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Interim Report of the Los Alamos Historical Document Retrieval and Assessment (LAHDRA) Project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

The Los Alamos Historical Document Retrieval and Assessment (LAHDRA) project began in early 1999. It was conducted by the Centers for Disease Control and Prevention (CDC), with much of the work of the project conducted by contractors to CDC, namely ENSR Corporation and subcontractors Shonka Research Associates Inc., ChemRisk Inc., and Tech Reps, Inc. The primary purpose of the LAHDRA project was 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 draft 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, and
- the relative importance of identified releases in terms of potential health risks.

The information in this draft 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. For various reasons that are discussed 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. The funding allotted to the contract between CDC and ENSR Corporation, the prime contractor for the LAHDRA project, is nearing depletion. As CDC contracting rules will not allow the cost ceiling of the contract to be substantially increased, CDC instructed the project team bring information gathering at LANL to a close within remaining contract funding. Based on the findings of the information gathering to date, which are summarized in this report and evidenced in the project information database, and on the extent of progress made with DOE and LANL concerning remaining issues of information access, CDC will evaluate whether to competitively procure another contract to continue towards completion of information gathering and assessment at Los Alamos.

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; 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 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 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.

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 and has not yet been reviewed by LAHDRA analysts. As of the pause in active document review, approximately 200 boxes of documents and 2,000 rolls of microfilm received before calendar year 2000 remained to be reviewed at the LANL Records Center.

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.

In addition, access to classified reports issued by any of the following entities with publication dates after 1962 has been denied since 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.

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.

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. 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 has reviewed less than 1% of 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. The original plan was for LAHDRA analysts to review the hardcopy indices of the LCLS database and select documents for review. These documents would then be made available to LAHDRA analysts by Legal Counsel staff. In early 2004, the LAHDRA team was denied access to the actual documents included in the LCLS database because LANL had insufficient funding to support an on-site review of the collection while the backlog of records at the Records Center was being processed. Therefore, only the database listing was reviewed.

Challenges to 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

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 priority indices are slightly higher in this assertion for the pre-1975 era, since these years 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 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. 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 as compared to nuclides.

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 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, Pu-238, Pu-239, Sr-89, Sr-90, 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), Ac-227, Am-241, Be-7, Cs-134, Cs-137, Co-57, Co-60, Mn-54, Na-22, Rb-83, Rb-84, Se-75, Sr-85, and Y-88.

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, Pu-238, or Pu-239. 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 Ac-227 value at 10^{14} and several Am-241 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. However, it should be noted that, in general, liquid-borne releases appear to warrant lower priority than airborne releases, and pathways for public exposure from these liquid releases appear to have not been as complete as those for airborne releases.

Measurements of Plutonium in Soil as Indicators of Historical Releases

Although LASL began operations in 1943, no documents have been found by LAHDRA analysts that show that LANL actually measured airborne plutonium releases at all until 1951, when releases were 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 Pu-239 deposition at various distances in each direction from a unit release (1 curie) of Pu-239 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. 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. If the data are used to compute an average (rather than median), airborne plutonium release estimates range from 60 (DP Site) to 101 curies (D Building) based on the 37 samples.

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 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 number from the McInroy 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.

Appendices to this Interim Report

The information outlined below is contained in appendices to this draft 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: Summaries of Public Meetings Held by the LAHDRA Project Team
- Appendix L: Rules for Specifying Dates and Names in Database Records when Incomplete Information is Available

Introduction to the LAHDRA Project

The Los Alamos Historical Document Retrieval and Assessment (LAHDRA) project began in early 1999. It was 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 ENSR Corporation and subcontractors Shonka Research Associates Inc., ChemRisk Inc., and Tech Reps, Inc.

The primary purpose of the LAHDRA project was 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 is currently in 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 Contents of this Report

This draft 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 offsite, and
- the relative importance of identified releases in terms of potential health risks.

The information in this draft 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.

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.

At this time, however, the funding allotted to the contract between CDC and ENSR Corporation, the prime contractor for the LAHDRA project, is nearing depletion. CDC contracting rules will not allow the cost ceiling of the contract to be substantially increased. In April 2003, CDC notified ENSR that a decision had been made to have the project team bring information gathering at LANL to a close within remaining contract funding.

Based on the findings of the information gathering to date, which are summarized in this report and evidenced in the project information database, and on the extent of progress made with DOE and LANL concerning remaining issues of information access, CDC will evaluate whether to competitively procure another contract to continue towards completion of the information gathering at Los Alamos.

Overview of Historical Operations at Los Alamos

When the Los Alamos facility was initiated, it had a single mission— perfection of the design and manufacture of the first atomic bombs. The initial plan for the first atomic weapon was for a “gun assembled” device that would use slow-burning propellants, as shown in concept in Figure 1 (LANL 1983). Gun-assembled weapons may be designed on the principle of using a propellant to drive a mass of fissile material at a target of the same material to attain a supercritical assembly. To develop and build gun-assembled weapons, Los Alamos personnel initially experimented with use of enriched uranium (^{235}U) and plutonium as the fissionable material. Other materials that were needed included the explosive propellant, a detonator to set off that propellant, and precision machined housings to support assembly of the critical mass in the necessary configuration within the required time frame. Part of the housings were cases of heavy metal (such as uranium), called “tampers,” that confined the explosion, reflected some neutrons that would otherwise escape, and thereby decreased the “critical mass” of fissile material required to give rise to an atomic explosion (Serber et al., 1992).

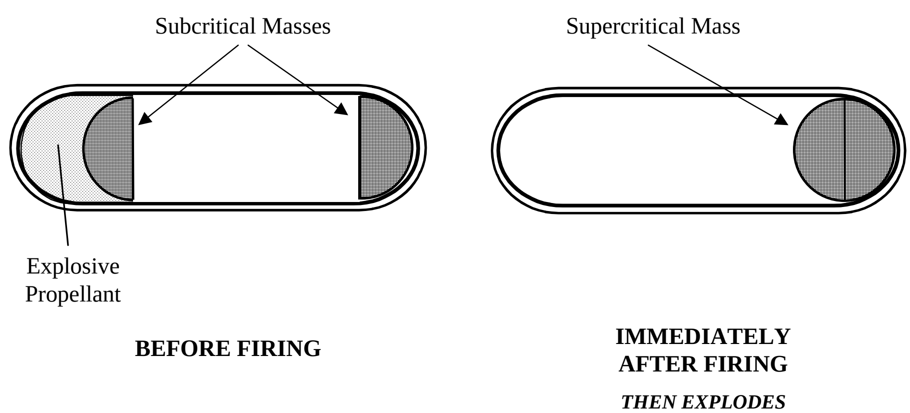


Figure 1: Concepts of a Gun-Assembled Atomic Weapon

Early development work centered on potential use of ^{235}U or ^{239}Pu in gun-assembled devices. Top priority was given to development of a plutonium-projectile gun device, with posed more problems than the uranium design due to tighter purity specifications and the need for a faster assembly velocity. In July 1944, it was found that the plutonium that was being received at Los Alamos would not work in gun-assembled weapons due to the presence of more of the ^{240}Pu isotope than expected amidst the desired ^{239}Pu. The spontaneous neutron emission rate from that plutonium was several hundred times greater than allowable. As a result, while research on the “certain to work” uranium gun device continued, development of a plutonium device shifted to an implosion-assembled design. A second design was needed because the delivery rate for enriched uranium would only support production of a single uranium weapon within the imposed schedule, and it was thought that more than one weapon would be necessary. Implosion-assembled weapons may be designed on the principle of squeezing (compressing) the fissile material to super-criticality by detonation of a high-explosive implosion system. The implosion type bomb is depicted conceptually in Figure 2 (LANL 1983).

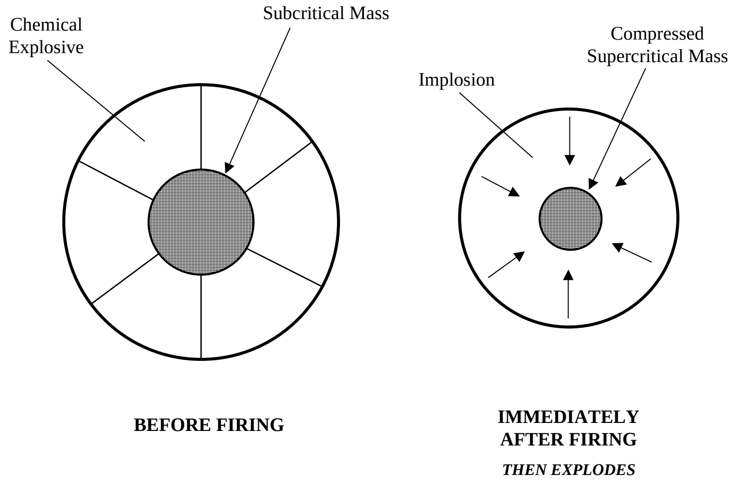


Figure 2: Concepts of the Implosion-Assembled Atomic Weapon

To develop and build implosion-assembled devices, much experimentation had to be done with getting chemical high explosives to precisely assemble something with great symmetry, in contrast to their typical uses in blowing things up. Work on high explosives centered on achieving precise timing of detonations at the surface of the explosive and use of “lenses” of a different explosive to focus the resulting shock waves on the metal sphere in the center of the device (Serber et al. 1992). In addition to fissionable material, high explosives, detonators, and tamper material, work on implosion-assembled devices included development of “initiators” that acted as strong sources of neutrons at the precise time that the supercritical masses came into position, to make sure that the fission chain reaction started when it had to. These initiators used materials including radium, beryllium, and polonium (Serber et al. 1992).

With the successful demonstration of fission devices, scientists were able to achieve the high temperatures necessary to bring about fusion of hydrogen nuclei for use in the “Super” bomb that had been studied for years as a theoretical possibility. Viewed by some as Los Alamos’ second historic mission, development of thermonuclear or “hydrogen” devices led to the first full-scale testing in the Mike shot in the Pacific in late 1952. Thermonuclear devices rely on a two-staged process, in which energy from a fission “primary” is contained and used to trigger a fusion or fusion-fission reaction in a physically-separate “secondary” portion of the device. These concepts of a staged thermonuclear weapon are shown in Figure 3 (LANL, 1983).

Materials needed for thermonuclear devices included many of those needed for a gun-assembled or implosion-assembled device, plus fuel for the fusion reaction. The first thermonuclear devices used liquid fuel, such as deuterium, that required significant developments in cryogenics in order to keep the fuel below its boiling point of –250 Celsius. Later devices used lithium deuteride fuel, in solid form, which “breeds” tritium when exposed to neutrons.

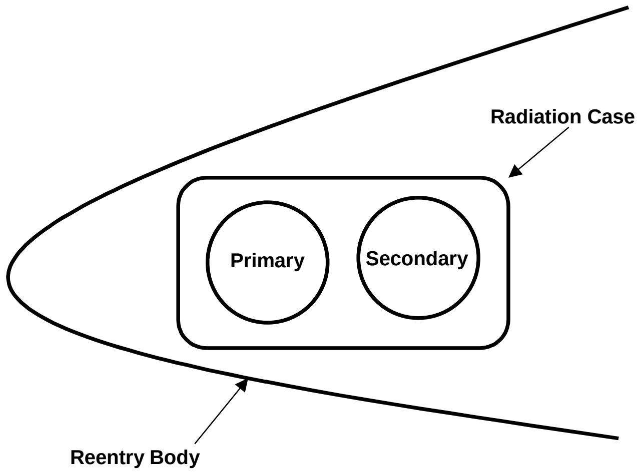


Figure 3: Concepts of a Staged Nuclear Weapon

After World War II, Los Alamos scientists and engineers were involved in development and testing of numerous designs of nuclear devices that were more and more powerful, compact, reliable, dependably deployable in the field, and contained in a variety of delivery vehicles suited to various combat objectives. They were involved in many tests of nuclear devices within the continental United States, in the Pacific, and in Alaska, including some that were part of the Plowshare program that aimed to develop peaceful applications for nuclear explosives.

Los Alamos was the lead site for U.S. nuclear component fabrication until 1949, when the Hanford Plutonium Finishing Plant in Washington began making “pits,” the central cores of the primary stages of nuclear devices (USDOE 1997). In 1952, the Rocky Flats Plant near Denver began making pit components. After 1949, Los Alamos was a backup production facility and designed, developed, and fabricated nuclear components for test devices. Pit production stopped at the Hanford facility in 1965, and the Rocky Flats Plant ceased operations in 1989. From time to time, Los Alamos was called upon to perform special functions in its backup role. For example, because of an accident at the Hanford Plutonium Finishing Plant in 1984, plutonium was sent in oxide form to Los Alamos for conversion to metal (USDOE 1997). Special activity at Los Alamos might also have occurred after major fires in plutonium facilities at Rocky Flats in 1957 and 1969.

Operations, facilities, and capabilities that were needed to support development and production of the various types of nuclear devices expanded in many cases to support other missions after World War II. Programs in chemistry, metallurgy, and low temperature physics expanded into nonmilitary development and fundamental research. For example, Los Alamos developed one of the largest experimental machine shops in the country. The Health Division grew significantly and expanded into many areas of health physics, industrial hygiene, medicine, safety, and biomedical research regarding people and radiation.

Early reactors that were built to confirm critical masses for fissionable materials and to study properties of fission and the behavior of resulting neutrons, were the forerunners of a variety of reactors that were designed and in some cases built and operated at Los Alamos. While some of these reactors served as sources of neutrons for various types of nuclear research or for materials testing, other designs were pursued for potential applications in power generation and propulsion of nuclear rockets into deep space. Some of the first significant steps towards controlled nuclear fusion as a power source were taken at Los Alamos, and the plasma thermocouple program explored methods for direct conversion of fission energy to electricity for potential application in propulsion of spacecraft.

Operations at Los Alamos have taken place in land divisions called Technical Areas, or TAs. Table 1 contains a listing of these Technical Areas, including some that have been abandoned, some that were combined with other TAs, and some that were cancelled before they ever became operational. Table 1 also contains listings of some of the various radioactive materials that are documented to have been used at each technical area, based on information reviewed to date. A similar tabulation of chemicals used at each technical area has not yet been compiled.

Figure 4 shows the locations of the modern-day Technical Areas, and Figure 5 presents a timeline of some selected operations and activities at (or related to) Los Alamos.

References

LANL 1983. "Nuclear Weapon Illustrations", Classification Bulletin No. 9. August.

Serber et al. 1992. "The Los Alamos Primer– The First Lectures on How to Build An Atomic Bomb." Contains an annotated version of report LA-1, "The Los Alamos Primer" (1943). University of California Press, Berkeley.

USDOE 1997. "Linking Legacies– Connecting the Cold War Nuclear Weapons Production Processes To Their Environmental Consequences." DOE/EM-0319. U.S. Department of Energy, Washington, DC. January.

Table 1: Los Alamos Technical Areas Past and Present

TA	Name and Description	Radioactive Materials Involved[a,b]
TA-0	Los Alamos Townsite: leased space in Los Alamos and White Rock for training, support, unclassified research and development, community outreach, museum	None
TA-1	Original Main Technical Area (inactive): 1943-65 active; turned over to Los Alamos County or private interest in 1966; all contamination removed by 1975	enriched U, DU, ^{238,239}Pu, ^{241}Am, ^{210}Po, ^{140}Ba, ^{140}La
TA-2	a.k.a.[c] Omega Site: Early critical assembly experiments. Water Boilers (1944-1974); Pu Fast Reactor, a.k.a. Clementine (1946–1950); and Omega West Reactor (1956-1992); reactors used for critical experiments up until 1946 when experiments were moved to TA-18. Omega Site reactors operations were then centered around neutron experiments and isotope production	^{235}U; ^{239}Pu; ^{131}I; ^{88}Rb; ^{137}Cs; ^{131}Xe; ^{125}I; ^{41}Ar, ^{3}H
TA-3	Core Area (a.k.a. South Mesa Site; active 1949 to present): detonator manufacturing, metallurgy burn pit, firing sites from 1943-49, Listed below are brief descriptions of key TA-3 operations.	^{238,239}Pu, ^{235,238}U, DU, U-natural, ^{210}Po,
TA-3-29	Chemistry and Metallurgy Research: actinide chemistry and metallurgy research since 1952 to present	^{239}Pu; ^{238}Pu; ^{235}U; ^{238}U, DU
TA-3-66	Sigma: materials fabrication since 1958; also –141 Rolling Mill, -35 Press Bldg, -159 thorium storage	^{235}U; DU
TA-3-1698	Materials Science Laboratory: processing, mechanical research	DU
TA-3-39,102	Machine shops: since 1953; Be in Bldg 39, DU in Bldg 102	DU
TA-4	Alpha Site: firing site until 1956; Material Disposal Area C	DU
TA-5	Beta Site: former firing site used extensively in 1945	DU
TA-6	Two-Mile Mesa Site: mostly undeveloped; detonator manufacturing and testing 1944-50	DU
TA-7	Gomez Ranch Site: former firing site used from 1944-47 for small explosive experiments with short-lived radionuclides	DU; unknown
TA-8	GT Site (a.k.a. Anchor Site West): gun firing sites 1943-45; explosives processing 1945-50; nondestructive X-ray testing 1950-present	^{239}Pu; ^{238}Pu; ^{235}U; DU; ^{60}Co; ^{192}Ir; ^{137}Cs; X-rays
TA-9	Anchor Site East (a.k.a. Anchor Ranch): firing areas; explosives research (active)	DU; ^{3}H
TA-10	Bayo Canyon: Radioactive lanthanum test shots 1944-61; Radioactive lanthanum radiochemistry 1944-50; site removed in 1963	^{90}Sr; DU; NU; ^{140}La
TA-11	K Site (active): implosion studies; later drop and vibration tests, dates unknown at this time	DU; ^{226}Ra, betatron
TA-12	L Site: explosives testing (1945-46); abandoned in mid-1950s	DU
TA-13	P Site: X-ray studies of explosives; later incorporated with TA-16, status unknown	X-rays, DU, ^{210}Po
TA-14	Q Site (active): explosives testing 1944-present	DU
TA-15	R Site: explosives testing; eight inactive firing sites (A-H, R44, R45); Pulsed High-Energy Radiation Machine Emitting X-Rays (PHERMEX) 1962-present; Dual-Axis Radiographic Hydrodynamics Test (DARHT) Facility	^{239}Pu; DU; ^{3}H; X-rays
TA-16	S Site (active): former explosives casting/machining operations; burning ground; Weapons Engineering Tritium Facility. Began in the 1950s	^{239}Pu; DU; ^{3}H; X-rays
TA-17	X Site (canceled)	None
TA-18	Pajarito Laboratory: criticality testing 1946-present; Rover 1955-73; Hydro assembly 1957	^{235}U; ^{239}Pu; ^{240}Pu; ^{233}U; MFP; ^{131}I; polonium; neutron
TA-19	East Gate Laboratory: released to U.S. Atomic Energy Commission in 1962	None

Table 1: Los Alamos Technical Areas Past and Present *(Continued)*

TA	Name and Description	Radioactive Materials Involved[a,b]
TA-20	Sandia Canyon Site: former firing site abandoned in 1957	DU
TA-21	DP Site: a.k.a. DP Mesa: former plutonium operations (DP West); uranium/polonium operations (DP East); Material Disposal Areas A,B,T,U,V; Tritium Systems Test Assembly, Tritium Science and Fabrication Facility (1945 to 1978)	^{239}Pu; ^{238}Pu; ^{240}Pu; ^{241}Pu; ^{241}Am; ^{235}U; ^{238}U; ^{210}Po; ^{227}Ac; ^{3}H
TA-22	TD (Trap Door) Site: detonator development; shops; disposal pits	DU
TA-23	NU Site: reduced firing load at TA-9 1945-50	Unknown
TA-24	T Site: X-ray studies of explosives; later incorporated with TA-16	X-rays, DU
TA-25	V Site: explosives assembly; later incorporated with TA-16	DU
TA-26	D Site: storage vault and guard building 1946-48; removed in 1966	^{3}H, ^{235}U; ^{233}U
TA-27	Gamma Site: plutonium gun assembly 1945-47	^{239}Pu, DU, thorium
TA-28	Magazine Area A (active): firing site 1979; explosives storage area	DU
TA-29	Magazine Area B: explosives storage area; abandoned in 1957	DU
TA-30	Electronics Test Area: electronics testing 1945-48	Unknown
TA-31	East Receiving Yard: 1948-54 warehouses W of airport; removed 1954	Unknown
TA-32	Medical Research Laboratory: bio-research facility; 1943-54; removed in 1954; incinerator use included	Unknown
TA-33	HP (Hot Point) Site: 1948-56 shaft experiments; High Pressure Tritium Laboratory 1970s; Material Disposal Areas D, E, K	^{3}H
TA-34	New Laboratory Warehouse Area (canceled)	None
TA-35	Ten Site: Radioactive lanthanum 1951-63; Los Alamos Power Reactor Experiment (LAPRE) I/II 1950s; Los Alamos Molten Plutonium Reactor Experiment (LAMPRE) I 1960s; laser fusion research 1974	^{3}H; ^{90}Sr; ^{140}Ba; ^{140}La; ^{235}U; DU; ^{237}Np; Pu; Po; Co; VFP
TA-36	Kappa Site: replaced TAs-9, 23, 12 in 1950; four active firing sites; non-nuclear ordnance and armor	DU
TA-37	Magazine Area C (active): explosives storage area	DU
TA-38	Monterey Site (canceled)	None
TA-39	Ancho Canyon Site: five firing points; incinerator 1955-60; photographic study of the behavior of non-nuclear weapons	NU; DU; thorium
TA-40	DF (Detonator Firing) Site: six firing points; detonator development	^{3}H
TA-41	W (Weapons Group WX) Site: engineering of nuclear components; fabrication of test materials	^{3}H; plutonium; uranium; americium
TA-42	Incinerator Site: for low-level Pu contaminated waste; abandoned 1970	All
TA-43	Health Research Laboratory: biological research 1953-70; replaced TA-32	All
TA-44	Los Angeles Shop: experimental machine shop in Los Angeles, CA 1949-58; abandoned in 1958	Unknown
TA-45	Radioactive Liquid Waste Treatment Plant (inactive): removed majority of plutonium before discharge to Acid Canyon	$^{238/239}$Pu, $^{235/238}$U
TA-46	WA Site: Rover batteries 1950-74; U isotope separation 1976-early 1980s; photochemistry research; lasers	^{235}U, ^{238}U thorium
TA-47	BR Site (Bruns Railhead): shipped materials via a railhead near Bruns Hospital in Santa Fe, 1943-58; abandoned in 1958	DU; unknown
TA-48	Radiochemistry Site: actinide chemistry and hot cell isotope production, area used for analyzing samples from weapon test shots, 1950s to present	U; TRU; MAP; MFP
TA-49	Frijoles Mesa Site: underground hydronuclear experiments 1960-61; now Hazardous Devices Team Training	^{3}H; plutonium; uranium
TA-50	Waste Management Site: treated liquid wastes before discharge to Mortandad Canyon; replaced TA-45,-35; controlled air incinerator 1976	All
TA-51	Environmental Research Site: animal exposure facility 1962; now studies of impact of waste and waste storage on the environment	^{60}Co, strontium
TA-52	Reactor Development Site: Ultra-High Temperature Reactor Experiment (UHTREX)	^{235}U; ^{238}Pu; ^{3}H; VFP; Kr; Xn

Table 1: Los Alamos Technical Areas Past and Present *(Continued)*

TA	Name and Description	Radioactive Materials Involved[a,b]
TA-53	Los Alamos Neutron Science Center (LANSCE)	^{3}H; ^{41}Ar; ^{7}Be; ^{11}C; ^{13}N; ^{15}O; U
TA-54	Waste Disposal Site: solid wastes; Materials Disposal Areas G, H, J, L	All
TA-55	Plutonium Facility Site (active): replaced TA-21; SNM storage, 1978 to present	^{239}Pu; ^{3}H
TA-56	Subterrene Basalt Site: melting basalt with electrically heated penetrator; abandoned in 1976	Unknown
TA-57	Fenton Hill Site: Hot Dry Rock geothermal project (inactive)	Unknown
TA-58	Two-Mile North Site: experimental sciences for TA-3 programs	Unknown
TA-59	Occupational Health Site: Office of Environment, Safety, and Health offices, emergency management	None
TA-60	Sigma Mesa: Test Fabrication Facility and Rack Assembly; Alignment Complex	Unknown
TA-61	East Jemez Road: physical support and sanitary landfill	Unknown
TA-62	Northwest Site: reserved for experiments, research, buffer zones	Unknown
TA-63	Pajarito Service Area: environmental and waste management functions	Unknown
TA-64	Central Guard Facility, Hazardous Materials Response Team	None
TA-65	Not currently active or never assigned	None
TA-66	Central Technical Support Site: industrial partnership activities	Unknown
TA-67	Pajarito Mesa: former TA-12; dynamic testing area; archeological sites	DU
TA-68	Water Canyon Site: dynamic testing area with study areas	DU
TA-69	Anchor North Site: undeveloped; buffer for the dynamic testing area	Unknown
TA-70	Rio Grande Site: undeveloped; buffer for the high-explosives test area	Unknown
TA-71	Southeast Site: undeveloped; buffer for the high-explosives test area	Unknown
TA-72	East Entry Site: Protective Forces Training Facility	Unknown
TA-73	Los Alamos Airport: on-site disposal area; incinerator 1950s	All
TA-74	Otowi Tract: water wells, archeological sites, endangered breeding area	None
Miscellaneous Locations of Activities that Involved Los Alamos Personnel		
Pacific	Nuclear tests: Marshall Islands (1945-51)	All
AK	Nuclear tests: Amchitka (Long Shot, Milrow, Cannikin) 1965,1969,1971	All
NV	Nevada Test Site: nuclear tests, Rover nuclear rocket engine program Nuclear tests, non-NTS: Fallon (Shoal); Tonopah (Faultless) 1968	All
CO	Nuclear tests: Grand Valley (Rulison) 1970; Rifle (Rio Blanco) 1973	All esp. ^{3}H; ^{85}Kr
NM	Nuclear tests: White Sands (Trinity) 1945; Carlsbad (Gnome) 1961; Farmington (Gasbuggy) 1967	All esp. ^{131}I; ^{133}I; ^{135}I; ^{137}Cs; $^{140}Ba/^{140}La$
MS	Nuclear tests: Hattiesburg (Salmon and Sterling)	Unknown

All = ^{239}Pu; ^{240}Pu; ^{238}Pu; ^{241}Am; ^{235}U; DU; ^{3}H; ^{210}Po; ^{227}Ac; ^{226}Ra; DU = depleted- ^{238}U;
MAP = mixed activation products (e.g., ^{41}Ar; ^{7}Be; ^{11}C; ^{13}N; ^{15}O);
MFP = mixed fission products;
NU = natural uranium;
VFP = volatile fission products.
Element names without number (e.g., plutonium, uranium) indicate isotope not specified.
a.k.a. = also known as.
SNM = Special Nuclear Material.

