including ventilation system issues, modifications, etc.)
- waste disposal practices and issues

Of particular note is the fact the reports provide information on various chemicals and compounds that were being utilized at various times, where the materials were being used, and what they were being used for. While this information is largely qualitative, it still provides a valuable resource for prioritization of non-radioactive hazardous materials for time periods for which such information is scarce. The reports also yield valuable information regarding sources of unmonitored releases and fugitive emissions that are always difficult to evaluate in retrospective assessments.

Beyond the specific information contained in the individual H-division progress reports, the continuity of the information they provide collectively (the monthly reports in particular) gives insight into chronic and recurring concerns that may not have been apparent at the time. Applied retrospectively, this information can be used to advance both the document search tasks and the evaluation of information obtained relative to off-site releases and potential effects.

The Contents of this Report

This Interim Report represents a summary of information that has been obtained by the LAHDRA project team regarding:

- historical operations at Los Alamos,
- the materials that were used,
- the materials that were likely released off site,
- development of residential areas around Los Alamos, and
- the relative importance of identified releases in terms of potential health risks.

The information in this report was obtained from records reviewed at Los Alamos by the project team, some books and reports that are publicly available, and some interviews with past and current Los Alamos workers.

Preparation of LAHDRA project reports has been an iterative process. A preliminary draft report was issued in February 2002, so that interested parties could see the types of information the LAHDRA team was finding, be introduced to the approaches being taken to interpret the information that was found, and offer comments and criticism as to how the report could be improved as work progressed. A Draft Interim Report and then an Interim Report were issued in 2004, as the first LAHDRA contract came to a close.

While millions of documents have been reviewed at Los Alamos, the information gathering is not complete. For various reasons that will be discussed later in this report, document review at Los Alamos has taken significantly longer than expected. There are now known to be significantly more documents at LANL than was originally estimated, and the processes for access to classified documents and for public release of relevant documents have been more complicated and time consuming than was expected.

Based on the findings of the ongoing information gathering process, which are summarized in this report and evidenced in the project information database, CDC will work with stake holders to evaluate whether historical releases for radionuclides or other toxic materials from Los Alamos operations warrant more detailed evaluation.

Figure1-4: An early photo of the main gate into Los Alamos

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