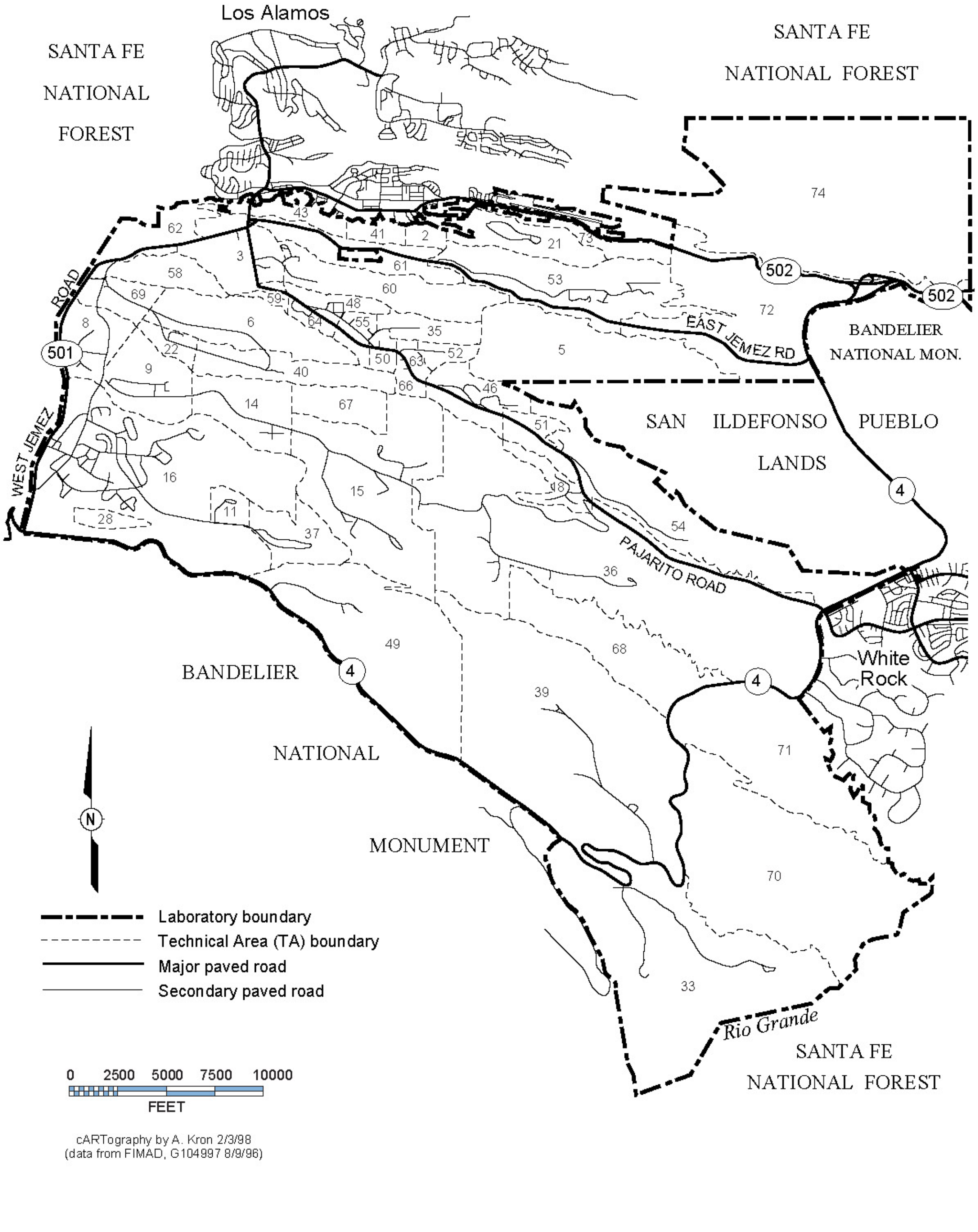
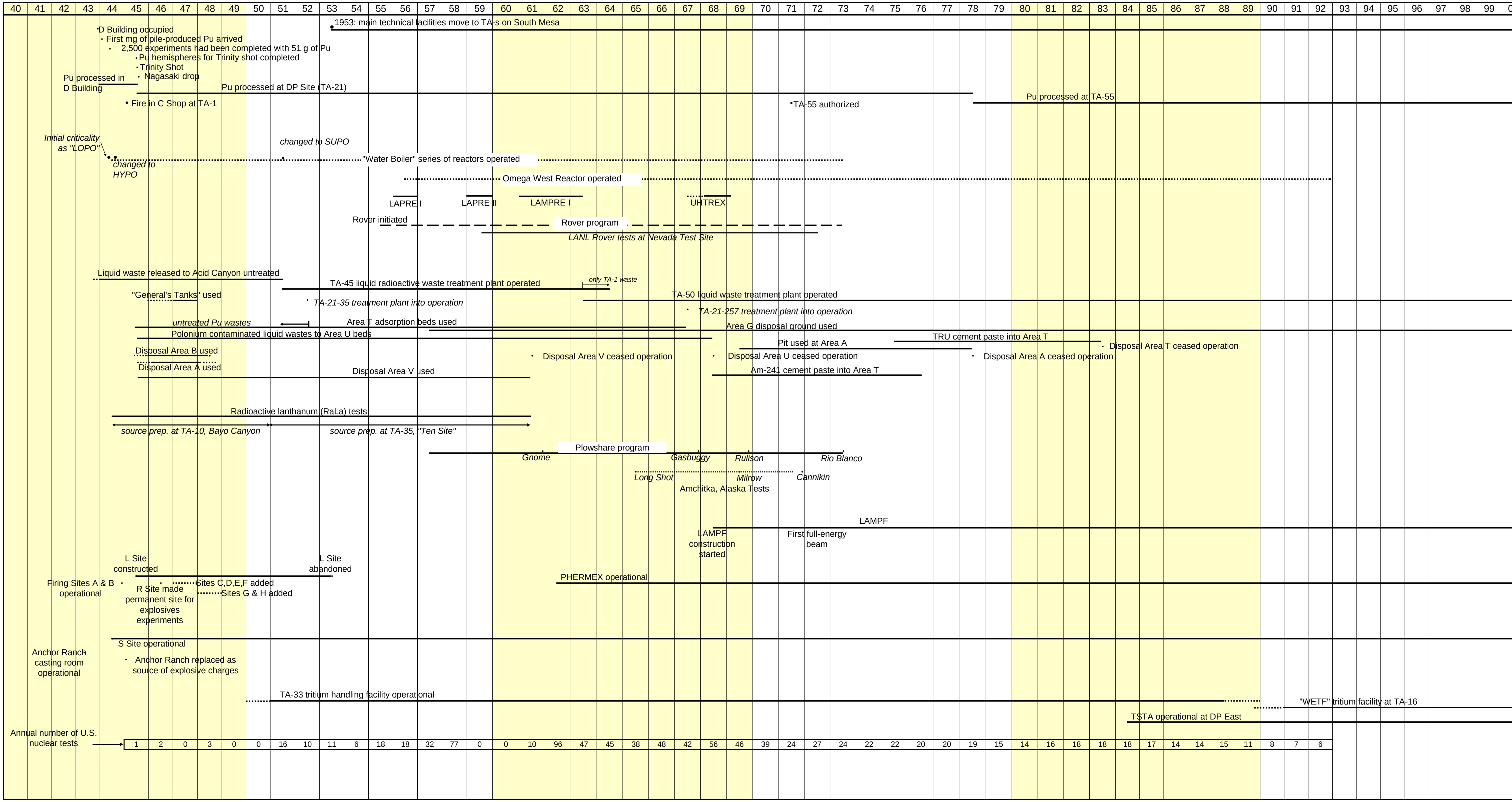


Figure 4: Map of LANL Technical Areas and Roads

Figure 5: Timeline of Selected Los Alamos Operations and Activities



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 final revision of the database was V3-9-0015. 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."

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 171,840 pages of documents. These documents are arranged sequentially by Repository Number. In addition, a duplicate set was supplied to the Zimmerman Library at the University of New Mexico. 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.

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 **6** 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.

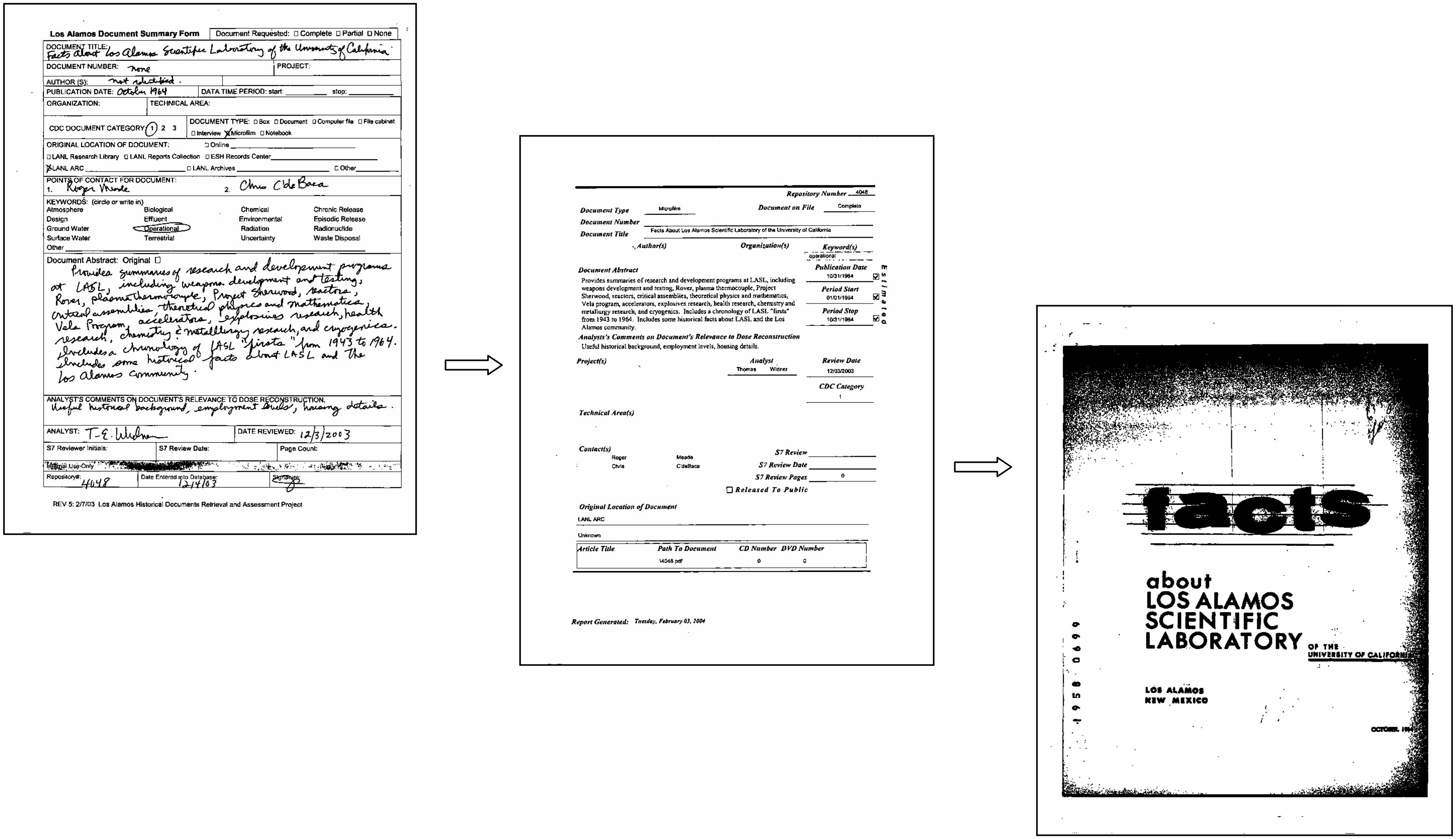
A Fujitsu M4097D scanner was used to scan the documents. Scanning speed in simplex mode was 50 letter-size-pages per minute (ppm), and in duplex mode was 90 images per minute (ipm). Each image has a maximum resolution of 600 dpi, while sophisticated dithering and diffusion algorithms deliver optimal halftone rendering. An automatic document feeder with 100-sheet capacity allowed for unattended scanning.

Fujitsu's optional ScanRight VirtualReScan technology (VRS) was used, 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.

Adobe® Acrobat® Capture® 3.0 software was used with the scanner to convert volumes of paper documents into searchable Adobe Portable Document Format (PDF) files. That 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.

Indexing of documents was achieved using Adobe Acrobat 6.0 Professional's Catalog tool. The Catalog feature generates an index definition file (which has a ".pdx" extension) and a support folder. The support folder contains files that are generated automatically during the indexing process. The indexing allows efficient searching across many PDF files.

Due to the imperfect quality of many repository documents and to budget limitations, clerical verification of this OCR and correction of translation errors were not performed. The full-text search capability is more powerful than the Access search of the DSFs. As of this writing, the project database and all PDFs were available on two DVDs or 10 CDs. A "Readme" file is included with each software installation with instructions on how to install the database and how to perform these searches.



Los Alamos Document Summary Form — Document Requested: ☐ Complete ☐ Partial ☐ None

DOCUMENT TITLE: Facts about Los Alamos Scientific Laboratory of the University of California

DOCUMENT NUMBER: none — PROJECT:

AUTHOR (S): not identified.

PUBLICATION DATE: October 1964 — DATA TIME PERIOD: start: stop:

ORGANIZATION: — TECHNICAL AREA:

CDC DOCUMENT CATEGORY: 1 2 3 — DOCUMENT TYPE: ☐ Box ☐ Document ☐ Computer file ☐ File cabinet ☐ Interview ☒ Microfilm ☐ Notebook

ORIGINAL LOCATION OF DOCUMENT: ☐ Online ☐ LANL Research Library ☐ LANL Reports Collection ☐ ESH Records Center ☒ LANL ARC ☐ LANL Archives ☐ Other

POINTS OF CONTACT FOR DOCUMENT: 1. Roger Meade 2. Chris C'deBaca

KEYWORDS: (circle or write in) Atmosphere, Design, Ground Water, Surface Water, Other; Biological, Effluent, Operational, Terrestrial; Chemical, Environmental, Radiation, Uncertainty; Chronic Release, Episodic Release, Radionuclide, Waste Disposal

Document Abstract: Original ☐ Provides summaries of research and development programs at LASL, including weapons development and testing, Rover, plasma thermocouple, Project Sherwood, reactors, critical assemblies, theoretical physics and mathematics, Vela Program, accelerators, explosives research, health research, chemistry & metallurgy research, and cryogenics. Includes a chronology of LASL "firsts" from 1943 to 1964. Includes some historical facts about LASL and the Los Alamos community.

ANALYST'S COMMENTS ON DOCUMENT'S RELEVANCE TO DOSE RECONSTRUCTION. Useful historical background, employment levels, housing details.

ANALYST: T-E. Widner — DATE REVIEWED: 12/3/2003

S7 Reviewer Initials: — S7 Review Date: — Page Count:

Internal Use Only

Repository#: 4048 — Date Entered into Database: 12/4/03 — Signature:

REV 5: 2/7/03 Los Alamos Historical Documents Retrieval and Assessment Project

Repository Number 4048

Document Type: Microfilm — Document on File: Complete

Document Number

Document Title: Facts About Los Alamos Scientific Laboratory of the University of California

Author(s) — Organization(s) — Keyword(s): operational

Document Abstract

Provides summaries of research and development programs at LASL, including weapons development and testing, Rover, plasma thermocouple, Project Sherwood, reactors, critical assemblies, theoretical physics and mathematics, Vela program, accelerators, explosives research, health research, chemistry and metallurgy research, and cryogenics. Includes a chronology of LASL "firsts" from 1943 to 1964. Includes some historical facts about LASL and the Los Alamos community.

Publication Date 10/31/1964 ☑ — Period Start 01/01/1964 ☑ — Period Stop 10/31/1964 ☑ — Estimated

Analysts's Comments on Document's Relevance to Dose Reconstruction

Useful historical background, employment levels, housing details.

Project(s) — Analyst: Thomas Widner — Review Date: 12/03/2003

CDC Category: 1

Technical Area(s)

Contact(s): Roger Meade; Chris C'deBaca

S7 Review — S7 Review Date — S7 Review Pages: 0

☐ Released To Public

Original Location of Document: LANL ARC

Unknown

Article Title	Path To Document	CD Number	DVD Number
	\4048.pdf	0	0

Report Generated: Tuesday, February 03, 2004

Figure 6: Original DSF, Access Database DSF, Original Document PDF

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 over 200 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 H-Division reports that the project team has in its possession are being reviewed, and a chronology of episodic or off-normal events that are relevant to off-site releases or health effects is being prepared. Each event will be described briefly, and references will be provided. This listing and an overview discussion of the nature of the predominant events that could have resulted in public exposure will be added to the Interim Report of the project before it is finalized. To the extent possible, information contained in the incident report files that were also reviewed by the LAHDRA team will also be referenced.

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.

Methods Used to Gather Information at Los Alamos

Information gathering performed in the course of the LAHDRA project took the form of systematic document searching and interviewing of past and current workers and area residents.

Systematic Document Review

Systematic document review (or searching) has been conducted to date on the LAHDRA project. Systematic searching involves identifying the document collections at a facility, both classified and unclassified, then progressing through those documents in an appropriate and orderly fashion until all potentially relevant documents have been reviewed by a person qualified to recognize information that a competent scientist would use to evaluate historical releases and/or the potential for off-site health hazards. This approach best supports the "leave no stone unturned" goal that best fosters public credibility in public dose reconstruction studies. Systematic document searching can be contrasted with "directed" document searching, in which researchers have identified needs for specific types of information, and they go directly to the document locations or particular types of documents that are believed to be most likely to contain that information. Systematic searching, directed searching, and combinations of the two approaches have been applied in dose reconstruction studies in the U.S. over the past 15 years.

Interviews

Interviews of current and retired workers and area residents were conducted by the LAHDRA team to assist in the identification and description of operations possibly associated with off-site releases, identification of relevant collections of records, and development of an understanding of historical operations. Workers sometimes help the document analysts assemble the "big picture" with regard to site operations. Interviewees can also identify interview candidates with knowledge about specific subject areas, assist in the interpretation of information from documents or other interviews, and describe record-keeping practices of years gone by.

Interview candidates are often identified from author or distribution lists from key documents, from division rosters or progress reports, or from other interviews. While interviews are often conducted with individuals, group interviews often allow interviewees to jog each others memories, yielding more information that would otherwise been offered. All interviews are voluntary, and interviewees have the option to remain anonymous. In these cases, names are excluded from our records. In some cases, people who have held security clearances in the past can receive special authorization to speak freely during an interview, provided it is conducted in an appropriate facility and in accordance with all regulations and guidelines concerning handling of potentially sensitive content.

Members of the project team prepare a summary of each interview. Summaries are reviewed for classified information, and the interviewees are offered the opportunity to review the summaries for factual accuracy. Interview summaries are normally included in the project information database.

How Documents Were Categorized, Summarized, and Catalogued

When a document that is relevant to off-site releases or health effects from Los Alamos operations was found by LAHDRA analysts, a Document Summary Form (DSF) was completed. Each document was assigned a Repository Number, and the information from the DSF was entered into a project information database. Copies of the most relevant documents were requested. After these documents were photocopied, they went through several review processes before public release was possible. A classification review was required, personal information that is protected under the Privacy Act had to be identified and removed, and a legal review had to be done to identify any information that was attorney-client privileged.

The Document Summary Form (DSF)

A DSF was developed for use by the LAHDRA analysts to enter bibliographic and project specific information about relevant material found during the search of records at LANL. This form was revised several times during the course of the project. A copy of the latest version, Rev. 6, is presented in Figure 7.

For purposes of completing this form, the word "document" was used as a generic term to represent the collection of information being described on the form. In many cases this was an individual document. However, the collection may have been a notebook, a file drawer, a box of records, or some other grouping of material.

LAHDRA analysts placed each selected document or group of documents into one of three categories. These categories, which were defined by CDC, are as follows:

Category 1. These are documents that a competent scientist would use in estimating off-site releases or their health effects from operations at LANL or other LANL-sponsored operations within the State of New Mexico (e.g., Trinity). Examples of Category 1 documents include effluent monitoring data, accident reports with estimates of releases, release point information, or results of environmental monitoring performed near locations where people lived or recreated. All Category 1 documents were copied for the project document repository and for release to the public via reading rooms or other means.

Category 2. These are documents that contain supporting information that could be useful in *confirming* estimated release quantities or health effects from operations at LANL or other LANL-sponsored operations within the State of New Mexico. Examples of Category 2 documents include historical documents on site activities, notebooks of relevant operations, or process flow sheets. They could also include analyses of sediment cores (which could be used to confirm the identity and timing of past contaminant releases to surface water bodies); measurements of iodine-129 in local soils (which could be used to establish patterns and levels of past iodine-131 releases); or measurements of mercury in the tree rings (which could be used to estimate the magnitude of past mercury releases). In general, Category 2 documents were not copied for the project repository. However, there are some cases when Category 2 documents were included, such as when the documents were derived from microform sources; when complete copies are readily available (e.g., surplus copies of LANL reports or PDF versions available); or when a document contained information about historical operations at LANL.

Los Alamos Document Summary Form	Rep #	Date	Initials
	Document Requested: ☐ Complete ☐ Partial ☐ None		

DOCUMENT TITLE:			
DOCUMENT NUMBER:		PROJECT:	
AUTHOR (S):			
PUBLICATION DATE:		DATA TIME PERIOD: start: ___________ stop: ____________	
ORGANIZATION:	TECHNICAL AREA:		
CDC DOCUMENT CATEGORY: 1 2 3		DOCUMENT TYPE: ☐ Box ☐ Document ☐ Computer file ☐ File cabinet ☐ Interview ☐ Microfilm ☐ Notebook	
ORIGINAL LOCATION OF DOCUMENT: ☐ Online ___________________________________ ☐ LANL Research Library ☐ LANL Reports Collection ☐ ESH Records Center______________________________ ☐ LANL ARC ____________________________ ☐ LANL Archives __________________________ ☐ Other____________			
POINTS OF CONTACT FOR DOCUMENT: 1. 2.			

KEYWORDS: (circle or write in)

Atmosphere	Biological	Chemical	Chronic Release
Design	Effluent	Environmental	Episodic Release
Ground Water	Operational	Radiation	Radionuclide
Surface Water	Terrestrial	Uncertainty	Waste Disposal

Other ____

Document Abstract: Original ☐

ANALYST'S COMMENTS ON DOCUMENT'S RELEVANCE TO DOSE RECONSTRUCTION

ANALYST:		DATE REVIEWED:
S7 Reviewer Initials:	S7 Review Date:	Page Count:

Figure 7: The LAHDRA Document Summary Form (DSF)

Category 3. These are documents that could be used to estimate or confirm off-site releases or health effects from nuclear weapons complex sites outside of New Mexico (for example, any nuclear device testing in Alaska, Nevada, or on any Pacific islands or atolls), or from operations sponsored by groups other than LANL at non-LANL sites within New Mexico (for example, sponsored by Sandia National Laboratory at Kirkland Air Force Base in NM). In contrast, documents about activities by LANL personnel that occurred off site but within New Mexico (such as at Trinity site) would be Category 1 or 2, depending on the type of information they contain. Documents concerning operations at foreign nuclear weapon sites in Russia, and at nuclear power plants (US and foreign such as Chalk River, Canada) were generally not defined as Category 3 material since they are not within the responsibility of the U.S. Department of Energy. As with Category 2 documents, Category 3 documents generally were not copied for the project document collection. However, there were some cases where copies of Category 3 material were included.

Table 2 provides a summary of how documents were categorized based on the location and sponsorship of the activity they described.

Table 2: Assignment of Document Category Based on Activity Sponsor and Location

Activity's Sponsor	Location of Activity		
	At LANL	Within New Mexico but not at LANL	Weapons Complex Site Outside of New Mexico
LANL	Category 1 or 2	Category 1 or 2	Category 3
Others	Category 1 or 2	Category 3	Category 3

A set of information could only be assigned one category number. Any documents not deemed to be Category 1, 2, or 3 were Category 4. Category 4 documents were not relevant to estimation or confirmation of releases or health effects from any sites of interest. Therefore, Category 4 documents were not summarized for inclusion in the project database or copied for the document repository.

The following is a description of the other fields on the DSF the analysts were asked to complete:

Document Title: This was the complete title of the document where possible, e.g., “Environmental Surveillance at Los Alamos during 1997”. If the collection of information had no official title, the analyst was instructed to enter a concise description of the material, e.g., “Flow charts and source terms for radioactive waste projections”. If a memo was being described, the subject of the memo was entered as the document title. Titles for all notebooks/logs begin with “Notebook:” and for all interviews with “Interview with:”.

Document Number: This is the official publication number if one existed, e.g., “LA-13487-ENV”. If the document had no document number, the field was left blank.

Project: This is the name assigned to a specific program or activity. About 60 projects were identified. Some examples include Project 56, Trinity, RaLa, ROVER and UHTREX.

Authors: The names of all authors were entered here, but only the names of individual authors. If an organization such as a company, group, or division was given as the author, it was included in the organization field.

Data Time Period - Start and Stop Dates: This is the time period that the data in the document cover or the time period covered by logbooks or other logs. If available, the beginning dates and ending dates were indicated.

Publication Date: This is the date that the material was published or presented.

In order to facilitate searching of dates, CDC required that values be assigned to each date field for each record. The three dates fields are publication date, start date and end date. A publication date was available for about half of the documents. However, the time period the document covered was oftentimes not completed by the analyst. Unless the time period was obvious (e.g., for annual reports) then it could be time consuming to review the material in enough detail to ascertain coverage period. CDC requested that the LAHDRA Project "estimate" the date fields for all entries. A set of rules, which are described in Appendix L, was developed. An example of a rule for date assignment is if only a publication date is available then start date would be the first day of January of the year of the publication and stop date would be the publication date. Given the arbitrary way in which most of these dates were assigned, use of the date time fields is sometimes limited.

Organization: This was the organization such as a group, division, company, or government agency that authored or sponsored the document. Over 250 organizations were identified. Some examples include: U.S. Atomic Energy Commission, History Associates, Inc., ESH-12, and A-Division.

Technical Area (TA): This is a numeric only field. Only the number of the TA was included here. A detailed description of each LANL technical area and their associated programs (similar to Table 1) was developed for use by the analysts in correctly assigning TA numbers.

Document Type: CDC requested that the material being documented in the DSF be classified as one of the following:

Box
Document
Computer file
File cabinet
Interview
Microfilm
Notebook

Original Location of Document: This is the physical location of the original document. Locations were:

LANL Records Center
LANL Research Library (Includes documents reviewed in the Online Collection)
LANL Reports Collection
ALDNW Vault
Los Alamos Neutron Science Center (LANSCE)/TA-53
Project Files
LAMPF
ESH-17 Air Quality
ESH Records Center
ESH Dosimetry Office Records

Points of Contact for Document: CDC requested names for individuals whom they would contact to make arrangements to review the original copy of any particular document.

Keywords: The following is a set of general keywords that were listed on the DSF:

atmosphere
design
ground water
surface water
biological
effluent
operational
terrestrial
chemical
environmental
radiation
uncertainty
chronic release
episodic release
radionuclide
waste disposal

Analysts typically circled the relevant keywords for each document. In addition to these keywords, over 400 additional keywords were indicated (written in) by analysts. The assignment of keywords was not rigorous. However, this field became less important once the ability to full-text search the database and scanned documents became available.

Document Abstract: This was meant to be a clear, complete and concise summary of the document or description of the collection of material. In some cases the abstract was taken directly from the document's abstract or executive summary. In these cases, a check or X was to be placed in the check box labeled "Original" to indicate that the inserted text represented the words of the document author(s), not the LAHDRA analyst.

Analyst's Comments on Document's Relevance to Dose Reconstruction: This was an optional field that an analyst could use to indicate why a document was selected for inclusion in the database, if that was not apparent from its abstract.

Analyst: This was the name of the analyst who reviewed the document.

Date Reviewed: This was the date the document was reviewed by the analyst and the DSF was created.

Document Requested[1]: Analysts were instructed to indicate whether a copy had been requested of the complete document (complete), a portion of the document (partial), or no part of the document (none).

S7 Reviewer Initials[1]: This was the initials of the person doing the classification review.

S7 Review Date[1]: This was the date S7 review was completed.

Page Count[1]: The analyst was asked to complete this field, if feasible. Page count was also usually specified by the S7 reviewer.

Repository #, date, and initials at the top of the form were used for internal use by database management staff only.

[1] The Document Requested, S7 Reviewer Initials, S7 Review Date, and Page Count fields were added too late in the project to be of much use. These fields were not populated for the majority of the entries. Their purpose was to aide tracking for administrative purposes, but these fields were difficult to retrofit.

Summary Statistics of the Document Collection

There are 4,055 files in the LAHDRA database. There is some duplication of documentation in the database. In other words, occasionally different analysts created DSFs for the same document. This occurred because of the delay in the review process. Sometimes it was many months to years before any given original DSF was released by LANL and available for entry into the database. Attempts were made to consolidate duplicate DSFs. In the cases where known duplication exists, the two files are cross-referenced in the "analyst comment field".

The breakdown of LAHDRA documents by category number is as shown in Table 3.

Table 3: Breakdown of LAHDRA Documents by Category Number

Category	#	Percentage
Category 1	1839	45%
Useful for reconstruction of off-site releases or health effects		
Category 2	1786	44%
Information to confirm off-site releases or health effects		
Category 3	430	11%
Information about other DOE sites		

There was significant lag time between when material was identified by an analyst as Category 1 and when it was actually released by LANL. At the closeout of this project, 232 Category 1 documents had not been released by LANL.

The breakdown by locations where the documents were found is as shown in Table 4:

Table 4: Breakdown of LAHDRA Documents by Location of Origin

Location	#	Percentage
LANL Records Center	2251	56%
LANL Research Library	389	10%
LANL Reports Collection	1033	25%
ESH Records Center	249	6%
ESH-17 Air Quality	30	1%
ESH Dosimetry Records	51	1%
LANSC/ALDNW Vault	2	0%
LANSC/TA-53	43	1%
Project Files	7	0%

The breakdown by document type is as shown in Table 5:

Table 5: Breakdown of LAHDRA Documents by Document Type

Location	#	Percentage
Box	424	10%
Document	2996	75%
Computer File	60	1%
File Cabinet	31	1%
Interview	3	0%
Microfilm	324	8%
Notebook	217	5%

The majority of the material was classified as "document".

The breakdown by publication date is as shown in Table 6:

Table 6: Breakdown of LAHDRA Documents by Decade of Publication

Location	#	Percentage
1940s	727	17%
1950s	633	16%
1960s	601	15%
1970s	749	18%
1980s	555	14%
1990s	722	18%
2000s	22	1%
Unknown Dates	46	1%

The majority of the material selected was pre-1980.

Document Review at the LANL Records Center

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 Central Records Management Center, Building 1001 in Technical Area 21 (TA-21-1001). This section describes and summarizes the document search and retrieval activities conducted at the LANL Central Records Center. This section does not address the LANL Archives, which is also housed at the TA-21-1001 facility.

Records Center Description

The LANL Records Center is a 15,000 square foot building located at 180 6th Street in Los Alamos, New Mexico. 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 and has not yet been reviewed by LAHDRA analysts.

Building TA-21-1001 is sub-divided into six "bays" denoted A through F. The records center includes a seventh bay, denoted G-bay, located in a separate building behind the primary facility. The primary facility, Building TA-21-1001, is a designated Vault-Type Room, and includes classified holdings. The records stored in G-bay are considered unclassified for access control purposes. The records center holdings are stored in bays B, C, E, F, and G. Each bay contains a number of rows consisting of either tall (10-drawer) filing cabinets or shelving. The filing cabinets (file drawers) are used primarily to store paper records. The shelving is used to hold records contained in standard, one cubic foot storage boxes. There are also a number of mobile storage units used in the records center to house media such as microfiche and microfilm. Each bay typically contains a mix of different types (formats) of records and records storage media/containers. For example, the tops of the rows of file cabinets are utilized for storing boxes and large-sized media such as drawings and blueprints.

All material accessioned by the records center is assigned a Transfer Record (TR) Number prior to delivery to the center. TR Numbers are assigned sequentially and are the principal means of identifying, locating, and tracking material in the LANL Records Center. Locations of records in the records center are referenced using a "bay-row-shelf" nomenclature, where "shelf" may be any number of storage locations, such as a file drawer or a specific box in a vertical stack of boxes. Thus, the location "B-1-2" would refer to material location in B-bay, Row 1, Location 2.

The LANL Records Center has been operating near its storage capacity for some time, thus new storage locations are created frequently as the need arises. As a result, the number of records storage locations in the center at a given time is variable quantity. As of February, 2001, the number of storage locations in the records center was 17,615. Note this total does not include the large volume of records the center holds on microfilm or microfiche media.

The space shortage faced by the LANL records center results in records frequently being relocated, reconsolidated, transferred to Federal Records Centers, or otherwise dispositioned to free up storage locations for newly-accessioned material. This frequent turnover of material presented challenges to the document search and retrieval effort that rendered elements of the original search plan ineffective and required additional measures to track the progress of the effort.

Summary of Document Review Activities at the Records Center

The records review effort for the LANL Records Center began in February of 1999. Depending on their physical location, records were either reviewed in place or pulled and brought to a more convenient location. Following review, the storage location for a set of records was marked using one of two rubber stamps. This first stamp was used to identify records deemed by the analyst to be Category 4, or documents that do not contain information pertinent to off-site releases or health effects:

✓ **CDC/NCEH REVIEWED** (in green ink)

The following stamp was used to identify boxes or drawers that contained some relevant information, in other words at least one contained document was judged to be in Category 1, 2, or 3.

★ **CDC/NCEH** ★ **DO NOT DESTROY** (in red ink)

For records stored in boxes, the outside of the box was stamped. For records stored in drawers, an adhesive label was stamped and affixed to the drawer. Upon review, a log entry was made identifying the material reviewed by its location and its TR number. The log entry included the document category assigned to the material (i.e., Category 1, 2, 3, or 4), its TR Number, location, the analyst that performed the review, and the review date. In addition, a DSF was completed for all material deemed Category 1, 2, or 3. For Category 1 material, a log entry was made identifying the material by its TR Number and location to both provide the classification reviewers a current listing of what required review and to aide them in locating it. Category 1 material was also flagged using self-stick notes or equivalent to make it easier for the classification reviewers or others to find later. Once material was either confirmed to be unclassified or properly redacted, it was copied and forwarded for an additional series of reviews to confirm the material could be released to the public, in other words it did not contain information that was protected under the Privacy Act or that was attorney-client privileged. The review log served as a tool to both identify material in need of classification review and that which had been forwarded for the second part of the review process or still needed to be copied.

Early in the review effort it became apparent the tools and methods originally specified for tracking progress and identifying material that had and had not been reviewed were untenable. The volume of the material in the records center coupled with its dynamic nature (i.e., high turnover) meant handwritten logs were of little use. Likewise, the fact that boxes and drawers that had been stamped as reviewed were often re-used to store material that had not been reviewed meant the presence or lack of one of the stamps was essentially meaningless. Further, the ever-changing number of storage locations and constant in-flux of new material made asserting a completion percentage problematic, and presented a task that was open-ended. It thus became clear the only reliable way to keep track of the review effort for the LANL Records Center was to create and maintain an electronic database of the center's holdings and to track what had and had not been reviewed by TR Numbers. In addition, a cut-off accession date had to be established to define the point where the center's holdings would be considered frozen for the purpose of asserting when the task of reviewing all of the material was completed.

The records database used and maintained by the records center staff was used as the starting point for the database developed to track the review effort for the LANL Records Center for the LAHDRA project. Additional tables, fields, and search criteria specific to the LAHDRA effort were then added as needed. The most visible of the additional tables was an electronic version of the box log completed by the analysts as they reviewed material. The box logs, along with accession information provided by the records center staff, provided the two sources of data used to maintain the database. As long as the database was kept current in terms of records locations and TR Numbers, any discrepancies between it and the handwritten box logs gave an immediate indication of either an error in the log or material that had been moved or otherwise dispositional. In this way, the difficult task of tracking material that had and had not been reviewed was simplified greatly, even for cases where the same locations required review a number of times due to material being rotated through. Because all records were tracked by TR Number, not location, this was possible.

The database developed and used to manage and track the review effort for the LANL Records Center was not used for microform records (i.e., microfilm or microfiche). These materials were not subject to the same turnover problems that hindered the review effort for the paper records, and as a result the review of microform could be managed and tracked in a manner more consistent with what was originally conceived for the paper records. Small red and green colored, adhesive dots were applied to microfilm cassettes in lieu of the rubber stamps to indicate material that had been reviewed. For microfiche records, the rubber stamps were applied to either the sleeve the media was stored in (for individual microfiche records) or to the storage container (such as the front of a drawer) if it was a large volume of records.

The cutoff accession date selected to define when the contents of the records center were considered frozen for the purpose of asserting when the review task was completed was December 31, 1999. The last Transfer Record assigned prior to this date was TR Number 13779. Thus, all material in the records center having a TR Number 13779 or less was targeted for review under the first phase of the LAHDRA project. As of now, this goal has yet to be met due to a number of impediments and circumstances beyond the project's control encountered subsequent to the goal being established. As of the pause in active document review, approximately 200 boxes of documents and 2000 rolls of microfilm received before calendar year 2000 remained to be reviewed at the Records Center.

Document Review at the LANL Report Collection

From 1942 to 1992, the LANL Reports Collection was a filing point for reports issued by LANL and by other Department of Energy sites. A 1973 publication concerning report series codes (Godfrey and Redman 1973) describes how reports were initially issued by LANL:

> Formal reports issued by the Los Alamos Scientific Laboratory are given serial numbers in the LA-series. Less formal reports were once prefixed by LAMS-. Until late 1949 the two series were separately numbered, but after LA-756 and LAMS-953 they were combined. Beginning with -954 only one numerical series was maintained, but the prefix was either LA- or LAMS- as appropriate. In 1964 this pattern was changed, with the MS relegated to the position of suffix. Subsequently other suffixes were adopted, BIB for bibliographies, PR fro progress reports, SOP for standing operating procedures, and TR for translations. Only important translations that have been carefully edited are included in this series. Two other series are also maintained. LA-TR-(YEAR) is used for informal translations. The LA-DC-series (formerly LADC- and currently LA-DC-(YEAR)- is used for material released for publication as journal articles, conference papers, books, etc.
>
> AM- and BM- series were assigned by the LASL to miscellaneous reports received from 1946 through 1949, and occasionally thereafter. The choice of designator was determined by the country of origin of the report, e.g., AM-American and BM-British (including Canadian). Within each series, numbers were assigned in order of accession.

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
- Reports on microfiche

Classified Reports

Approximately 3,000 classified report titles issued by LANL as LA- or LAMS- reports are located in the Report Collection. Since there are two to four copies of many of the LA-reports, quantities are reported as titles rather than as reports. There are an additional 32,000 classified reports from DOE sites other than LANL, other defense-related agencies, and academic institutions and private corporations that conducted research on behalf of DOE or its predecessor agencies.

In the later part 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.

In addition, access to classified reports issued by any of the following entities with publication dates after 1962 has been denied since 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

A listing of the classified and unclassified LANL technical reports (mostly LA- and LAMS-reports) is available, and was shared with the project team. That listing is the basis of the Table 7 summary of “LA-“ and “LAMS”-series reports that are in the Report Collection’s holdings. Approximately 55-60% of the classified LANL-issued technical reports had been reviewed prior to March 2001. There are approximately 1,144 classified LANL reports issued after 1962 that have not been reviewed by the project team because of the March 2001 decision by LANL to withhold them from review. 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.

Table 7: "LA"- and "LAMS"-Series Technical Reports in the LANL Report Collection

"LA" Report Number Range			Number of Titles	Number Unclassified	Range of Years of Issuance			Percent Unclassified
1	to	500	1,139	638	1943	to	1963	56%
501	to	1,000	775	424	1944	to	1950	55%
1,001	to	2,000	1,071	735	1945	to	1967	69%
2,001	to	3,000	1,057	818	1947	to	1967	77%
3,001	to	4,000	1,023	826	1963	to	1978	81%
4,001	to	5,000	1,028	802	1967	to	1982	78%
5,001	to	6,000	1,040	868	1972	to	1982	83%
6,001	to	7,000	1,014	897	1974	to	1981	88%
7,001	to	8,000	1,021	939	1971	to	1986	92%
8,001	to	9,000	1,013	934	1979	to	1984	92%
9,001	to	10,000	1,056	934	1981	to	1988	88%
10,001	to	11,000	1,039	839	1984	to	1995	81%
11,001	to	12,000	1,027	799	1987	to	1993	78%
12,001	to	13,000	1,027	880	1990	to	1995	86%
13,001	to	50,000	701	613	1995	to	2000	87%
Totals			15,031	11,946				79%

Access to classified reports issued by entities other than LANL has been denied to LAHDRA analysts since November 2001, unless specific permission is granted by the non-LANL "owner" of the document. These "owner" entities number in the hundreds, many of which no longer exist, so the project team has not pursued approaching each individual entity for permission to review associated documents. 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 in November 2001. No listing of the classified non-LANL reports issued after 1962 is available.

Unclassified Reports

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[2] reports are available as PDF files in the LANL electronic library catalog. Unclassified reports with limited distribution categories, i.e., OUO (Official Use Only), are not available electronically, and have to be reviewed in the vault.

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 www.lanl.gov Web site. Currently, the files can only be accessed from a computer with a LANL IP address or possibly by certain government computer users. The project team reviewed 100% of the unclassified "LA" reports that were formerly available without restriction on the Internet. Most of these reports were reviewed using LANL computers at an office made available to the LAHDRA team at TA-35.

There are also approximately 90,000 unclassified reports in the Report Collection vault that were issued by the following types of non-LANL entities:

- 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 had to be halted for contractual reasons.

Reports on Microfiche

LANL historically subscribed to multiple UC (University of California) distribution codes for DOE-related reports. When the Office of Scientific and Technical Information (OSTI) took over the distribution of DOE-related reports, reports were distributed on microfiche instead of paper. There are approximately 1.5 million documents on microfiche at the LANL Reports Collection. In 1999, the LANL Research Library changed their subscription to electronic, so the microfiche collection is no longer being added to.

All reports on microfiche are unclassified, but some are marked for limited distribution. Journals are not included in the microfiche collection due to copyright laws. Many reports in the microfiche collection appear to be conference proceedings. The fiche cards are

[2] LA=Los Alamos; LA-MS=Los Alamos Manuscript (not formally edited); LA-UR=Los Alamos Unlimited Release; LA-PR=Los Alamos Progress Report.

organized in Lektreiver™ power filing units according to document number (e.g., LA-1234-MS). Duplicates of LANL reports exist in paper and microfiche format. These reports would not need to be reviewed on microfiche if a paper copy of the same report had already been reviewed. However, there are approximately 22,225 LA reports on microfiche according to the Library Catalog. Although there are thousands of report series in the microfiche collection, the three largest collections are DOE Energy (~500,000 reports), Nuclear Science Abstracts (NSA; ~100,000 reports) and NASA (~20,000 reports).

At least 900,000 of the 1.5 million reports on microfiche are not part of any electronic database currently accessible at LANL that might be usable to search the contents of the report collection on microfiche. The Research Library has current subscriptions to two electronic databases, DOE Energy and NSA, and until recently also had a subscription to the NASA electronic database. About 500,000 reports on microfiche are in the DOE Energy (1969 to present) database and 100,000 are in the NSA database (1949-76). A search of those two databases indicated that Los Alamos 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 has reviewed less than 1% of the reports on microfiche.

References Relevant to the Report Collection

Godfrey, L.E. and H.F. Redman, editors. *Dictionary of Report Series Codes, 2nd Edition*. Special Libraries Association. New York. 1973.

Document Review at the ESH Records Center

The Environment, Safety, and Health (ES&H or ESH) Records Center, which is located in Building 46 at TA-35, was reviewed as part of what would have been "Phase 4" review of records at the various Technical Areas.

The ES&H Records Center

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 Records Management Center (RMC). Many of the records stored at the ES&H Records Center are recent, i.e., from the 1990s.

Records in the ES&H Records Center are stored in a combination of 25 rows of shelving and 9 file cabinets. In addition, there are often a number of boxes staged in various areas of the center that are awaiting accessioning. Many (270) locations contained records that had not been accessioned yet. Rows are used to store standard one cubic foot boxes. The file cabinets are used to store a combination of boxes and other items or containers. Note that each file cabinet has a number of "shelves" that are also referred to as rows (not to be confused with the other rows).

Contents of records stored at the ES&H Records Center are described on CIC Form 170, the Records Transfer Request Form. This form defines a unique transfer record (TR) number for each set of records submitted to the center by various groups within the ES&H Division. The format of the TR numbers used for materials accessioned by the ES&H Records Center is TR-120-xxxx, where "xxxx" is a sequential number. The TR number is used to track the records in a database maintained for this purpose. Hard-copies of the TR forms are kept in binders, with a different binder used for each group. The hard-copy TR's are stored in the binders in numerical order.

Satellite ES&H Records Centers

Some ES&H groups have storage areas for the records they have not sent to the ES&H Records Center or the RMC (IM-5). For example, ESH-17 (Air Quality) has file drawers that are organized by year. They keep records for the last three years and send the data for the previous years to the ES&H Records Center. ESH-20 (Ecology) stores their records in file drawers, which are organized by topics such as Biology, Contaminate Monitoring, and Cultural Resources. In general, these types of record collections are considered to be "active records". That is, they are not part of a formal report collection and are difficult to catalogue and track.

Table 8 below identifies the various groups within the ES&H division and whether or not they maintain satellite records collections.

Table 8: Satellite Records Collections within ES&H Groups

ES&H Group	Satellite Collection?
ESH-1: Health Physics Operations	No
ESH-2: Occupational Medicine	No
ESH-3: Integrated Risk Analysis, Management and Communication	No
ESH-4: Health Physics Measurements	No
ESH-5: Industrial Hygiene and Safety	No
ESH-6: Nuclear Criticality Safety	Yes
ESH-7: Occurrence Investigation	No
ESH-10: Hazardous Materials Response	No
ESH-12: Radiation Protection Services	Yes
ESH-13: ES&H Training	Yes
ESH-14: Quality Management	No
ESH-17: Air Quality	Yes
ESH-18: Water Quality and Hydrology	No
ESH-19: Hazardous and Solid Waste	No
ESH-20: Ecology	Yes

When the original HSE-8 group was broken up, it was decided that their historical records would go to storage. However, ESH-20 kept their records to maintain continuity within their environmental monitoring activities. ESH-17 has since begun an ongoing effort to find historical records pertaining to releases to the environment. These records currently go back to 1958.

Summary of Document Review Activities

The bulk of records review for the ES&H Records Center took place between January and October of 2000. Records were reviewed at their storage location. Following review, records were marked using one of the two rubber stamps described earlier based on whether they contained any Category 1, 2, or 3 documents. Upon review, a log entry was made identifying the material reviewed by its location and its TR number. The log entry included the document category assigned to the material (i.e., Category 1, 2, 3, or 4), the analyst that performed the review, and the review date. In addition, a DSF was completed for any document identified as Category 1, 2, or 3. Category 1 material was flagged for review for public release, which included reviews for classified or sensitive matter, information protected under the Privacy Act, and information that is attorney-client privileged.

On several occasions during the review period, records that had been reviewed were subsequently replaced with other newly accessioned records. In general, these new records were also reviewed, meaning that several locations were reviewed two and even three times as new material displaced older material in the center. Since the ES&H Records Center is an active staging area for records, a cutoff date of October 31, 2000 was established as a stopping point for the formal review. The rationale for this date was the fact that all of the accessioned material in the Center had been reviewed by this time and the rate at which new material was being accessioned was too slow to justify a continuing effort. However, plans were made for TR's for material accessioned after the cutoff date to be reviewed periodically to look for records of interest to the project. As of the cutoff date, there were an estimated 200 boxes in the Center pending accessioning. This is in addition to the other 270 un-accessioned boxes already on the shelves.

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. The majority of the relevant material was designated as Category 2, as it was records from the 1990s that have been summarized in official reports that are readily available. An example of such information would be AIRNET (NESHAPS) data that are used in reports on exposures to the public from LANL operations required by the EPA. Stack release data from this period is another example. This information is also reported in the annual environmental surveillance reports.

The only material found in the ES&H Records Center that was designated as Category 1 were two notebooks of working notes and document extracts that contained data on site-wide radionuclide releases. The first notebook (Volume 1 – Repos. No. 1733) contained data from 1948 to 1972. The second (Volume 2 – Repos. No. 1734) contained data from 1972 to 1996. These compilations were assembled by ES&H as part of an effort by LANL to assess historical radionuclide releases.

In July, 2003, the ES&H Records Center was revisited. The purpose was to review the materials that had been accessioned into the Center since the initial LAHDRA review. As indicated above, that review effort had established October 31, 2000, as the stopping point for that initial effort. All Transfer Request Numbers since that time [TR-120-186 (11/14/00) through TR-120-358 (6/20/2003)] were printed out. The content descriptions were examined to identify any potentially relevant documents. It was determined that 10 boxes described on three TR's needed further review. The contents of these boxes were reviewed. They contained materials on the Rover nuclear rocket engine program and soil sampling files from the 1980s and 1990s. However, no new document summary forms were generated.

Satellite ES&H Records Centers

Since the records stored in the satellite records centers are considered to be “active”, a detailed review of these materials was not performed as part of the records review for the ES&H Records Center. Instead, the materials contained in each satellite center were described and those thought to be good candidates for future reviews were identified. Satellite centers that contain material that the project may want to revisit in the future include:

- ESH-5 (Industrial Hygiene and Safety): this group has several databases available (some active, some inactive) for areas such as chemical inventory, sampling and monitoring, materials information (metals, carcinogens, VOCs), etc.
- ESH-7 (Occurrence Investigation): this group is in the process of developing a database, with the most recent occurrences first.
- ESH-12 (Radiation Protection): this group has a vault that contains worker radiation exposure records.
- ESH-17 (Air Quality): this group retains the most recent three years’ worth of AIRNET data (summarized in NESHAPS reports), with the oldest data being sent to the ES&H Records Center once the most recent year’s data are added. This group also has a file cabinet of information being compiled to examine the accuracy of historical release data. This effort is proceeding very slowly, but currently dates back to 1958. A DSF (Category 1) was completed for a printout of the ODIS database that was found at the ESH-17 document center. The information in this database include stack ID/location, total activity discharged, total volume of air discharged, and the radionuclides or type of activity discharged.

- ESH-18 (Water Quality): this group maintains databases on LANL environmental surveillance data for surface water, ground water, soils, and sediment going back to 1970 and main aquifer radiological data dating back to 1945 (in spreadsheet form). Another database contains the results of environmental testing performed by the U.S. Geological Survey from 1945 to 1969.
- ESH-20 (Ecology): this group maintains records of biological assessments performed for various Operable Units and foodstuffs (produce). These records are stored in Building TA-21-210, Room 133.

The AIRNET data held by ESH-17 for 1997, 1998 and 1999 were reviewed by a CDC analyst at the satellite storage location. A sheet of paper stating that the records had been reviewed and were relevant to the project was placed with them so the boxes can be appropriately marked once the records are transferred to the ES&H Records Center. The ES&H Records Center staff know to look for the notification when records are submitted by ESH-17.

The ESH-6 group (nuclear criticality safety) maintains records at their facilities at TA-18. These records have not yet been evaluated by the project due to classification and need-to-know issues.

Document Review at Other LANL Locations

Document reviews in other LANL divisions (i.e., document-holding locations other than the Records Center, Report Collection, and ESH records collection) were initiated during the systematic document search for relevant records.

Review of the ADWEM Records Vault-Type Room and Classified Safes

Reviews completed during this project include holdings located in Weapons Engineering and Manufacturing (WEM) and Weapons Physics (WP) divisions. 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. 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 during this project. A summary of those divisions is listed below.

Records reviews were conducted in accordance with a Special Security Plan for the Office of the ADWEM and its divisions issued in June 2001. Review of ADWEM-related documents by LAHDRA team analysts consisted of two review paths. Reviews included those documents that are located within vaults or vault-type rooms and those that can be found in classified safes or unclassified safes and other individual documents holdings (e.g., bookshelves) located in division staff offices. Most of the classified safes are located within individual offices within a limited number of ADWEM divisions.

The initial LAHDRA reviews of ADWEM records focused on the contents of the WEM and WP vault-type room (VTR) located in the Administration Building located at TA-3. Most of the documents produced and/or retained by these two divisions are classified as RESTRICTED DATA and contain nuclear weapon design and testing information. All classified document reviewed in the VTR were published after 1962. According to the Special Security Plan, reviews of available documents were performed on a restricted-access basis, which meant that only document titles could be examined and LAHDRA team analysts were prohibited from reviewing the contents of classified documents published after 1962. During the review, no pre-1962 classified documents were found in the above document holdings.

The WEM/WP VTR contained approximately 18,876 classified documents and 1126 classified photographs. The number of documents within this holding can vary depending on the flow of records and is limited by the capacity of the vault. At the time of our review, it was estimated that the VTR was at 95 percent capacity. One moving-shelf (approximately 6' x 10' in size) contained classified videos on various media (e.g., VHS format). The project team was denied access to these media. Two documents were identified as potentially useful to the project and were submitted through the appeal process to LANL and DOE. Full reviews by project team analysts were not possible, as the denial of access was upheld by DOE.

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.

Review of LANSCE Division Records

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 located in Sector R, Building 3, Room 3R-4 (TA-53-3). This archive is located adjacent to the main target Area A. Approximately 10,000 documents located in office files located in the Main Administration Building were reviewed. 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. Approximately 20% of the documents were identified as duplicates. 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. The collective group of records (boxes) contain detailed information regarding radiological monitoring techniques and results from 1971 to the present. The majority of information contains information about airborne releases from TA-53.

Remaining LANL Division/Office Record Holdings Not Reviewed

Table 9 lists the divisions, program offices, institutional offices, and special project offices at LANL that were not reviewed by the LAHDRA team. Not much information was made available concerning the volume or nature of records that each organization holds, so there is much uncertainty in estimates of the work that remains. Rough and incomplete estimates of the numbers of documents within some of the organizations are given in the second column below. It is recommended that a complete assessment of these document holdings be performed during any future retrieval and assessment efforts. Organizations that reportedly possess the most classified records are shown in bold in Table 9.

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.

LANL Legal Counsel Litigation Support Database

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 2003 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 copyee, date, status, and page count. The LCLS database consists of the following document categories:

H-Division	1,442 documents
Human Studies Project Team	4,767 documents
Central Records Management	11,198 documents
Others	10,395 documents
Records Processing Facility	47,922 documents
Total	75,724 documents

The original plan was for LAHDRA analysts to review the hardcopy indices of the LCLS database and select documents for review. These documents would then be made available to LAHDRA analysts by Legal Counsel staff. In early 2004, the LAHDRA team was denied access to the actual documents included in the LCLS database because LANL had insufficient funding to support an on-site review of the collection while the backlog of records at the Records Center was being processed. Therefore, only the database listing was reviewed.

Table 9: Estimated Numbers of Documents Reported to be at Other LANL Divisions

Organization	Estimated No. of Documents
Applied Physics (X)	5,000
Audits and Assessments (AA)	
Bioscience (B)	
Business Operations (BUS)	
Computer and Computational Sciences (CCS)	10,000
Computer, Communications and Networking (CCN)	10,000
Communications and External Relations Division (CER)	
Community Relations (CR)	
Chemistry (C)	
Decision Applications Division (D)	
Diversity Office (DVO)	
Dynamic Experimentation (DX)	10,000
Earth and Environmental Sciences EES	
Engineering Sciences and Applications (ESA)	250,000
Energy and Sustainable Systems Program Office (ESS-PO)	
Facility and Waste Operations (FWO)	
Government Relations Office (GR)	
Human Resources Division (HR)	
Industrial Business Development Division (IBD)	
Integrated Safety Management Program Office (ISM)	
Laboratory Counsel (LC)	
Materials Science and Technology (MST)	
Nonproliferation and International Security (NIS)	
Nuclear Materials Technology (NMT)	15,000
Office of Equal Opportunity (OEO)	
Office of Internal Security (ISEC)	
OMBUDS Office (OMBUDS)	
Project Management Division (PM)	15,000
Performance Surety (PS) Division	
Physics (P)	5,000
Quality Improvement Office (QIO)	
Risk Reduction and Environmental Stewardship (RRES)	
Security and Safeguards (S)	
Spallation Neutron Science (SNS)	
Science and Technology Base Programs (STB)	
Theoretical (T)	

H-Division Documents in the LCLS Database

The H-Division portion of the LCLS database primarily includes monthly (1943-44 1947-64), and quarterly (1965-75, 1978-90) and annual (1943, 1947, 1949-53, 1957, 1987-90) Health Division progress reports. It also contains progress reports from several subgroups within the H-Division, such as H-1 Radiologic Monitoring (formerly H-6 and CMR-12) and H-4 Biological and Medical Research, which were responsible for monitoring the use of radiological and non-radiological hazardous materials at LANL. Although the LCLS database contains 1,442 documents, there are typically three versions of each H-Division progress report in the database- a complete report, a redacted for personal privacy version, and an abstract of the complete report.

The LAHDRA project team requested release of copies of all Health Division reports that were identified in LANL document repositories during the records review task. Monthly reports for 1947-49 and annual reports for 1949-57, and 1987-90 were assigned LA, LA-MS, or LA-PR report numbers and some were located in the LANL Report Library Collection. Other H-Division reports were located on microfilm and in boxes in the Central Records Center. The LAHDRA project database currently contains over 325 H-Division reports. Although the Litigation database is the larger of the two collections in terms of number of reports, the LAHDRA collection complements the LCLS database by adding one annual report (1954) and eleven monthly reports (1949, 1950, 1956-58, 1960, 1964) that are not included in the LCLS database. Two monthly progress reports (Oct 1949, April 1958) and eight quarterly reports (1970, 1981, 1988, 1990) are not in either collection. There are no H-Division reports for 1945 or 1946 in either collection.

The LAHDRA project team requested access to 66 documents in the H-Division portion of the LCLS database, including 50 quarterly progress reports and 16 documents related to various historical operations.

Human Studies Project Team Documents in the LCLS Database

The 4,767 documents listed in the Human Studies Project Team (HSPT) section of the database primarily consist of weekly status reports, fact sheets, press releases, news articles, procedures, phone logs and other administrative documents generated during the HSPT document review at LANL. Therefore the majority of the documents were generated between1991-1995, although there are some historical documents from the 1940s, 1950s, and 1960s. There are also a large number of documents from the 1970s related to the Karen Silkwood case and pion radiotherapy studies, and from the 1958 Cecil Kelley fatality. These categories of documents are not relevant to the LAHDRA project.

However, of particular interest to the LAHDRA project are the weekly bibliographies of documents released to the public, inventories of documents in LANL record collections, reports from the LANL autopsy tissue program, and H-Division monthly progress reports. There is only one H-Division progress report cited in the HSPT section of the Legal database that's missing from both the H-Division section of the LCLS database and from the LAHDRA collection. A classification system for the H-Division reports is used in the HSPT section of the LCLS database. The classification categories are 001 Bayo Canyon activities, 002 DOD related activities, 003 human tissue studies, 004 non-Bayo Canyon releases, 005 other DOE contractor (human studies), 006 tracer studies (plutonium, uranium, radioiodine, tritium, radium, other), 007 history/general, 008 atmospheric testing programs, 009 pion radiotherapy.

The LAHDRA project team requested access to 113 documents in the HSPT portion of the LCLS database, including 51 documents related to historical operations, 61 describing contents of LANL records centers and documents released to public reading rooms, and one H-Division progress report (April 1958).

Central Records Management Documents in the LCLS Database

The 11,198 documents in the Central Records Management section of the LCLS database range from 1943-1965. The types of documents include:

- Monthly hazard reports and Note Accidents for month/year (1946-54)
- Health Tests for week ending (1950-56)
- Neutron Exposure report for month (1946-58)
- Personnel Exposure reports (1957-58)
- Monthly and weekly reports (1951-58)
- Monitoring results (1945-57)
- Weekly meeting of section heads minutes (1945-55)
- Air Counts, pencil and ink originals (1950-62)
- Hand, head, shoe and nose counts (1944-56)
- Urinalysis/urine counts (1944-57)
- Film badge exposures (1957-58)
- Protective Equipment- respirators, clothing (1947-62)
- Safety meetings (1961-62)
- Experimental shots at TA-33 (1948-55)
- Tritium exposures at TA-33
- SL-1 accident
- DP Site explosion (1-14-47)
- Pajarito accident (1-8-53)

Since these documents are primarily occupational records, they were noted by the LAHDRA project team but determined not to be particularly relevant to off-site releases.

Other Documents in the LCLS Database

The 10,395 “Other documents” are primarily administrative records that range from 1943 to 1989. Examples of these records include:

- Contracts and contract modifications
- Reimbursement authorizations
- Personnel policies regarding overtime, moving expenses, employee benefits
- Personnel administrative panel meetings
- Organization charts (1945-89)
- Telephone directories (1944-89)
- The Atom (1964-75)
- Annual reports to Congress of the AEC (1948-73)

However, starting on p. 195 of the “Other documents” listing, several types of environmental and occupational documents are presented, including:

- Annual environmental monitoring reports (1970-92)
- H-Division progress reports (1943-80)
- RFI work plans for operable units (1989-90)
- Glenn Neely Notes (p. 278-301)

- Dept. of Labor log and summary of occupational injuries and illnesses (1989-92)
- Occurrence reports
- Newspaper articles

There are very few administrative documents in the LAHDRA database, since they are not generally relevant to the project, except possibly historical organization charts and phone directories. The H-Division documents are the same ones as in the H-Division section of the LCLS database. The annual environmental monitoring reports and RFI work plans are already part of the LAHDRA database.

Records Processing Facility Documents in the LCLS Database

RPF documents are the administrative record for the Environmental Restoration program at LANL. The 47,922 documents are also available on a searchable, internal LANL web site. The original paper copies were returned to the Central Records Center after being microfilmed. A copy of the microfilm rolls is available in the RRES Group Office in the Pueblo School Complex on Diamond Drive in Los Alamos. The document collection covers the entire operational period of the Laboratory. Members of the LAHDRA team reviewed portions of the RPF documents at the Central Records Center and the Records Processing Facility.

Records Processing Facility

The Records Processing Facility (RPF) contains the administrative record index for the Environmental Restoration (ER) group at LANL. The distribution of RPF holdings by document data is shown in Table 10. A searchable version of an associated database is available on the internally-accessible LANL ER Web site. The 243 boxes of original ER records and 63,000 frames of microfilm copies are stored at the LANL Records due to fire regulations. A duplicate set of the microfilm rolls is kept at the RPF. The RPF also holds aerial photographs, photographs of LANL catalogued by Technical Area, and engineering drawings. The project team did not review microfilm at the RPF, based on an understanding that the original documents had already been reviewed at the RMC.

Table 10: Distribution of ER Documents at the RPF by Date of Issuance

Document Date	No. of RPF Documents
1942 – 1949	1,871
1950 – 1959	4,340
1960 – 1969	4,684
1970 – 1979	4,755
1980 – 1989	9,864
1990 – 1992	26,326
1993	21,591
1994	37,114
1995	28,123
1996	12,330
1997	9922
1998	4,836
1999	3,387
2000	3,209

Challenges to 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. This section documents the most significant circumstances under which members of the project team working for CDC at Los Alamos have been denied or restricted in their access to classified records or document repositories. The instances having the most severe impact early in the project were associated with the Cerro Grande fire and with the later security incidents that involved hard drives missing from an X-Division vault. When access was restored after those events, document review was initiated under Special Security Plans that list six categories of documents to which our access is to be denied. A chronology of the main document access challenges experienced on the LAHDRA project is presented below.

The Cerro Grande Fire

At the time the Cerro Grande fire got out of control in 2000 and Los Alamos was evacuated, five document analysts were in town. They were unable to gain access to LANL facilities on May 8, 9, or 10, and they evacuated the town when ordered to do so on the afternoon of May 10. This period without access lasted several weeks, as LANL was shut down for some time and a period of reviews to ensure readiness for reopening followed. Some of these reviews may have actually been associated with classified material security, which was the cause of the period of denial of access to classified materials that followed.

Security Stand-Downs and the Fallout of Security Incidents

After the Cerro Grande fire, members of the project team were only able to access classified material areas for several days. During the week of June 9-16, 2000, four document analysts were in town and were denied access to the Central Records Center and to the LANL Report Collection. This was in spite of the fact that, in calls near the end of the previous week, I had been told that access would again be possible during that week. As we were given indications that access would likely be quickly restored, another analyst traveled to LANL the week of June 19-23. He was also denied access, and returned home after several days of performing miscellaneous support functions. The denial of access resulted from the incident in which classified material was lost and subsequently reappeared.

Need-to-Know Letter Received

A memorandum from DOE Headquarters affirming the project team's "need to know" was signed by General John Gordon on September 17, 2000 and was distributed to appropriate personnel throughout LANL and DOE Albuquerque.

Security Plan Promised

CDC project leaders held a meeting with some key LANL division managers during the week of November 20, 2000. At that meeting, LANL officials pledged to have a special security plan prepared before the end of 2000. This plan was to outline the procedures by which access of CDC and its contractors to classified records at LANL were to be restored.

First Special Security Plan

Around January 16, 2001, final signatures were obtained on a Special Security Plan covering the LANL Records Center, Archives, and Report Collection that was prepared by LANL personnel with comments from the project team and CDC. Under this security plan, document analysts must be escorted at all times when in classified document repositories, and documents are to be pre-screened to identify those that contain information in the following five categories are to be withheld:

1. Nuclear Weapons Design Information (documents relating solely to nuclear weapons design, such as weapon component blue prints, drawings, other schematic/graphical design information).
2. Sigma 14 and 15 Information (may be expanded to include the emerging Sigma 16 category)
3. Sensitive Compartmented Information (SCI)
4. Special Access Program Information
5. Foreign Government Information (FGI)

There is a provision for appeal to DOE Albuquerque in cases when information is withheld from project team review. In mid-February 2001, members of the project team regained access to the Central Records Center and the Reports Collection.

Calls for Review by Title Alone

Requirements for prescreening of materials before review by LAHDRA analysts were found by LANL personnel to be difficult to implement. The flowchart of the "LANL Document Review Process" has a block entitled "LANL Staff Notifies Owner to Screen Records." When faced with the prospect of screening the "LA" reports in the Report Collection that were issued after 1962, LANL personnel requested that we review the reports by title alone and appeal to DOE if documents had to be reviewed beyond their titles. While this process greatly reduces the resources required for document screening by LANL personnel, the practice is problematic because document titles are often not very descriptive of a document contents.

Second Special Security Plan

Preliminary activities to gain access to records held by the Office of the Associate Laboratory Directorate for Nuclear Weapons (ALDNW) began in mid-2001. A Special Security Plan for review of the records of that group was issued in June 2001. This second security plan added a sixth category of deniable material, Unclassified Sensitive Vendor Proprietary Information, and includes a requirement that a large number of documents be reviewed by title only (i.e., all classified documents issued after 1962 by the key organizations associated with nuclear weapons, and all other documents judged by LANL personnel to contain information falling under the six categories of deniable material).

Practices Changed in the Report Collection

Up until late November 2001, project team members were allowed to review classified reports in the Report Collection that were issued by entities other than LANL. Thousands of these classified reports were reviewed, in most cases with full text access, but in some rare cases by title alone when their Report Collection escort determined that the documents contained deniable material such as foreign government information. At a meeting of LANL personnel on November 28, 2001, those in attendance decided that "LANL cannot give access based on need-to-know for non-LANL documents. Documents belonging to other DOE contractors, other government agencies, private companies or other governments will require CDC/DOE to contact those entities and provide LANL with written need-to-know acknowledgement and permission to grant access."

Report Collection staff indicated in early January 2002 that it would be impractical to approach the "owners" of each of the thousands of individual classified non-LANL technical reports. Report Collection staff recommended that CDC request that DOE and DOD grant blanket authorization for appropriately cleared members of the CDC project team to review the reports assembled by LANL in the course of their work for DOE and DOD.

First Appeal to DOE Issued

In late December 2001, the first appeal of denials of access to classified records at LANL was sent to DOE Albuquerque by the project team. LAHDRA team members were informed by DOEAL that the appeal letter was received, and was handed off by the addressee (Deborah Miller, who was in charge of security issues) to Larry Kirkman (who was in charge of safety issues). No response to the December 2001 appeal letter has ever been received.

UK Documents Not All Made Available for Review

While it appeared that CDC had received approval from the owners of UK records held by LANL, the volume of records that LANL made available to C.M. Wood and Bob Whitcomb in July 2002 was a fraction of what the LAHDRA team was told LANL held. Apparently over half of the UK documents were withheld from CDC review because someone at LANL judged that they contained deniable category material.

Second Appeal Letter Issued to LANL

In September 2002, at the request of LANL, the LAHDRA team resubmitted the DOE appeal letter in modified form to the LAHDRA team's LANL point of contact to encourage those involved to put a workable appeal process into place and test it.

Contract with Classification Reviewers Expires

The contract that LANL had with PMTech for classification review of documents that LAHDRA analysts selected as relevant expired in early 2003, and there were no immediate plans to renew it despite the existence of a significant backlog of documents awaiting review. After PMTech's period of document review in March 2003, there were no classification reviewers lined up to support the process for public release of documents. LANL's "S-7" classification office reportedly could not support that review without contractor assistance.

CDC Requests that Work be Brought to Close under Existing Contract

On April 25, 2003, CDC notified ENSR that a decision had been made to have the project team bring information gathering at LANL to a close within remaining contract funding. The cost ceiling of the existing contract could not be substantially increased. Based on the findings of the information gathering to date, as will be summarized in an Interim Report of the project and evidenced in the project information database, and the extent to which key information access issues that remain can be resolved with DOE and LANL, CDC will evaluate whether to award another contract to continue the assessment of potential releases and/or health effects from historical activities at Los Alamos.

Prerequisites for Continued Work at Los Alamos Outlined by CDC

At a July 2003 public meeting held by the LAHDRA team, CDC outlined requirements that will have to be satisfied if CDC is to continue the LAHDRA project. First, the Department of Energy would have to provide CDC with sufficient funding to perform the work. Second, several key issues must be successfully resolved with DOE and LANL staff; 1) clear establishment of CDC's "need-to-know," 2) establishment of workable procedures for CDC to access documents held by LANL but not originated at LANL, 3) implementation of a consistent, usable appeal process for when CDC is denied access to documents, and 4) establishment of an ability for appropriately-cleared CDC staff to review documents withheld to CDC's contractors.

Tasks Authorized to Bring Work to Clean Breakpoints

In August 2003, CDC issued a contract modification that authorized the project team to perform a series of defined tasks that should significantly improve the usefulness and/or defensibility of the Interim Report and leave key project activities at cleaner breakpoints. These activities included: 1) Prepare a chronology of episodic or off-normal events described in H-Division reports, 2) Add section on site-wide tritium use to project report, 3) Process the relevant documents that have been selected but not released, 4) Finish review of paper records at the LANL Records Center, 5) Pursue getting relevant portions of LANL Legal Database, 6) Revisit ESH repository to review more recent accessions, and 7) Interview top interview candidates.

Reports Collection Resources Raised as an Issue

At an August 20, 2003 meeting with the manager in charge of the LANL Reports Collection, the ENSR project director was told that the LANL Reports Collection did not have sufficient staffing to continue to support the LAHDRA project. Several days later, after speaking with the Report Collection staff, that manager indicated that the project team could access the Report Collection vault to perform the limited close-out activities that were projected to occur under the remaining period of the existing contract.

CDC Returns to Complete Review of "UK Records"

During the week of September 15, C.M. Wood of CDC revisited LANL to complete the review of the documents of U.K origin that were in LANL's possession. During that visit, there was discussion regarding whether or not CDC analysts had to make a list of every document that they reviewed. Mr. Wood voiced an opinion that such a requirement would make review of un-catalogued records of that type excessively cumbersome and impractical.

Response to Appeal Letter Received

On October 28, 2003, DOE provided CDC and the project team with a response to the second appeal letter. With a few minor exceptions, officials at the DOE Los Alamos office upheld the denials of access to the documents that the LAHDRA team had appealed. This continuance of the denial of access was in part based on an exercise in which a small subset (approximately 7%) of classified LA/LAMS reports issued after 1962 were reportedly sampled and reviewed by DOE and LANL personnel.

Classification Review Backlog Quantified

On October 30, 2003, the LAHDRA team provided their LANL point of contact with listings of the documents that LAHDRA analysts selected at LANL that are awaiting classification officer action (i.e., verify unclassified/clear for public release, downgrade to unclassified, or redact for public release). Some of the documents in that backlog were requested by LAHDRA analysts as far back as 1999. LANL staff reportedly asked for this accounting of the "backlog" so that resources and a new contract could be lined up for the classification reviews. The seven-part list included documents at the LANL Records Center, Report Collection, Central Research Library, and the TA-35-58 office that has been used by the project team. Team members then provided Ms. Holmes with a prioritization of the components of the list, so that the most important documents could be reviewed first if at all possible.

Review of Documents in Backlog Begins

In early 2004, LANL reestablished a contract with PMTech to review documents in the backlog of items requiring review for public release. LANL requested that the LAHDRA team work with PMTech to facilitate the review of items in the backlog, specifically in cases where items on the master list of documents for review could not easily be matched with documents in the identified box of records. LANL estimated that it would require the balance of calendar year 2004 to complete release of documents in the review backlog.

LANL Resources Limit LAHDRA Team Activities

In January 2004, LANL staff informed CDC that there were insufficient resources to support the processing of documents in the backlog by their contractor while also allowing the LAHDRA team to complete review of paper documents at the Records Center or review records in the Litigation Support files held by Lab Counsel. CDC instructed the LAHDRA project team to support PMTech in the release of documents from the backlog, and discontinue work on completing review of paper documents at the Records Center or review of documents in the Litigation Support files.

Airborne Radionuclide Effluent Monitoring Data and Prioritization of Airborne Radionuclide Releases

LANL operation started in 1943 and has continued to the present. In the early years, radiation science, environmental science, and occupational health were all disciplines that were in their infancy. As time progressed, LANL has, by their own volition and by pressure from the public and government, increased monitoring, documentation, and reporting.

Operational Eras

To provide some general overview, the operations of LANL were broken down into four phases:

<u>Phase I – 1944 to 1950</u> –

This was the period at Los Alamos where the pressure to develop the atomic bomb was the greatest, and the least was known about plutonium and other industrial hazards such as mercury.

In these early years of Los Alamos operations, some plutonium processing facilities such as D Building and the facilities at the DP Site were designed and operated with positive building pressure (LANL, 1947, Repos. No. 3085). No monitoring of stacks was performed, and the data that were collected were not necessarily stored as archival records. At many times the instruments to measure effluents were either not available, or did not have calibrations, since the measurement of radiation itself was so new.

As an example, in an effort to protect workers, there were samples taken by large converted vacuum cleaners called "Filter Queens" that were an attempt to measure "in-room" plutonium concentrations. However, these air samplers did not have built-in flow rate meters. As the filter papers got dirty, the flow rate decreased. Daily a "count" was taken with an instrument and counts per minute per liter were calculated to see if it was too "high" (no known limits were documented, but it is surmised that health protection personnel had guidelines). It is unknown if corrections for flow rate, or impinged radon particles, etc. were accomplished. Only simple log books with the count data on a daily basis have been found. The data is tagged with a "Filter Queen" (FQ) identifier or a room identifier, but where those FQs were located in the room has not been determined.

Environmental monitoring within the laboratory boundary and surrounding areas began shortly after the start of Laboratory operations in 1943. Most of the early monitoring involved collection of non-routine air, water, soil, and sediment samples for radioactive analyses. The early environmental monitoring program was used to determine the spread of radioactive contamination to surrounding land areas and to estimate potential radiation exposures that might be occurring as a result of laboratory emissions. The monitoring program grew in size and scope as activities at the laboratory expanded.

In general, this phase of operations resulted in a substantial amount of collected data, but the assumptions (i.e., flow rates, calibrations, room placement, and other measurement corrections) are largely unknown and therefore uncertain.

Data Completeness/ Missing Data– Data in this era are not complete and reconstruction from the available data will be difficult. Some radionuclides have little information, like polonium. Isotopic data is not usually available. As far as daily or monthly data are concerned, they exist but the surrounding supporting information is sparse or has not been found.

Incident vs. Routine Release Data– Incident data does exist but it is clear that dose to off-site personnel or the environment are not of concern, worker dose and safety are the primary focus. Data is collected for the purpose of protecting workers, not protecting the environment.

Compilation vs. Raw Data– No LANL compilations exist. Raw data is not analyzed and processing will be difficult since procedures used for collection are sparse or do not exist.

<u>Phase II – 1951 to 1973</u> –

In this phase of operations, LANL began to be concerned about releases to the environment. This was in part due to the fact that exhaust air re-entrainment was causing contamination at building air intake points. In this era scientists also began to be concerned more about occupational health and concerns for the environment.

Increased monitoring over the years meant the collection of a larger number of routine samples for all types of media (air, water, soil) and for a growing list of contaminants. The frequencies for which samples were collected also increased over the years and with the advent of new environmental protection and compliance laws of the early 1970s, LANL saw the need to further increase their monitoring of the environmental conditions both on-site and off-site and enhance the format with which they reported measurement results. The need to do more monitoring was also brought to the LANL's attention by independent reviewers and experts (Parker, 1974).

Based on reports reviewed by the LAHDRA team to date, most of the emphasis for environmental monitoring during the early years was placed on measuring radioactive constituents, however later on beginning in the late 1960s and 1970s some limited sampling was performed for lead, mercury, chromium, and beryllium. A review of early LANL's environmental monitoring of the surrounding areas (e.g., canyons) pointed out the need to increase sampling for all media and to perform radiochemical analyses for isotopic plutonium and specific fission products associated with fall-out from atmospheric weapon tests to better differentiate between global fallout and impacts from LANL operations (Parker, 1974).

Environmental monitoring of the laboratory and surrounding areas has been conducted primarily by the University of California-Los Alamos National Laboratory, the United States Department of Energy and its predecessors, U.S. Geological Services, and in more recent years the State of New Mexico. From 1955 to 1970 the U.S.G.S. performed radiochemical and metal analyses of samples collected from supply wells, the Rio Grande River, local surface streams, and test monitoring wells.

Data Completeness/ Missing Data - The documents found in this era are more complete and detailed data with collection techniques begin to appear in the 1960s. Procedures used are still sparse. More radionuclides are reported and isotopic analysis is more frequent. Environmental data is collected but not in a routine fashion (changing nuclides) and without an established baseline it is difficult to assess the LANL site impact.

Incident vs. Routine Release Data – Routine releases are beginning to be cataloged and stacks are monitored, however measurement ineffectiveness and poor documentation still affect data quality. Incidents are cataloged in the same way as the previous period. Compilation vs. Raw Data – Compilations do not exist for most of this period, but in 1970 the first annual environmental monitoring report is published, and in 1973 a draft of the site-wide Environmental Impact Statement (EIS) is begun. It was finally published in 1979. Raw data has been found for most of these years but has not been compiled into a database to check for omissions.

Phase III – 1974 to 1985 –

The 1970s brought an era of social responsibility and new government regulations that sought to protect the environment. The first LANL annual environmental monitoring report was published in 1970. Environmental science was now an established field and sampling programs and advanced methods and instrumentation began to be applied to collection, analysis, and reporting of environmental data. 1979 brought the publishing of the first site-wide Environmental Impact Statement (EIS), and thus brought LANL into the era where monitoring was of a very high priority.

Data Completeness/ Missing Data - The data in this era is largely from compiled data from the ES&H group at LANL. Raw data from laboratory analyses or direct instrument measurements was not solicited by the LAHDRA team.

Incident vs. Routine Release Data – For this era both incidents and routine releases are cataloged and data is available.

Compilation vs. Raw Data – Compilation data exists and was the primary source for the LAHDRA team. Raw data is available but due to the volume of data was not solicited.

Phase IV – 1985 to the Present –

This is the modern era of LANL operations. Annual environmental reports are created each year and extensive raw data are collected and cataloged in the LANL computer systems.

Data Completeness/ Missing Data – Since LANL environmental reports are accepted to be correct; in this era the compilation data was used directly and raw data has not been generally requested.

Incident vs. Routine Release Data – For this era both incidents and routine releases are cataloged and data is available.

Compilation vs. Raw Data – Compilation data exists and was the primary source for the LAHDRA team. Raw data is available but due to the volume of data was not solicited.

Airborne Release Points

Appendix J (Table J-1) contains a list of all the cataloged release points from 1944 to the present based on data collected from environmental reports and other LANL supplied documents. Since LAHDRA team members do not have direct experience at each of the facilities, there may be release points that are entered twice due to naming issues.

Prioritization of Airborne Radionuclide 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. This section outlines the calculation of priority indices for six airborne radionuclide sets (plutonium, uranium, tritium, Radioactive Lanthanum (RaLa), Mixed Fission Products (MFP), and Mixed Activation Products (MAP)) for airborne off-site releases for LANL.

Priority Index (PI) is 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 10 CFR 20 (10CFR20, 2003). 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 (O'Brien and Burmeister, 2004 [Repos. No. 4136]). 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. The priority index does not consider environmental transport and dilution. Although the lowest available (most conservative) MPC is used, the priority index does not otherwise address uptake factors. It does not consider decay in transport, which means, as calculated, the priority index would tend to overstate the importance of short-lived materials. Within these limitations, it provides a simple tool for establishing the relative importance of various airborne releases.

For the years 1944 to the present, LANL summary data were reviewed to collect available information for air releases or inventories used in explosions. This effort did not include a source term reconstruction, rather it relied on LANL compilations of releases with some adjustments by the LAHDRA team. Not all the data compiled herein are measurements of stack releases. A Microsoft Access® Off-Site Releases (OSR) Database was created to tabulate the information and to link it to existing LANL documents that have been assembled by the LAHDRA project team. In most cases, these documents are available as electronic scanned documents, in Adobe Acrobat® Portable Document Format (PDF) files that are linked via forms in the database.

<u>Data Sources</u>

Presently, there are five main data sources for the radionuclide releases information at LANL (see Figure 8 for time period coverage for these documents):

1) (Graf, Unknown) - Joe Graf Binders 1 and 2 – These are two binders of documents assembled by an ES&H employee (Joe Graf) in the early 1970s to document releases from LANL before 1973. This was done to support development of a draft site-wide Environmental Impact Statement (EIS) in 1973. The EIS was finally published in 1979. These data consist of room air concentrations, stack monitoring data, ES&H reports, and miscellaneous memos.

2) (Miller, 2001) - Scott Miller was an ES&H employee who compiled stack release data from 1973 to 1990. These data were assembled in a three-ring binder that was entered into the LAHDRA project information database. A Microsoft Excel® file containing this information was also provided to the project team.

3) (Dummer et al., 1996) – A detailed study of all the RaLa shots and the quantities of RaLa involved in high explosives tests from 1944 to 1962.

4) (Drake, 1971) – This is a memo that details uranium used in explosive testing from 1944 to 1970.

5) (Jordan and Black, 1958) – This is an article in the American Industrial Hygiene Association Journal that speaks of airborne radioactive effluents from LANL. This work is one of the most important early studies on releases; it is the best-available scientific data identified on possible early emissions.

Radionuclides Included in the Prioritization

The summary data for airborne radionuclide prioritization is grouped by radionuclide “sets”. These “sets” are as follows: plutonium, uranium, tritium, Radioactive Lanthanum (RaLa), Mixed Fission Products (MFP), and Mixed Activation Products (MAP). Table 11 through Table 16 contain the summary data for the six sets of radionuclide data. The sums of the corrected activities and calculated priority indices are included.

If a year is not listed, it does not necessarily indicate a lack of summary data. The data may exist and not have yet been found, the data may not exist at all, or available information may consist of qualitative anecdotal evidence from interviews.

The data in this preliminary prioritization build upon the work documented in the earlier draft LAHDRA report (LAHDRA, 2002), and represent roughly a three-fold increase over LANL compilations for plutonium due to the application of additional corrections for sample line loss (Shonka, 2001) and filter burial factors (Vasilik, 1976) for particulate releases from stacks. In some cases, like uranium, the release quantities are smaller than in the past assertions, since corrections for release fractions from explosive tests have now been applied. The effort described in this calculation represents our best knowledge as of the date of this calculation. With the use of the OSR database, each data record can now be traced to the LAHDRA database repository number, and the scanned image as an Adobe PDF file can be verified or reviewed.

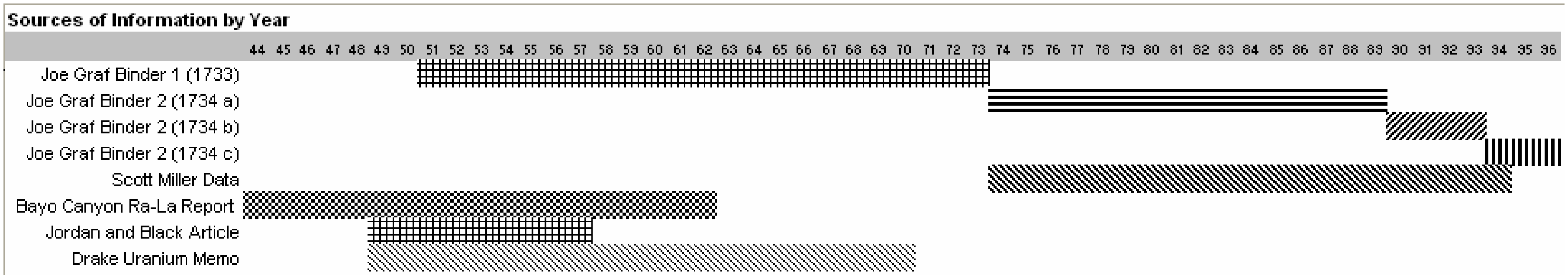


Figure 8: Time Period Coverage for Key Effluent Data Source Documents

Table 11: Airborne Plutonium Summary Data

Activity Released in µCi and Priority Index (Dilution Volume in mL)

Year	Pu Activity	Pu Priority Index
1948	4.96E+05	2.48E+19
1949	4.96E+05	2.48E+19
1950	5.92E+05	2.96E+19
1951	8.64E+04	4.32E+18
1952	1.82E+05	9.12E+18
1953	1.13E+05	5.64E+18
1954	7.46E+04	3.73E+18
1955	2.88E+05	1.44E+19
1956	2.48E+05	1.24E+19
1957	2.40E+05	1.20E+19
1958	2.66E+05	1.33E+19
1959	5.99E+05	3.00E+19
1960	1.22E+05	6.12E+18
1961	2.61E+04	1.31E+18
1962	3.13E+04	1.57E+18
1963	2.23E+04	1.11E+18
1964	9.24E+03	4.62E+17
1965	3.49E+04	1.74E+18
1966	3.94E+04	1.97E+18
1967	1.03E+05	5.13E+18
1968	9.74E+04	4.87E+18
1969	1.41E+05	7.04E+18
1970	4.10E+04	2.05E+18
1971	2.04E+04	1.02E+18
1972	2.68E+04	1.34E+18
1973	2.77E+04	1.39E+18
1974	2.72E+03	1.36E+17
1975	7.96E+02	3.98E+16
1976	6.79E+01	3.39E+15
1977	1.27E+02	6.35E+15
1978	1.12E+02	5.61E+15
1979	1.09E+03	5.43E+16
1980	7.47E+02	3.73E+16
1981	5.65E+01	2.83E+15
1982	1.12E+02	5.60E+15
1983	1.13E+02	5.63E+15
1984	1.41E+02	7.05E+15
1985	2.13E+02	1.06E+16
1986	2.07E+02	1.04E+16
1987	7.28E+01	3.64E+15
1988	7.23E+01	3.62E+15
1989	4.53E+01	2.27E+15
1990	2.57E+01	1.28E+15
1991	3.55E+01	1.77E+15
1992	1.91E+01	9.54E+14
1993	6.44E+00	3.22E+14
1994	1.25E+01	6.24E+14
1995	8.90E+01	4.45E+15
1996	2.33E+01	1.16E+15

Note regarding scientific notation: 4.96E+05 equals $4.96 \times 10^{+5}$, which equals 4.96 x 100,000 or 496,000.

Table 12: Airborne Uranium Summary Data

Activity Released in µCi and Priority Index (Dilution Volume in mL)

Year	U Activity	U Priority Index
1949	1.88E+03	3.13E+16
1950	1.95E+04	3.25E+17
1951	4.54E+03	7.56E+16
1952	3.91E+03	6.52E+16
1953	7.68E+01	1.28E+15
1954	3.76E+03	6.27E+16
1955	3.88E+03	6.47E+16
1956	4.40E+03	7.34E+16
1957	2.68E+03	4.47E+16
1958	2.41E+03	4.02E+16
1959	2.16E+03	3.61E+16
1960	1.72E+03	2.86E+16
1961	1.57E+03	2.61E+16
1962	9.25E+03	1.54E+17
1963	2.51E+04	4.19E+17
1964	5.22E+03	8.70E+16
1965	7.27E+03	1.21E+17
1966	7.75E+03	1.29E+17
1967	6.14E+06	1.02E+20
1968	4.02E+06	6.70E+19
1969	4.12E+06	6.87E+19
1970	7.48E+03	1.25E+17
1971	3.53E+04	5.89E+17
1972	1.00E+04	1.67E+17
1973	4.82E+03	8.03E+16
1974	2.57E+03	4.29E+16
1975	2.94E+03	4.90E+16
1976	1.35E+03	2.24E+16
1977	7.09E+02	1.18E+16
1978	5.27E+02	8.78E+15
1979	9.33E+02	1.55E+16
1980	7.91E+02	1.32E+16
1981	1.27E+03	2.12E+16
1982	1.37E+03	2.29E+16
1983	8.88E+02	1.48E+16
1984	1.21E+03	2.01E+16
1985	7.28E+02	1.21E+16
1986	8.44E+02	1.41E+16
1987	1.08E+03	1.79E+16
1988	5.59E+02	9.31E+15
1989	3.94E+02	6.56E+15
1990	3.49E+03	5.81E+16
1991	7.92E+04	1.32E+18
1992	2.60E+03	4.33E+16
1993	5.15E+03	8.59E+16
1994	3.88E+02	6.47E+15
1995	5.27E+03	8.78E+16
1996	3.90E+01	6.50E+14

Table 13: Airborne Tritium Summary Data

Activity Released in µCi and Priority Index (Dilution Volume in mL)

Year	H-3 Activity	H-3 Priority Index
1967	2.79E+10	2.79E+17
1968	3.17E+10	3.17E+17
1969	3.45E+10	3.45E+17
1970	3.71E+10	3.71E+17
1971	1.02E+10	1.02E+17
1972	6.51E+09	6.51E+16
1973	1.29E+09	1.29E+16
1974	7.32E+09	7.32E+16
1975	6.20E+09	6.20E+16
1976	3.40E+09	3.40E+16
1977	3.86E+10	3.86E+17
1978	1.86E+10	1.86E+17
1979	1.50E+10	1.50E+17
1980	7.52E+09	7.52E+16
1981	7.23E+09	7.23E+16
1982	1.59E+10	1.59E+17
1983	7.89E+09	7.89E+16
1984	1.49E+10	1.49E+17
1985	8.64E+09	8.64E+16
1986	1.07E+10	1.07E+17
1987	3.17E+09	3.17E+16
1988	1.10E+10	1.10E+17
1989	1.44E+10	1.44E+17
1990	1.18E+10	1.18E+17
1991	5.17E+09	5.17E+16
1992	1.30E+09	1.30E+16
1993	1.48E+09	1.48E+16
1994	1.07E+09	1.07E+16
1995	1.11E+09	1.11E+16
1996	5.77E+08	5.77E+15

Table 14: Airborne RaLa Summary Data

Activity Released in µCi and Priority Index (Dilution Volume in mL)

Year	RaLa Activity	RaLa Priority Index
1944	1.11E+06	5.56E+14
1945	1.84E+07	9.18E+15
1946	2.06E+07	1.03E+16
1947	2.27E+07	1.14E+16
1948	1.22E+07	6.12E+15
1949	2.83E+07	1.41E+16
1950	1.98E+07	9.89E+15
1952	6.37E+06	3.19E+15
1953	1.07E+06	5.32E+14
1954	1.56E+07	7.79E+15
1955	4.08E+07	2.04E+16
1956	3.60E+07	1.80E+16
1957	1.74E+07	8.68E+15
1958	9.85E+06	4.92E+15
1959	8.32E+06	4.16E+15
1960	5.56E+06	2.78E+15
1961	2.43E+07	1.22E+16
1962	1.36E+07	6.80E+15

Table 15: Airborne Mixed Fission Products Summary Data

Activity Released in µCi and Priority Index (Dilution Volume in mL)

Year	MFP Activity	MFP Priority Index
1956	9.35E+05	9.35E+12
1961	1.80E+03	1.80E+10
1962	4.31E+05	4.31E+12
1963	6.77E+05	6.77E+12
1964	3.12E+05	3.12E+12
1965	3.84E+05	3.84E+12
1966	3.98E+04	3.98E+11
1967	1.31E+04	1.31E+11
1968	1.35E+04	1.35E+11
1969	1.44E+08	1.44E+15
1970	1.74E+04	1.74E+11
1971	3.75E+04	3.75E+11
1972	7.13E+08	7.13E+15
1973	2.10E+08	2.10E+15
1974	6.11E+03	6.11E+10
1975	2.31E+03	2.31E+10
1976	1.97E+03	1.97E+10
1977	2.85E+03	2.85E+10
1978	1.69E+03	1.69E+10
1979	1.71E+03	1.71E+10
1980	2.29E+03	2.29E+10
1981	1.61E+03	1.61E+10
1982	1.97E+03	1.97E+10
1983	9.26E+02	9.26E+09
1984	1.69E+03	1.69E+10
1985	1.40E+03	1.40E+10
1986	2.64E+03	2.64E+10
1987	1.29E+03	1.29E+10
1988	1.16E+03	1.16E+10
1989	4.36E+05	4.36E+12
1990	2.01E+04	2.01E+11
1991	4.70E+03	4.70E+10
1992	1.29E+04	1.29E+11
1993	3.28E+03	3.28E+10
1994	3.00E+08	3.00E+15
1995	1.14E+03	1.14E+10
1996	4.07E+02	4.07E+09

Table 16: Airborne Mixed Activation Products Summary Data

Activity Released in µCi and Priority Index (Dilution Volume in mL)

Year	MAP Activity	MAP Priority Index
1976	5.89E+09	2.95E+16
1977	4.77E+10	2.38E+17
1978	1.17E+11	5.84E+17
1979	1.19E+11	5.96E+17
1980	1.46E+11	7.30E+17
1981	3.53E+11	1.77E+18
1982	2.51E+11	1.26E+18
1983	4.64E+11	2.32E+18
1984	7.37E+11	3.68E+18
1985	1.26E+11	6.30E+17
1986	1.12E+11	5.61E+17
1987	1.50E+11	7.50E+17
1988	1.21E+11	6.06E+17
1989	1.56E+11	7.81E+17
1990	1.13E+05	5.66E+11
1991	5.72E+10	2.86E+17
1992	1.43E+11	7.14E+17
1993	3.34E+10	1.67E+17
1994	1.01E+11	5.05E+17
1995	4.34E+10	2.17E+17
1996	1.12E+10	5.60E+16

Nuclide "Collections"

In this work, the concept of a "nuclide collection" was developed. This is simply the collection of nuclides as grouped in the LANL document from which they came. For instance, in many cases values reported have the radionuclides Pu-239, Pu-238 and U-235 associated with them. No mention of the analysis type is made and so the analysis can be attributed to several nuclides. In these cases, the nuclide collection would have all of these radionuclides listed in it as a string. During the analysis when separating the nuclides, "nuclide sets" were created that are simply the nuclide collection values that will be attributed to a nuclide such as plutonium. These nuclide sets are defined in the queries labeled with a "NC" in the beginning of the title. Plutonium has the lowest MPC, so if a nuclide collection contained both plutonium and uranium, then the value was counted for plutonium. This method was used to prevent both "double" counting the release and to assign the larger value to plutonium since it is believed to be the most important radionuclide and of the highest priority. This practice may overstate the importance of plutonium, particularly after the late 1970s. When the "nuclide set" was created for uranium, only those entries that did not contain plutonium radionuclides were included.

Plutonium**:** The 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 priority indices are slightly higher in this assertion for the pre-1975 era, since these years have a sample line loss correction factor of 2.0 (Shonka, 2001) applied and a filter burial correction factor of 1.6 applied. The sample line loss factor is a generic one LANL applies to most old stack sampling systems, and the burial factor is one previously calculated by LANL (Vasilik, 1976). These corrections may also be appropriate for years following 1975, but have not been applied in this calculation. No documentation has been found identifying when LANL first applied these correction factors, but routine application is evident by the 1980s. See Table 11 for the total activity in microcuries (µCi) and the PI in dilution volume (mL) for plutonium.

<u>Uranium</u>**:** 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. In the case where a nuclide collection contained both plutonium and uranium it was counted in the plutonium data. The uranium data are for nuclide collections that contain only uranium (see note on “nuclide collections” above). 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 (Shonka, 2001) and filter burial correction factors (Vasilik, 1976) of 2.0 and 1.6 respectively, applied to all data prior to 1976. Note that the filter burial factor of 1.6 was originally specified for plutonium and was assumed in this calculation to be applicable for uranium, although uranium has a lower energy alpha, and subsequently this may warrant refinement in the future. Additionally, Atmospheric Release Fractions (ARF) and Respirable Factions (RF) (DOE, 1994) 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. Of course, the amount that was then transported off-site would be dependent on local meteorology, which is beyond the scope of this prioritization. The geometric mean of the ORF, estimated as the square root of the range of values, is 0.001. This value was applied to the entire uranium inventory expended in explosive tests.

The overall range for the priority index 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. It is noteworthy that the years 1967, 1968, and 1969 have very high uranium release values. These values are directly from the LANL documents (see Figure 9 below) and have been checked; however, in this phase of the project it has not been possible to confirm these data. See Table 12 for the total activity in microcuries (µCi) and PI in dilution volume (mL) for uranium.

TA-15 (R-Site)	1967	Normal Uranium	1.20
TA-15 (R-Site)	1967	Tritium	3.59×10^3
TA-15 (R-Site)	1968	Normal Uranium	0.75
TA-15 (R-Site)	1968	Tritium	4.50×10^3
TA-15 (R-Site)	1969	Normal Uranium	0.75

Figure 9: Unusually High Uranium Values, Ci (excerpt from “Joe Graf Binder 2”)

Tritium**:** The values for tritium 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. 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 MAP.

Tritium as an elemental gas (as opposed to water vapor that contains tritium) is a low density gas and disperses rapidly in the atmosphere. It also has a relatively short half-life (approximately 12.3 years - compared to plutonium and uranium at thousands of years) and it is readily incorporated into compounds. 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. See Table 13 for the total activity in microcuries (µCi) and PI in dilution volume (mL) for tritium.

Radioactive Lanthanum (RaLa)**:** RaLa has been subjected to a dose reconstruction by LANL personnel, including source term evaluation (Dummer et al., 1996). 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. No testing with RaLa was 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 not a high priority radionuclide as compared to nuclides, especially since many other of the radionuclides are believed to be understated. See Table 14 for the total activity in microcuries (µCi) and PI in dilution volume (mL) for RaLa.

Mixed Fission Products (MFP)**:** 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}. The reasons for this variability and the lack of data prior to 1961 have not yet been explored. 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 is much higher than normal. The reasons for these elevated values have not yet been explored.

The MPC used for MFP (1.0E-7) is from footnote 2 of Appendix B of 10CFR20. The priority indices for MFP are not high. If the decay correction for environmental transport were applied, they would be even lower, since MFP radionuclides in general have short half-lives. See Table 15 for the total activity in microcuries (µCi) and PI in dilution volume (mL) for MFP.

Mixed Activation Products (MAP)**:** MAP is the largest portion of the airborne radioactive releases post-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 nuclides included in the MAP "nuclide set" were as follows: MAP, G/MAP, P/VAP and the air activation products C-11, N-13, O-15, and Ar-41 (*Note – G/MAP is Gaseous Mixed Activation Products and P/VAP is Particulate Various Activation Products*). These are all short-lived MAP radionuclides that accelerator Health Physicists consider to be "MAP" traditionally. However, this facility also releases activation products that are longer-lived particulates. These particulate releases are traditionally not considered "MAP". Short-lived MAP is measured via an in-stack ion chamber, whereas the particulates are long-lived measured by counting of the in-stack filters in a laboratory.

In 1990, the priority index was smaller than in other years. In 1991 there are five records that meet the MAP "nuclide set". In 1990, however, there are only two records. This lack of reported data resulted in the lower priority index in 1990. No further investigation has yet been done.

The maximum priority index was 10^{18} and the minimum was 10^{16} (ignoring the 1990 data). See Table 16 for the total activity in microcuries (µCi) and PI in dilution volume (mL) for MAP.

Figure 10 plots all six nuclide sets on the same graph to see the relative magnitude of priority indices (dilution volume in milliliters based on non-occupational MPC) for non-decay corrected activity. For the purposes of this report, data was cut off in 1996.

Conclusions Regarding Prioritization of Airborne Radionuclide Releases

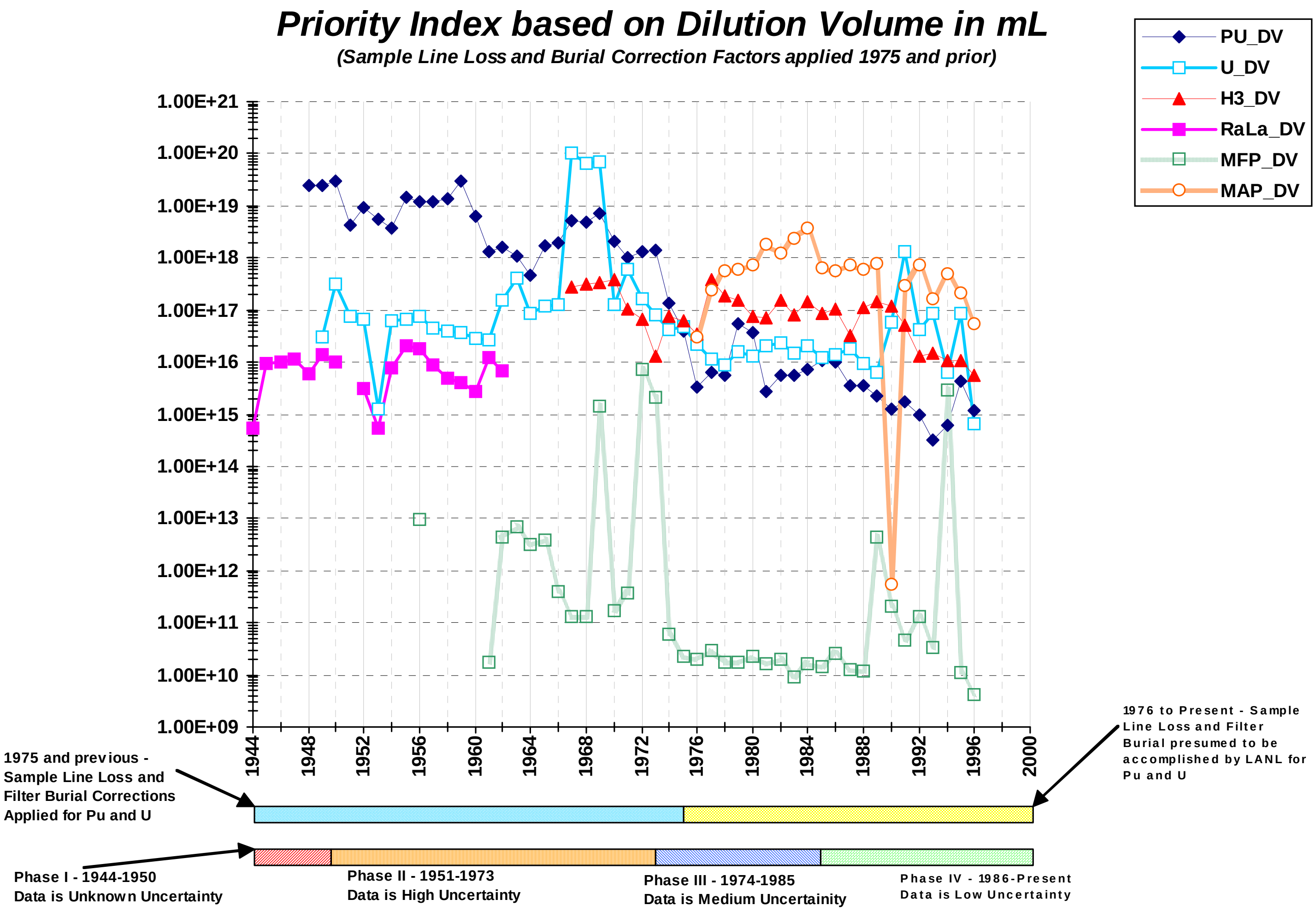
The current results indicate that, based on LANL compilations of releases, plutonium and uranium would be of primary concern up until the early 1980s. From then until the present, the MAPs would be of primary concern. However, in some cases, limited or no data were found in LANL compilations of releases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

Data completeness **-** This effort was intended to prioritize and get a "first look" at the scope and extent of radionuclides released at LANL over the years of its operation. Due to those scope limitations during this information gathering phase, limited effort has been expended entering raw data from LANL. In general, the values entered into the Off-Site Releases Database came from LANL compilations. Little effort could be expended to enter data from logbooks or other more detailed data sources. A significant amount of original release information (that is, lab measurements of a filter from a stack) for the 1950s and 1960s is available.

Polonium **-** No effluent data have been found for polonium, but it is known that significant quantities were used. Due to its shorter half-life, perhaps thousands of times more curies of polonium then plutonium were used. In the early years, plutonium was the most valuable substance on earth and was held in strict control. However, since polonium was more readily available, it was not inventoried as closely as plutonium. Large amounts were used in explosive or destructive tests for nuclear weapon initiators.

Pre-1967 tritium **-** There are no pre-1967 effluent data for tritium. The LAHDRA project has identified documents that refer to significant tritium releases before 1967, but those documents have not been released by LANL as of this writing. Appendix D contains information about tritium operations at LANL.

Unmonitored, unintentional releases **-** In the early years of Los Alamos operations, some plutonium processing facilities such as D Building and the facilities at the DP Site, were designed and operated with positive building pressure (LANL, 1947, Repos. No. 085, see Figure 11 below). This could have resulted in significant unintentional release of building air out of doors and exit points other than the stacks. This also can impact releases from large facilities such as LANSCE.



The eras of operation in the priority index chart are broken up into four phases in an attempt to connote that the uncertainty of the data is different.

Phase I - In the years 1944-1960, data are not available or are in many cases missing. Due to the "new" nature of the science of radioactivity, measurements were not accomplished as in modern times, so the data have "unknown" uncertainty. Workers were protected, but consequences to the environment were not widely acknowledged until later in this era.

Phase II – For the period of 1961-1973, the data collected are more voluminous, but the modern era of "environmental consciousness" has not occurred, and so the data are of relatively high uncertainty.

Phase III – The period of 1974-1985 was after the US government demanded a site-wide Environmental Impact Statement (EIS), and so ushered in the modern era of "environmental consciousness". Therefore, measurements were being taken in a more systematic way and the uncertainty of the measurements is "Medium".

Figure 10: Plot of Priority Index Values for LANL Airborne Contaminants over Time

> The ventilation system has been designed so as to give a change of air in each of the operating areas once every two minutes. This has been sufficient to keep the plutonium concentration in the rooms well below tolerance. Outside air is blown into each of the buildings through cloth filters at such a rate as to maintain the inside pressure slightly above atmospheric. It is then drawn out through the central duct system to the air filtration plant, where it passes through a bank of five electrostatic precipitators and then is exhausted up the stacks. The system handles 200,000 cubic feet of air per minute. The average

Figure 11: LANL Description of DP Site Ventilation (excerpt from LANL, 1947)

Small contributors **-** There are a number of nuclides like Mn-54, Au-194, or Ac-227, which do not fall into one of the six existing "nuclide sets". Since there were few data records involving these radionuclides, and it is known that these nuclides were not primary radionuclides that LANL was working with, priority indices were not calculated. The overall contribution of these nuclides is thought to be very small and subsequently no priority indices are computed or assigned in this calculation.

Beryllium **-** In the site-wide EIS (LANL, 1979) table 4.1.2-8 (see Figure 12 below) contains information on explosive tests for uranium and beryllium. Using this information, the priority indices in Table 17 (see below) were computed based on required dilution volume in cubic meters. Note that the priority index for beryllium is five times that of uranium. Furthermore, these data are only from explosive tests, and there were other sources of beryllium such as the beryllium shop and initiator testing. In a logbook from October 1947, one LAHDRA team member noted that the LANL director was just starting to require beryllium protection for workers. Therefore, it was surmised that there were no beryllium controls before 1947. Furthermore, it would appear that there were ventilation hoods used after 1947 to protect workers but the stacks were unfiltered and unmonitored. As time progressed and more was learned, LANL began to accomplish more to protect the environment from beryllium, but no study of the historical progression has been found. These factors indicate that beryllium is in need of further study and could be equivalent to plutonium in terms of the priority it warrants in evaluation of potential health effects.

Pre-1973 LANL plutonium releases **– Figure 13** and Figure 14 are a table and text, respectively, from the site-wide EIS (LANL, 1979) from which the 1.2 curie release value for plutonium comes from for the years 1948-1972. More work should be undertaken to estimate pre-1948 airborne plutonium releases, since there were simple control measures in place during this period. It is also important to note that the 1.2 Ci value is uncorrected by sample line loss and filter burial (see plutonium summary). Early plutonium releases are not well known and further study should be done.

ORF Corrections **–** In the site-wide EIS (LANL, 1979), the percentages of various elements aerosolized from explosive tests are listed as 10%, or 0.1 (see Figure 12 below). In this LAHDRA prioritization calculation, it was asserted that the Overall Release Fraction (ORF) was 0.001. This was based on a combination of Airborne Release Fraction and Respirable

Fraction. If the LANL asserted figure of 0.1 were to be used, the uranium priority index would change significantly for the years where uranium was used in explosive tests. At this time the 0.001 ORF was retained in this calculation since it was judged to be more appropriate.

TABLE 4.1.2-8

CALCULATED ATMOSPHERIC CONCENTRATIONS OF ELEMENTS USED IN DYNAMIC EXPERIMENTS[c]

Element	1976 Annual Usage (kg)	Percent Aerosolized	Annual Avg. Conc. (ng/m^3) @ 4 km	@ 8 km	Applicable Standard (ng/m^3)
Uranium (D-38)	1023	10[a]	0.1	0.04	9000
Be	25.5	2[a]	0.0007	0.0002	10 (30 day avg.)
Hg	36.1	100[b]	0.05	0.02	None
Pb	18.6	100[b]	0.02	0.08	None
TOTAL			0.17	0.068	10,000 (For total heavy metals N > 21)

a) Based on experimental measurement.

b) Assumed percentage aerosolized.

c) See Appendix H, pages H-37, H-38, and H-104, for update.

Figure 12: 1979 EIS Data on Uranium and Beryllium in Dynamic Experiments

Table 17: 1976 Beryllium Priority Calculation

Element	1976 Annual Usage (kg)	Percent Aerosolized	Aerosolized Quantity (kg)	Applicable Standard (ng/m^3)	Priority Index (m^3)
Depleted Uranium	1023	10%	102.3	9000	1.14E+10
Be	25.5	2%	0.51	10	5.10E+10

TABLE 4.1.2-3

ATMOSPHERIC RELEASES OF RADIOACTIVITY

Cumulative Radionuclides Released to the Atmosphere Prior to 1973[a]

^{3}H	120,000
Mixed Fission Products	0.006
^{235}U	0.086
^{238}U	0.005
^{238}Pu	0.056
^{239}Pu	1.2

Figure 13: Pre-1973 Airborne Releases Table (Excerpt from LANL, 1979)

The inventory of radioactive atmospheric releases before 1973 (see Table 4.1.2-3) was made on the basis of stack sampling through December 1972.[4-42] The absence of stack sampling programs during the early years of the Laboratory and continuing uncontained tests with high explosives involving natural or depleted uranium prevented preparation of a complete inventory. In general, the inventory covers releases during the period from 1948 through 1972 for plutonium, 1961 through 1972 for mixed fission products, and 1967 through 1972 for other radionuclides such as tritium, ^{235}U, and ^{238}U. Inventories of short-lived nuclides such as ^{131}I, ^{88}Rb, ^{133}Xe, ^{135}Xe, ^{41}Ar, ^{11}C, ^{13}N, and ^{15}O (whose half-lives range from about 2 minutes to 8 days) were not included, since they decay rapidly and have little biological significance. The activity values for ^{239}Pu include contributions from ^{241}Am and other alpha emitters associated with the ^{239}Pu. Data since 1973 is based on actual stack sampling.

Probable releases of radioactivity to the atmosphere during the next 25 years are likely to be less than releases to date. For example, if releases of plutonium were to continue at the 1976 rate for 25 years, the cumulative amount would be less than 1.5% of the total plutonium released before 1976. Construction and use of a new plutonium facility with extensive filtration equipment is expected to significantly reduce plutonium emissions. At the 1976 rate, tritium releases over 25 years would be about the same as the total before 1976. New treatment equipment and construction of new facilities for tritium research are expected to significantly reduce tritium releases from the 1976 level.

Figure 14: Pre-1973 Airborne Releases Text (Excerpt from LANL, 1979)

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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, Pu-238, Pu-239, Sr-89, Sr-90, 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 Ba/La-140 (radioactive lanthanum), Ac-227, Am-241, Be-7, Cs-134, Cs-137, Co-57, Co-60, Mn-54, Na-22, Rb-83, Rb-84, Se-75, Sr-85, and Y-88. It is important to note that data were not available for all radionuclides for all years. There are missing data in certain eras (for instance, from 1962-1971, Pu-239 measurements ceased, but total plutonium measurements were done. The reasons for the change in nuclides analyzed or reported are not known). In some later years, there were uranium data collected, but they were stated in milligrams and the enrichment was unknown. Therefore, since the overall liquid-borne releases of uranium were estimated to be low, uranium was not evaluated in this assessment. The radionuclides named above are the only radionuclides for which historical compilations of liquid releases by LANL were found.

Data Sources

As described in the previous section, there are currently three main data sources for liquid-borne radionuclide releases at LANL:

1) (Graf, Unknown) – "Joe Graf Binders 1 and 2"

2) (LAHDRA, 2000) – Excerpts and compilations of AEC-789T "Radioactive Effluent/Onsite Discharges/Unplanned Releases" forms (1945-1972).

3) (LANL, 1971-1996) – LANL Annual Environmental Surveillance Reports from 1971-1996. These contain effluent information for TA-21, TA-50 and TA-53 waste treatment plants. Data from these published reports took precedence over other data that were found.

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 (10CFR20, 2003). 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 (O'Brien and Burmeister, 2004 [Repos. No. 3925]). 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. The priority index does not consider dilution and dispersion that can occur between the release point and points of potential public exposure. Although the lowest available (most conservative) MPCs are used, the priority index does not otherwise address uptake factors. It does not consider decay in transport, which means as calculated, the priority index would tend to overstate the importance of short-lived materials. Within these limitations, PIs provide a simple tool for establishing the relative importance of various liquid-borne releases.

Priority Index is calculated as follows:

$$\text{Priority Index} = \text{Dilution Volume (mL)} = \left(\frac{\text{Total Nuclide Activity in } \mu\text{Ci per year}}{\text{Non-occupational Maximum Permissible Concentration (MPC) in } \mu\text{Ci/mL}} \right)$$

The non-occupational MPC values from 10 CFR 20 Appendix B were used (10CFR20, 2003). Values that were used are shown in Table 18. Conservatively, of the radionuclides reported by LANL, the most restrictive MPC value for alpha emitters is Pu-239 and for beta emitters is Sr-89 (see Table 18 below). Therefore, MPC values for gross alpha were taken from Pu-239, and gross beta from Sr-89. The MPC values used are as follows:

Table 18: MPC Values Used for Liquid-Borne Radionuclide PI Calculations

Nuclide	Non-Occupational MPC (µCi/mL)
Gross Alpha	2.00E-08
Gross Beta	8.00E-06
H-3	1.00E-03
Pu	2.00E-08
Pu-238	2.00E-08
Pu-239	2.00E-08
Sr-89	8.00E-06
Sr-90	5.00E-07

For the years 1948 to 1996, LANL liquid waste and effluent data were collected and analyzed by the LAHDRA project team. For this effort, no summary data have been found for the years 1974, 1975, and 1976. Given the releases previous to and after that period it is highly unlikely that releases during these years would significantly change any of the conclusions of this prioritization if they were found. They would likely not add any substantive information, only completeness. A Microsoft Access® database was created to tabulate the information and to link it to existing LANL documents that have been assembled by the LAHDRA project team. In most cases, these documents are available as scanned document images as Adobe Acrobat® Portable Document Format (PDF) files. The database records in turn link to associated document image files to allow viewing of the actual LANL references for the data in question. The database is called the Off-Site Releases (OSR) database and contains information for both airborne and liquid-borne releases.

Summary of Results for Prioritization of Liquid-Borne Releases

Table 19, Table 20, and Table 21 comprise the summary data for the liquid-borne radionuclide data that have been located for LANL. The first two tables present annual releases of the various radionuclides, in curies. The third table presents priority indices for each radionuclide on an annual basis, calculated as the dilution volume required for dilution of the reported release quantity to the MPC. It was determined that the radionuclides in Table 20 were relatively insignificant due to the very low activity reported; therefore in Figure 15, the plotted nuclides of interest are: Pu, Pu-238, Pu-239, Sr-89, Sr-90, H-3, gross alpha, and gross beta radioactivity. In this calculation, a data cutoff of 1996 was used since it was deemed that this was far enough into the modern era, and prioritization was most important for previous eras.

This calculation is based upon the work documented in an earlier LAHDRA draft report (LAHDRA, 2002), and adds the data from the LANL environmental surveillance reports for the years of 1973 through 1996 (LANL, 1971-1996). No liquid effluent data for 1974, 1975, and 1976 were found in these reports. The effort described in this calculation represents our best knowledge as of the date of this report, and with the use of a database, each data record can now be traced to a LAHDRA database record and document image file with a corresponding page number to facilitate authentication or review.

Plutonium: The plutonium data throughout the years have been reported as Pu, Pu-238, or Pu-239. During the very early years the constant value reported for plutonium would suggest that there was one number that was "spread" among those years as an estimate. In the cases where, in later years the plutonium was specified for several nuclides including Pu-239, the LAHDRA project team entered it into the database as Pu-239. For instance in 1993, plutonium was reported as Pu-238,239,240 (entered into database as Pu-239) then again in 1994 it was reported as Pu-238,239,240, but it was reported as Pu-238 and Pu-239 for both 1994 and 1995. In this case, the plutonium was entered as Pu-238 and Pu-239. Separate radionuclide reporting was used whenever possible. The priority indices for plutonium range from approximately 10^{10} to around 10^{14}. See Table 19 for the total activity in curies (Ci) and Table 21 for priority index (dilution volume in mL).

Strontium: The priority index values for strontium range from 10^{9} to 10^{12}. It is important to note that LANL changed reporting conventions for strontium several times. Sometimes Sr-89 and Sr-90 were reported separately, and sometimes they were not. In the later years, where Sr-89 is not reported separately, the strontium values were recorded as Sr-90 in the database by the LAHDRA project team. This may result in increased values for Sr-90, but since the MPC for Sr-90 is lower than for Sr-89, this is a conservative assumption. Note in the years 1989-1995, Sr-89 was either not in the compilations or was reported as Sr-82,85,89,90 all in one. These data were entered into the database as Sr-90. That is why Sr-89 does not show data points in Figure 15 for those years. Subsequently it appears that Sr-90 has increased in priority relative to Sr-89 for these years. See Table 19 for the total activity in curies (Ci) and Table 21 for priority index (dilution volume in mL).

Tritium**:** The PI values for tritium range from 10^{8} to 10^{11}. Based on the currently available information, it would appear that tritium warrants lower priority than the other radionuclides. See Table 19 for the total activity in curies (Ci) and Table 21 for priority index (dilution volume in mL). 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.

Other Radionuclides: In Table 20 there are effluent values for other reported radionuclides. PI values calculated for these radionuclides ranged from 10^{7} to 10^{11}, except for one Ac-227 value at 10^{14} and several Am-241 values of 10^{12}. There were a number of these radionuclides present, but none in concentrations that would yield a greater priority than plutonium. The information for these "other" radionuclides is included for completeness.

Conclusions

It is important to note that the information compiled here is for liquid effluents. The current results indicate that, based on this study of the LANL data, plutonium would be of highest concern for liquid-borne radionuclides. However, it should be noted that, in general, liquid-borne releases appear to warrant lower priority than airborne releases, and pathways for public exposure from these liquid releases appear to have not been as complete as those for airborne releases.

Comments and Issues

In the later years, when plutonium or strontium radionuclides were not listed by nuclide separately, values were entered into the database as Pu-239 and Sr-90, respectively. This may result in increased PI values for Pu-239 or Sr-90. Since the MPCs for these radionuclides are lower than for their sister radionuclides Pu-240 and Sr-89, this is a conservative assumption. There were two years (1970 and 1971) for which gross gamma radioactivity was reported (LAHDRA, 2000); however, this was a compilation by a LAHDRA project team member, and since the 1971 LANL Annual Environmental report did not have gross gamma measurements, the data on gross gamma for 1970 and 1971 were not included in this work.

Table 19: Liquid-Borne Radionuclide Releases (Ci) from LANL Based on LANL Compilations

Year	Pu	Pu-238	Pu-239	Sr-89	Sr-90	Sr-89, Sr-90	H-3	Gross Alpha	Gross Beta
1945	1.02E+00		3.50E-03	6.05E-02	1.88E-01		3.00E+00		
1946	1.02E+00		3.50E-03	6.05E-02	1.88E-01		3.00E+00		
1947	1.22E+00		3.50E-03	6.05E-02	1.88E-01		3.00E+00		
1948	1.22E+00		3.50E-03	6.05E-02	1.88E-01		3.00E+00		
1949	1.22E+00		3.50E-03	6.05E-02	1.88E-01		3.00E+00		
1950	2.02E+00		3.50E-03	6.05E-02	1.88E-01		3.00E+00		
1951	2.41E+00		3.50E-03	3.05E-02	1.77E-01		3.25E+00	2.45E-03	
1952	8.01E-01		3.50E-03	2.05E-02	1.73E-01		5.00E+00	4.11E-03	
1953	2.24E-03		3.50E-03	2.05E-02	1.73E-01		5.00E+00	4.97E-03	
1954	3.21E-03		3.50E-03	2.05E-02	1.73E-01		5.00E+00	5.42E-03	
1955	3.14E-03		3.50E-03	2.05E-02	1.73E-01		5.00E+00	1.06E-01	
1956	1.81E-03		3.50E-03	1.89E+00	5.03E-01		5.00E+00	1.07E-01	2.30E-01
1957	1.94E-03		3.50E-03	4.47E-01	2.47E-01		5.00E+00	1.68E-02	2.33E-01
1958	9.16E-02		3.50E-03	2.25E-01	2.01E-01		5.00E+00	9.46E-03	1.65E+00
1959	2.06E-03		3.50E-03	7.25E-02	1.81E-01		5.00E+00	9.84E-03	4.40E+00
1960	4.36E-03		3.50E-03	8.85E-02	1.85E-01		5.00E+00	1.34E-01	1.35E+00
1961	1.07E-02		3.50E-03	3.85E-02	1.75E-01		5.00E+00	7.55E-01	6.05E-01
1962	6.84E-03			1.80E-02	1.00E-03		5.00E+00	1.15E-02	1.22E+00
1963	6.81E-03			1.49E-01	3.98E-02		5.00E+00	2.84E-02	1.28E+00
1964	3.11E-03			6.07E-02	8.87E-02		3.20E+00	5.67E-03	2.67E+00
1965	4.48E-03			4.23E-02	6.18E-02		2.00E+00	7.30E-03	8.13E-01
1966	2.50E-03			2.44E-02	3.56E-02		2.00E+00	4.73E-03	3.98E-01
1967	6.58E-03			5.35E-02	1.34E-02		2.00E+00	1.51E-02	6.86E-01
1968	4.20E-03			3.26E-02	8.20E-04	4.89E-02		5.16E-03	3.26E-01
1969	8.36E-03			5.46E-02	1.31E-02	1.54E-03		4.33E-03	4.19E-01
1970	6.47E-03			1.54E-02	2.24E-02			8.28E-03	6.38E-01
1971	4.24E-03	2.70E-03	6.50E-04	4.68E-03	1.21E-02	2.80E-02		1.16E-02	1.09E+00
1972		7.86E-03	1.10E-03	4.15E-03	6.51E-03		9.60E+00	1.49E-02	3.96E-01
1973		8.60E-03	8.00E-04	4.90E-03	7.50E-03		1.90E+01	1.55E-02	9.99E-01
1974									
1975									
1976									
1977		2.63E-03	1.55E-03	2.29E-03	3.10E-02		3.97E+01		
1978		4.36E-03	2.05E-03	2.67E-03	1.05E-02		1.41E+01		
1979		1.76E-03	6.37E-04	6.10E-03	1.42E-02		3.31E+01		
1980		8.23E-03	1.31E-03	4.10E-02	1.81E-02		4.50E+01		
1981		3.35E-03	5.54E-02	4.16E-02	2.37E-02		1.74E+01		
1982		3.10E-03	1.68E-02	1.18E-02	1.34E-02		1.53E+01		
1983		1.10E-02	4.23E-02	5.68E-02	2.54E-03		1.04E+01		
1984		6.19E-03	8.23E-03	2.62E-01	7.03E-03		1.32E+01		
1985		3.92E-03	5.83E-03	9.01E-03	1.26E-03		7.02E+01		
1986		1.50E-03	3.60E-03	9.20E-03	6.90E-04		2.45E+01		
1987		1.40E-03	3.20E-03	6.40E-02	1.00E-03		1.11E+02		
1988		1.10E-03	3.20E-03	8.10E-02	2.00E-04		2.62E+01		
1989		6.00E-04	2.00E-03	1.80E-02	1.10E-03		4.10E+01		
1990		2.00E-04	6.00E-04		2.53E-01		1.20E+01		
1991		3.00E-04	1.00E-03		1.24E-01		1.06E+01		
1992		3.20E-04	3.90E-04		1.70E-02		1.06E+01		
1993			1.08E-03		3.40E-03		2.66E+00		
1994		2.80E-03	4.00E-04		3.70E-02		2.23E+00		
1995		3.40E-03	6.00E-04		6.00E-04		7.31E-01		
1996		2.25E-03	3.90E-04	6.60E-04	6.00E-04		1.02E+00		

Table 20: Other Liquid-Borne Radionuclide Releases (Ci) from LANL Based on LANL Compilations

Year	Ba-La-140	Ac-227	Cs-137	Am-241	Be-7	Co-57	Co-60	Mn-54	Na-22	Rb-83	Rb-84	Se-75	Sr-85	Y-88	Cs-134
1945	2.00E-03														
1946	2.00E-03														
1947	2.00E-03														
1948	2.00E-03														
1949	2.00E-03														
1950	2.00E-03														
1951	2.00E-03														
1952	2.00E-03														
1953	2.00E-03	2.50E+00													
1954	2.00E-03														
1955	2.00E-03														
1956	2.00E-03														
1957	2.00E-03														
1958	2.00E-03														
1959	2.00E-03														
1960	2.00E-03														
1961	2.00E-03														
1962															
1963															
1964															
1965															
1966															
1967			1.20E-02												
1968															
1969															
1970															
1971															
1972															
1973			2.94E-01	1.50E-03											
1974															
1975															
1976															
1977			1.43E-01	2.14E-03											
1978			3.18E-01	4.03E-03											
1979			1.71E-01	5.27E-03											
1980			1.32E-01	5.75E-03											
1981			1.23E-01	2.44E-02											
1982			2.10E-01	1.88E-02											
1983			4.50E-02	3.84E-02											
1984			1.97E-02	9.04E-03											
1985			5.20E-05	5.54E-03											
1986			1.49E-01	3.20E-03	8.31E-01	5.02E-02	3.60E-03	1.89E-02	1.42E-01						
1987			8.10E-03	3.60E-03	3.30E-01	8.10E-02	8.50E-03	2.30E-02	8.90E-02						7.90E-02
1988			3.99E-02	3.70E-03		1.60E-02	4.00E-03	9.80E-03	1.90E-02						
1989			3.90E-02	4.10E-03	6.90E-02	5.40E-02	6.50E-02	1.43E-01	1.30E-01	2.30E-01	2.60E-02	1.10E-01	1.00E-01	1.90E-03	
1990			1.25E-02	2.70E-03			1.19E-02	1.30E-03			5.08E-01	5.30E-02		4.00E-04	
1991			6.70E-02	1.10E-03			1.00E-03	0.00E+00			4.50E-02	6.00E-03		6.00E-04	
1992			7.80E-03	8.90E-03											
1993			8.17E-03	1.12E-02											
1994			8.50E-03	3.10E-03											
1995			6.60E-03	1.40E-03											
1996			2.20E-03	1.99E-03											

Table 21: Priority Indices for Liquid-Borne Radionuclide Releases

(mL required to dilute to the MPC)

Year	Pu	Pu-238	Pu-239	Sr-89	Sr-90	H-3	Gross Alpha	Gross Beta
1945	5.12E+13		1.75E+11	7.56E+09	3.75E+11	3.00E+09		
1946	5.12E+13		1.75E+11	7.56E+09	3.75E+11	3.00E+09		
1947	6.12E+13		1.75E+11	7.56E+09	3.75E+11	3.00E+09		
1948	6.12E+13		1.75E+11	7.56E+09	3.75E+11	3.00E+09		
1949	6.12E+13		1.75E+11	7.56E+09	3.75E+11	3.00E+09		
1950	1.01E+14		1.75E+11	7.56E+09	3.75E+11	3.00E+09		
1951	1.20E+14		1.75E+11	3.81E+09	3.53E+11	3.25E+09	1.22E+11	
1952	4.01E+13		1.75E+11	2.56E+09	3.45E+11	5.00E+09	2.06E+11	
1953	1.12E+11		1.75E+11	2.56E+09	3.45E+11	5.00E+09	2.48E+11	
1954	1.61E+11		1.75E+11	2.56E+09	3.45E+11	5.00E+09	2.71E+11	
1955	1.57E+11		1.75E+11	2.56E+09	3.45E+11	5.00E+09	5.30E+12	
1956	9.05E+10		1.75E+11	2.36E+11	1.01E+12	5.00E+09	5.34E+12	2.88E+10
1957	9.70E+10		1.75E+11	5.58E+10	4.93E+11	5.00E+09	8.41E+11	2.91E+10
1958	4.58E+12		1.75E+11	2.81E+10	4.03E+11	5.00E+09	4.73E+11	2.06E+11
1959	1.03E+11		1.75E+11	9.06E+09	3.61E+11	5.00E+09	4.92E+11	5.50E+11
1960	2.18E+11		1.75E+11	1.11E+10	3.69E+11	5.00E+09	6.69E+12	1.68E+11
1961	5.35E+11		1.75E+11	4.81E+09	3.49E+11	5.00E+09	3.78E+13	7.57E+10
1962	3.42E+11			2.25E+09	2.00E+09	5.00E+09	5.74E+11	1.53E+11
1963	3.41E+11			1.86E+10	7.96E+10	5.00E+09	1.42E+12	1.60E+11
1964	1.56E+11			7.59E+09	1.77E+11	3.20E+09	2.84E+11	3.34E+11
1965	2.24E+11			5.29E+09	1.24E+11	2.00E+09	3.65E+11	1.02E+11
1966	1.25E+11			3.05E+09	7.12E+10	2.00E+09	2.36E+11	4.98E+10
1967	3.29E+11			6.69E+09	2.68E+10	2.00E+09	7.55E+11	8.58E+10
1968	2.10E+11			4.08E+09	1.64E+09		2.58E+11	4.08E+10
1969	4.18E+11			6.83E+09	2.62E+10		2.17E+11	5.24E+10
1970	3.24E+11			1.92E+09	4.47E+10		4.14E+11	7.98E+10
1971	2.12E+11	1.35E+11	3.25E+10	5.85E+08	2.42E+10		5.78E+11	1.36E+11
1972		3.93E+11	5.50E+10	5.19E+08	1.30E+10	9.60E+09	7.47E+11	4.95E+10
1973		4.30E+11	4.00E+10	6.13E+08	1.50E+10	1.90E+10	7.75E+11	1.25E+11
1974								
1975								
1976								
1977		1.31E+11	7.76E+10	2.86E+08	6.19E+10	3.97E+10		
1978		2.18E+11	1.03E+11	3.33E+08	2.10E+10	1.41E+10		
1979		8.81E+10	3.19E+10	7.63E+08	2.85E+10	3.31E+10		
1980		4.12E+11	6.57E+10	5.12E+09	3.62E+10	4.50E+10		
1981		1.68E+11	2.77E+12	5.20E+09	4.73E+10	1.74E+10		
1982		1.55E+11	8.41E+11	1.48E+09	2.68E+10	1.53E+10		
1983		5.52E+11	2.11E+12	7.10E+09	5.08E+09	1.04E+10		
1984		3.10E+11	4.12E+11	3.28E+10	1.41E+10	1.32E+10		
1985		1.96E+11	2.91E+11	1.13E+09	2.51E+09	7.02E+10		
1986		7.50E+10	1.80E+11	1.15E+09	1.38E+09	2.45E+10		
1987		7.00E+10	1.60E+11	8.00E+09	2.00E+09	1.11E+11		
1988		5.50E+10	1.60E+11	1.01E+10	4.00E+08	2.62E+10		
1989		3.00E+10	1.00E+11	2.25E+09	2.20E+09	4.10E+10		
1990		1.00E+10	3.00E+10		5.06E+11	1.20E+10		
1991		1.50E+10	5.00E+10		2.48E+11	1.06E+10		
1992		1.60E+10	1.95E+10		3.40E+10	1.06E+10		
1993			5.40E+10		6.80E+09	2.66E+09		
1994		1.40E+11	2.00E+10		7.40E+10	2.23E+09		
1995		1.70E+11	3.00E+10		1.20E+09	7.31E+08		
1996		1.13E+11	1.95E+10	8.25E+07	1.20E+09	1.02E+09		

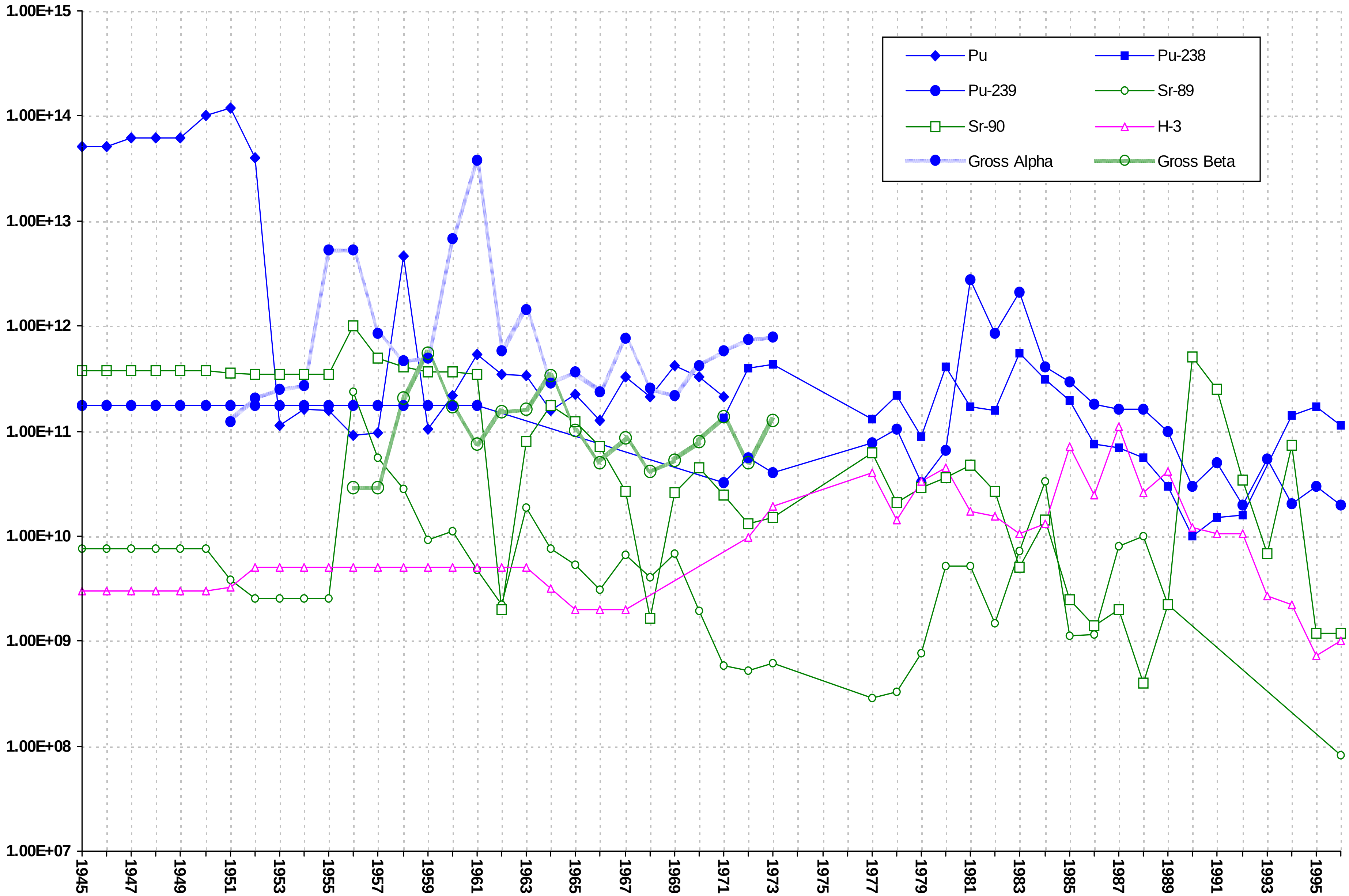

Figure 15: Priority Indices for LANL Liquid-Borne Releases

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Measurements of Plutonium in Soil as Indicators of Historical Releases

Although LASL began operations in 1943, no documents have been found by LAHDRA analysts that show that LANL actually measured airborne plutonium releases at all until 1951, when releases were 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. With the possible exception of cleanup activities at the original Technical Area (TA-1) in the mid-1970s, these doses have reportedly been sufficiently low as to not pose significant health risks to humans from resuspension of soil containing plutonium. However, these data have not to our knowledge been used by LANL scientists to “back-calculate” airborne plutonium releases that would be consistent with plutonium concentrations observed in soil samples around LANL. In 1958, LANL scientists presented an estimated total release of 0.81 curies from DP Site from 1949 through 1957 and demonstrated that the value was consistent with soil measurements they had made (Jordan and Black, 1958).

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 (Shonka, 2004 [Repos. No. 4135]).

Initial Assessment

The initial iteration of an assessment to estimate airborne plutonium releases based on soil measurements was based on 37 measurements of plutonium in soil samples collected near Los Alamos from 1975 to 1977 (Purtymun, 1980). These measured concentrations of Pu-239 in soil included global fallout from atmospheric testing of nuclear devices. The average concentration of Pu-239 of distant sample sites (approximately 50 miles from LANL) was 0.006 ± 0.001 pCi/g. This value was subtracted from the 37 values used in the analysis. The “corrected” soil concentrations reflected 0.003 to 0.045 pCi/g net positive contributions of Pu-239 from LANL operations.

The Radiological Safety Analysis Computer program (RSAC version 6.2) was run with Los Alamos meteorological data to calculate Pu-239 deposition at various distances in each direction from a unit release (1 curie) of Pu-239 over 50 years. Pasquil-Gifford Stability Class C and a deposition velocity of 0.001 m/s were assumed. 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.

The ratios over the 37 sampling locations were log-normally distributed. Based on the distances involved with releases from D Building (where plutonium was first processed), the geometric mean was 620, with a factor of uncertainty (geometric standard deviation of the mean) of 1.2. For the distances associated with releases from the DP Site (where plutonium processing took place from late 1945 to 1978) the geometric mean was 670, with a factor of uncertainty of 1.3. While these results were quite uncertain, they indicated that airborne plutonium releases from LANL operations could have been hundreds of times higher than the 1.2 Ci officially reported.

Expansion of the Soil Measurement Dataset

Following the initial calculations, a search for additional soil sampling data was performed, and 697 soil sample analyses were found. LANL ES&H staff provided these data to the LAHDRA team electronically.

Refined Assessment

The project team performed a follow-up assessment to estimate integrated airborne releases of plutonium from LANL based on historical soil measurements. This calculation provided an independent estimate of LANL plutonium releases using soil samples collected after 1970. To accomplish this, the ratio of plutonium and cesium was calculated using LANL data and plotted along with the dry pCi/g of plutonium and cesium. Further examination of the resulting data plotted as a lognormal cumulative frequency distribution reveals that there are two datasets for plutonium:

- Those measurements that reflect contributions from LANL operations ("impacted" measurements), and
- Those measurements that reflect no significant contribution from LANL operations, only fallout from weapons testing ("fallout" measurements).

A mean value for fallout from LANL publications that was consistent with the dataset for fallout was subtracted from the plutonium to get net plutonium for the "impacted" samples. The values of these impacted samples were then plotted on a map at the associated sample collection location.

Two approaches were then used. First, 679 soil samples at 34 sample points were analyzed. The LANL ES&H staff provided these data electronically. Of these, 106 samples at 24 sample points were judged impacted based on analysis of the plot of plutonium-to-cesium ratios. These points were used for geospatial studies of the location and magnitude of elevated levels of plutonium soil concentration. This first approach was oriented towards analysis of the data, not towards estimation of LANL releases.

The Pu-239 to Cs-137 ratio is the middle curve in Figure 16. As can be seen, the ratio sharpens the differences observed in Pu-239, with a slightly worse fit to a lognormal distribution. This ratio helps establish the point at which samples impacted by LANL operations can be detected. A ratio of about 0.065 marks the break (or "knee") in the line, above which data shows evidence of LANL impact, and below which, the site added Pu-239 is so low that the variability of fallout Pu-239 and Cs-137 masks its presence. This shows that the population of a large number of soil measurements can be used to separate the LANL-impacted locations from those that exhibit fallout alone. The higher one restricts the data above the ratio of 0.065, the less influence fallout has on the Pu-239 concentration.

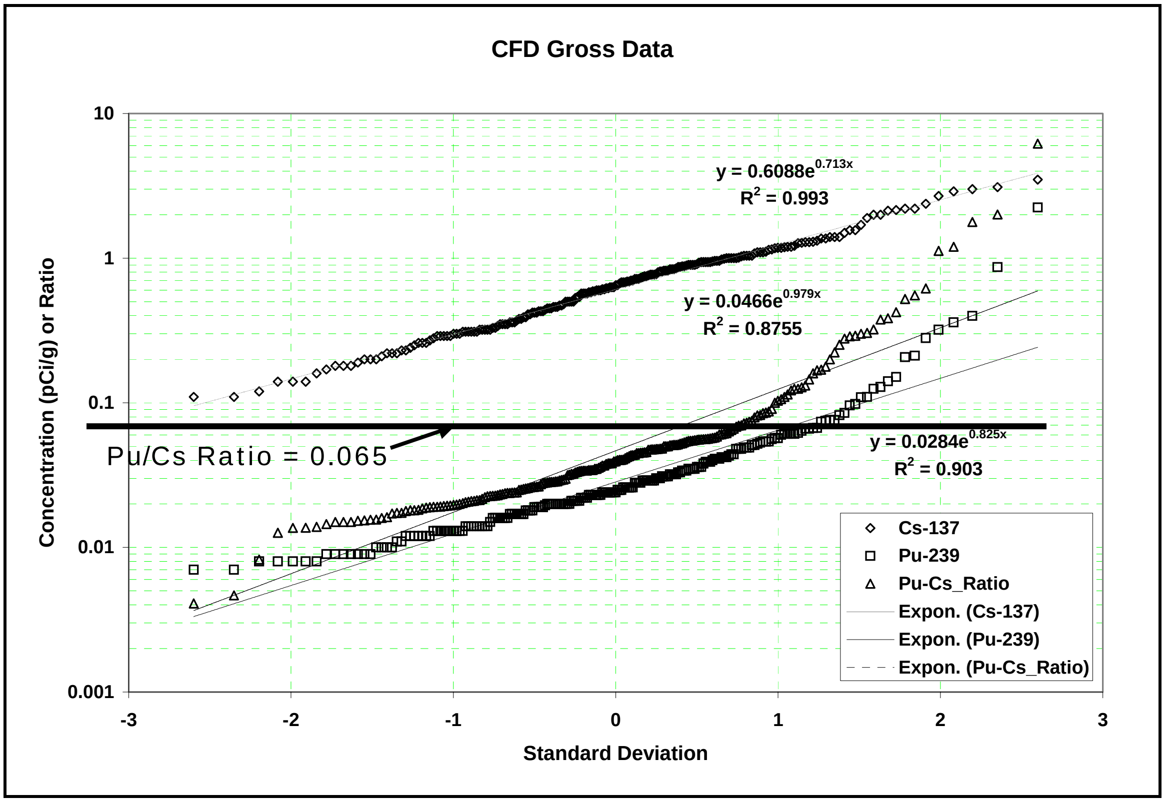

Figure 16: Cumulative Frequency Distributions of Cs-137, Pu-239, and Pu/Cs Ratio Data

In the second approach, 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 analyzed. This resulted in a data set with 119 members. The plutonium-to-cesium ratio was studied, and the Pu/Cs ratio <0.065 criterion 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 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.

For these 37 samples, the net plutonium and the range and bearing from the D Building and DP Site were calculated. The RSAC program was used to calculate the soil concentration as a function of wind direction and distance for a one-curie source term. When divided into the net sample data, an estimate of the integrated LANL source term was obtained for each of the 37 samples.

The results, shown in Figure 17, were log-normally distributed. 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. 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. These results appear to be inconsistent with the estimate by Jordan and Black. However, these results rely on many parameters, which should be the subject of further study. The methods established with this calculation, when validated, could be extended to other contaminants of concern for which monitoring data are not available for key periods of time, such as beryllium.

In the most recent calculation, to explore the relative contribution of D Building and DP Site to estimated site-total releases, many combinations of the possible release totals for the two sites were analyzed to find the breakdown that best satisfied the following criteria:

- Minimize the absolute value of the difference between concentrations calculated from LANL releases (D Building plus DP Site) and measured soil concentrations, averaged over all measurement locations
- Minimize the standard deviation of that mean (i.e., minimize uncertainty).

The cumulative frequency distribution plots for all 37 sample points for either DP Site as source or D Building as source are shown in Figure 17.

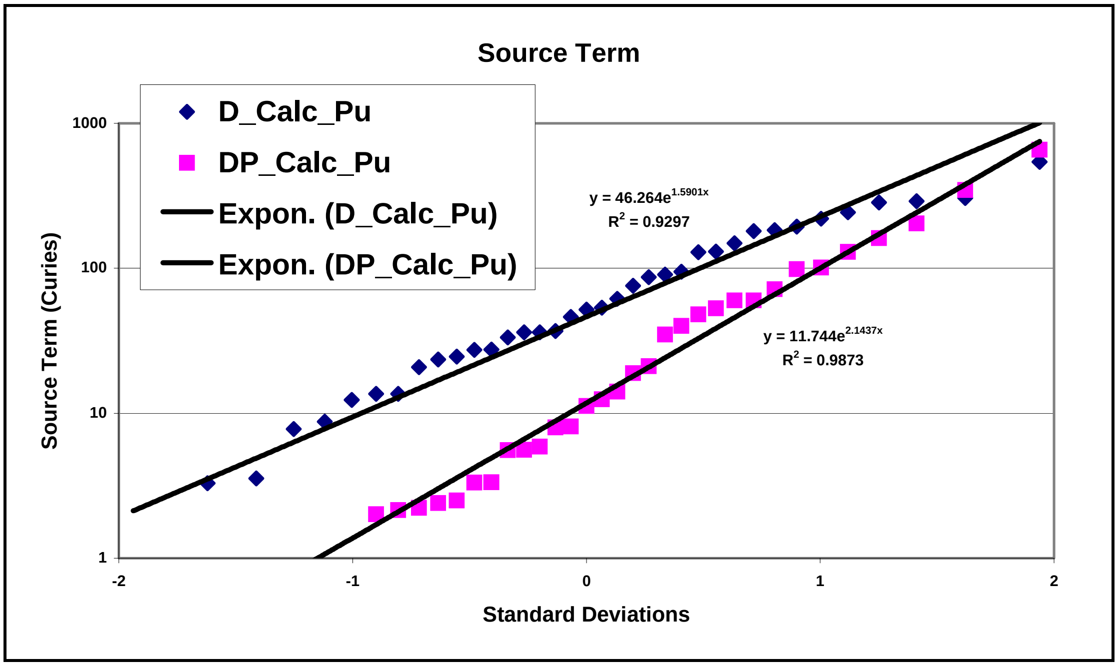

Figure 17: D-Building and DP-Site Source Term Fits

If one sums a fraction of D Building results with that of DP Site adjusted for 100% release, the curve would lie midway between those shown in Figure 17. The slope progressively decreases from a factor of 9 (100% DP Site) to a factor of 5 (100% D Building). A completely flat curve would show that all of the measured soil samples provide the same result, indicating no uncertainties in the answer. Thus, although DP Site happens to fit a lognormal distribution better than D Building, the results suggest most of the releases came from D Building.

Independent Analysis by Another Party

Dr. B. Schrader of the Idaho National Engineering and Environmental Laboratory (INEEL) performed an independent calculation using the expanded dataset of 679 soil analyses. Dr. Schrader is responsible for the Gaussian plume modeling RSAC program. Dr. Schrader estimated a release of slightly less than 4 curies.

Dr. Schrader suggested that the difference between his value of 4 curies and the current calculated value of 100 curies (at the 95 percentile) was due to the LAHDRA team's use of data at great distances (30 km or more) from the release points and the choice of the background level above which soil results were attributed to LANL operations. Dr. Schrader's observations were the reason the constraints (on uncertainty and Pu/Cs ratio) were applied in the most recent LAHDRA calculations, and those constraints resulted in selection of data within the 5.5 kilometers boundary. Dr. Schrader has reviewed this calculation, and believes that his results may understate the releases from LANL.

Conclusions

The plutonium release estimated as described above was log normally distributed (> 90% correlation). For this distribution, the median value is the preferred statement of central tendency. The average estimate of releases from this calculation is larger than the medians summarized here. The dataset limited to the best 37 samples would be consistent with a median predicted release value of 12 curies if all of the release were from the DP Site. A median value of 46 curies is obtained if all of the release is attributed to D Building. The best fit of the data to an exponential distribution is obtained when the model is referenced to the DP Site (99% squared residuals, as opposed to 93% of D Building); however, the variability in the answer (expressed by the geometric standard deviation) is larger for DP Site (factor of 9) as opposed to the D Site (factor of 5). While the medians are known with improved precision from the application of the central limit theorem, the 95th percentile bounds, for either of the two geographical points of reference, are roughly between 1 and 1,000 curies. This range represents the values expected 9 times out of 10 if one additional soil measurements were made. Answers between these two bounds are obtained for assumptions of varying fractional release from the two sites.

If the data are used to compute an average (rather than median), LANL release estimates range from 60 (DP Site) to 101 curies (D Building) based on the 37 samples. Results are considerably higher for the 119-sample set.

Previous median estimates of 440 curies have overlapping uncertainty ranges with the estimate from this calculation. However, the median estimate is significantly reduced. This is attributed to the smaller data set of (primarily) older LANL soil samples used in the earlier work, and inclusion of samples with significantly greater uncertainties in the earlier work. Those samples were removed from the current study. To a lesser extent, the difference is due to the magnitude of estimated fallout concentrations of plutonium (0.006 pCi/g vs. 0.0144 pCi/g) subtracted from the measured soil concentration to estimate deposition due to LANL. This change is a small contributor to the difference, because data for the current study involved samples with (on average) higher levels of plutonium (ranging from 0.2 to nearly 1 pCi/g).

This work has not confirmed Dr. Schrader's result. No estimate of uncertainty was made for Schrader's work, and in continuing discussions, he has acknowledged that the uncertainty of the results expressed here likely overlap with his own result. Dr. Schrader did use a different version of RSAC however, that is not generally available. That version allows a user to input dry deposition variables such as particle size, particle density, and other parameters. Based on the differences in Dr. Schrader's work and this work, and with some suggestions from Dr. Schrader as to the possible reasons for these observed differences, a very limited parameter study was accomplished to look at the affect of the following: (1) Jet Plume, (2) Weather Stability Class, (3) Plume Standard Deviation Control, (4) Deposition Velocity, and (5) Wind Speed. The largest difference was no more than a factor of two and subsequently these parameters do not seem contribute significantly to the difference between this work and Dr. Schrader's. For a true resolution to the differences between the models, more detailed parameter studies would need to be accomplished and a more detailed review and selection process for meteorological parameters would be required. This work has also not confirmed the earlier published work of Jordan and Black (1958) that approximately 0.81 curies of plutonium was released from 1947 to 1957.

Potential Utility of Soil Measurements

This simple analysis indicates the potential utility of soil measurements in estimating releases that were largely unmonitored. It suggests that priority should be given to collecting soil and air sampling data to refine estimates of total plutonium releases from Los Alamos operations. The LAHDRA team believes that expanding the dataset will reduce the uncertainty of analyses to bound historical releases. This method could also be applied to other contaminants of concern for which limited or no effluent monitoring data are available, such as beryllium.

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Analysis of Measurements of Plutonium in Body Tissues of Los Alamos Area 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 (McInroy, 1995). That issue is available on the LANL Library's web page.

The data have been analyzed by Los Alamos to demonstrate that the differences between US states in the median values of plutonium concentration in tissue were small. However, the autopsy results from deaths at the Los Alamos Medical Center (designated as either Los Alamos residents or residents of Northern New Mexico) were generally the highest median values for nearly all organs, as compared to other states.

The exposure to fallout plutonium in an area would be broadly similar for most individuals who share similar lifestyles. However, the exposure to releases from plutonium facilities would not be similar, since individuals residing closer to the facility would generally have greatest exposure to releases. These individuals might be a small subset of the total population. This subset (individuals residing close to a nuclear facility) might not significantly alter the median value of a dataset, especially when small numbers of samples are all the data that are available.

The LAHDRA project 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 (LANL, 1947). This would tend to increase non-point source (non-stack) emissions as compared to modern plutonium processing buildings.

Several factors are needed to use room air concentrations to estimate effluent totals, such as: room air changes per unit time, the sampling method (i.e., with or without a sampling tube), building air changes, etc. The uncertainty in the values for these factors is quite large. 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.

Summary Of Results

This 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.

The data from the residents who were present in Los Alamos can be used to estimate exposures for any resident of Los Alamos and also be used to provide upper and lower bounds on the plutonium source term from LANL operations. A full analysis of the data would require that the range and bearing from significant release points at Los Alamos, along with the time dependent source term, be incorporated into this model. Additionally, the date of death should be used in correcting the autopsy results for fallout.

From the results of this calculation, the median estimated exposure is a factor of 5 times higher in the long-term residents, while the geometric standard deviation is reduced by 20% from that of all Los Alamos residents taken as an aggregate population. This implies that stratifying the population results can significantly improve (that is, reduce the uncertainty) of the estimate of the potential exposures that an individual in Los Alamos received from past operations. The current model does not remove the range and bearing impact on the results, and further improvements are suggested.

Another use of this analysis would be the application of this method to estimate worker exposure for LANL workers who were not considered plutonium workers, and did not receive routine internal dosimetry.

Methods

The method used in this calculation was as follows:

1. Enter the data from the 1979 Health Physics journal paper (McInroy et al., 1979).

2. Conduct a public records search for information on persons in the HP journal article from Los Alamos.

3. Calculate the ratio of deposited plutonium in the lung vs. vertebrae.

4. Plot the standard deviation of Pu Ratio for the populations of Los Alamos and Denver.

5. Draw conclusions about the individual cases in Los Alamos and possibilities of exposure.

Dose Estimates from Exposure of Organs to Plutonium

The autopsy data are provided for various organs in units of disintegrations per minute (dpm) per kilogram of organ. The following material is presented to assist in understanding what these units (dpm/kg organ) mean in terms of dose or risk.

A fraction of the plutonium present in inhaled air is retained in the lung. The lung retains the plutonium for a period of time of about a year or a year and one-half. Thus, the autopsy data for lung largely reflects the plutonium air concentration for the last few years prior to death. Since most of the autopsies are from the 1960s and 1970s, the lung data largely reflect atmospheric fallout from the testing of nuclear weapons. The largest plutonium releases from Los Alamos appear to have occurred in the 1940s and 1950s. This plutonium, if measurable, would no longer be present in lung tissue.

The ICRP 30 model of plutonium behavior in the human body distributes plutonium present in systemic circulation, with 45% going to the liver, 45% to bone, and the remainder going largely to excretion. Small fractions are assigned to other organs. The liver and skeleton retain the plutonium for decades. Reference Man notes that Thoracic Vertebrae are 75% trabecular, the spongy bone where marrow resides. Thus, the vertebrae and liver are appropriate tissues to sample to measure plutonium deposited in an individual over a long period. The program at LANL sampled these two tissues, along with other tissues such as lung.

The autopsy data are provided in dpm/kg organ. It may be of some use to understand the potential doses that are involved with the measured data. The dose, in rem, per dpm/kg skeleton can be derived as follows: a systemic uptake of 1 dpm ultimately results in 0.45 dpm in the skeleton or liver. The liver has a mass of 1.8 kg in Reference Man, resulting in 0.25-dpm/kg liver for each dpm that is incorporated into the body.

A conversion for the skeleton depends on the type of tissue sampled. The entire skeleton ranges from 10% to 20% trabecular bone by weight. If the tissue sample had the same proportions, one could divide by about 2 kilograms (or 20% of the 10 kg total mass of skeleton) to yield a value of 0.225 dpm/kg skeleton. This value is close to that for liver. It has also been noted that the plutonium concentration in bone (from humans) is inversely proportional to the percent bone ash (McInroy et al., 1979). Plutonium is concentrated in the trabecular bone rather than hard, compact cortical bone. Each person is, of course, unique and their weights are not the same as the average that is expressed in “Reference Man”. The LANL compilations provide the actual dpm/kg organ, and express the data as if the individual had the same weight organ as reference man.

The dose resulting from a one dpm systemic uptake depends on the chemical form of the intake (and of course the isotope, particle size, etc.). For inhalation of Pu-239 oxide, Federal Guidance Report (FGR) 11 asserts a dose factor of 8.21E-04 Sv/Bq for bone surfaces, which converts to 1.37 mrem/dpm (intake). Dividing 1.37 mrem by 0.225-dpm/kg skeleton then gives six mrem committed bone dose per dpm/kg skeleton.

The committed effective dose equivalent (CEDE) is a measure of radiation exposure that estimates risk by adding the dose from all of the organs (weighted for their risk for cancer) for as long as the radioactive material will be present in the body. On the basis of CEDE, the value for Pu-239 oxide is 0.6 mrem CEDE per dpm/kg skeleton, or 0.6 mrem CEDE per dpm/kg liver. For more soluble forms (inhalation Class W), the values for Pu-239 are 16 and 0.9 mrem per dpm/kg skeleton for bone surfaces and CEDE, respectively. Values for Pu-238 are similar to those for Pu-239.

A simplification that expresses the results in the right “ballpark” would be that 1 dpm/kg is approximately one mrem CEDE for either liver or vertebrae results from the autopsy program.

Fallout Levels of Plutonium

The plutonium deposition from worldwide fallout in the Los Alamos area has been reported by LANL (Purtymun, et al., 1990). Soil and river sediment samples were taken. The data were reported in units of concentration, fCi/g. One can convert the concentration measured in soil samples to areal deposition by multiplying the concentration by the mass of soil sampled and dividing by the total area of the samples. This conversion is needed to be able to compare the LANL data with that taken by the Environmental Measurements Laboratory (EML) as reported by Krey for the Denver area (Krey et al., 1976). Krey reported fallout for the Denver area as 1.7 ± 0.5 mCi/km^2. Krey’s data did not include the contribution to fallout from Chinese testing in the late 1970s that may be present in the LANL data from the early 1980s. Krey's data also would not have included any weathering that might have occurred between the time of the Denver samples and those taken around Los Alamos. Both of these minor influences would likely offset one another, since weathering would decrease the values and the Chinese testing would increase the values.

Each of the sites sampled by LANL consisted of a square area 9 meter on each side, with soil collected from each corner and the center. The sample collected at each point was 7.5 cm in diameter and 5 cm deep. The samples were combined to form a composite sample. The total volume of soil collected was 1100 cc, which would weigh nearly 2 kilograms at an estimated average soil density of 1.8 g/cc. This is believed to be a conservative (high) soil density, which will overstate the fallout levels compared to values if a lower soil density value were assumed. The area collected by the LANL sampling method was 221 square centimeters.

Plutonium release estimates have been found in LANL documentation for 1948 – 1973. This total value is approximately 1.2 curies (Graf, Unknown). This activity could contaminate an area of 1200 square kilometers (assuming an unrealistic completely and uniform fallout distribution) to a level of 1 mCi/km^2. Thus, the sampling for background levels of plutonium in Los Alamos would have to be outside of a radius of 20 kilometers to avoid including the impact of site operations in the results (a radius of 20 km includes approximately 1200 km^2).

As described by Purtymun, six sites within a 50-mile radius of Los Alamos were sampled in 1981 and 1983, and additional locations along the continental divide were sampled in 1986. In fact, the sampling locations were located at approximately a radius of 50 miles, or 80 kilometers. Thus, the sampling locations were far enough removed from the site to avoid significant impact from LANL releases if the releases were on the order of curies.

In the Purtymun study, the average of the Pu-239 results for the six sites within the 50-mile radius near Los Alamos over two years was 8.75 $\pm$ 5 fCi/g. The data appear to fit a normal distribution with a better correlation than a lognormal distribution. In areal deposition, this value corresponds to approximately 0.8 $\pm$ 0.5 mCi/km^2. The total integral level of fallout plutonium for the Los Alamos area (Purtymun et al., 1990) appears to be about one-half of that for Denver (Krey et al., 1976). If the soil density is lower, then Los Alamos fallout plutonium levels found by Purtymun are even smaller than one-half of those found by Krey near Denver.

Further Interpretation of the Autopsy Data

The autopsy data reported by McInroy et al. in 1979 in the Health Physics journal shows that the cumulative frequency distributions of liver concentrations (dpm/kg liver) are nearly identical between Los Alamos and Denver. However, the vertebrae autopsy samples from Los Alamos are higher than Denver, and they have a different slope that indicates the plutonium has been in the body longer. These data are shown below in Figure 18 and Figure 19. To permit easy comparison, the figures from McInroy et al. were scanned in and the data for each organ were superimposed on one another using Corel Draw® software.

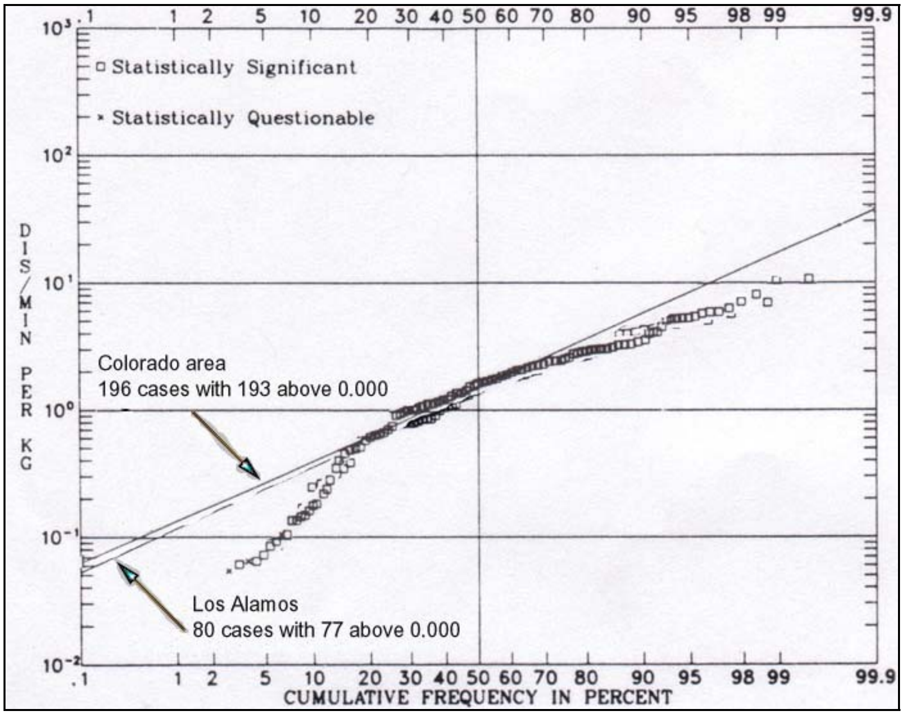

Figure 18: Liver Autopsy Results

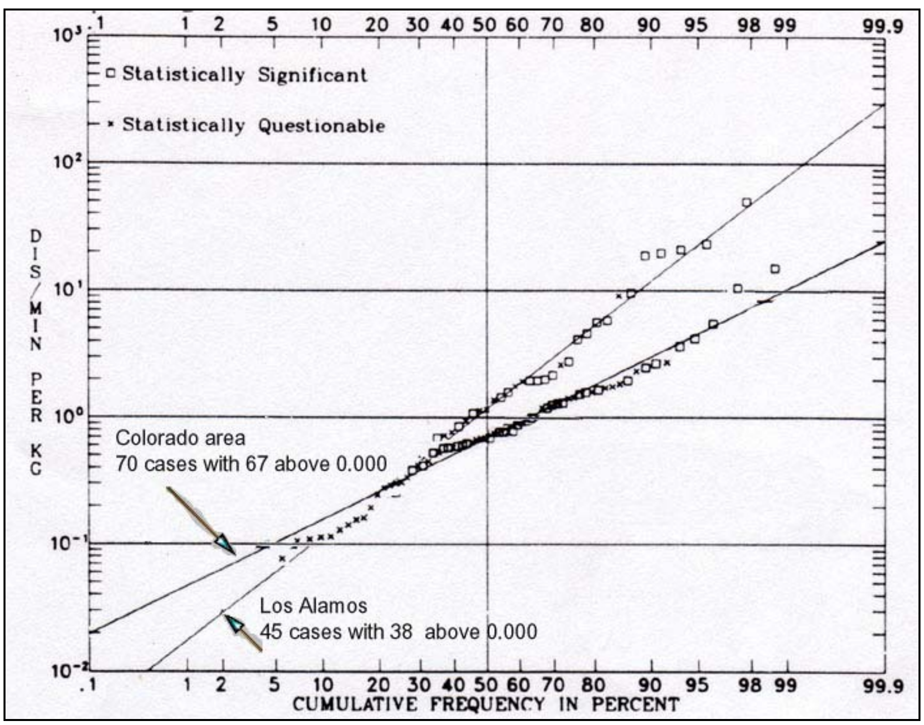

Figure 19: Vertebrae Autopsy Results

If Los Alamos indeed had one half (or less) of the fallout as Denver, the liver results should show this. However, this is not the case. The liver data would seem to indicate the plutonium present at Los Alamos is roughly equal that of Denver. If one believes the earlier fallout data from Purtymun and Krey, then this implies that the “extra” or “added” plutonium (that which makes the plutonium liver concentrations equal) is due to LANL emissions. The liver results show that all autopsy samples from residents of Los Alamos appear to have “added” plutonium. If there were two distinct populations, one might expect to see a bend in the curve indicating added plutonium in the fraction of the population living nearest the release points. However, no bend is seen. This is probably due to the fact that if the added plutonium was due to facility operations, one might expect that the impact would be sporadic, with a only few individuals impacted based on the winds and other factors. It is likely that releases from the site were not sufficient to cause this “bend” in the CFD plot or that the inherent variability of various factors dominates the distribution and masks the presence of two populations.

Analysis of Vertebrae to Liver Ratios

The vertebrae results show differences between Los Alamos and Denver, with the differences occurring in the population with higher bone concentrations. This result also appears to be consistent with a hypothesis that releases at Los Alamos impacted the population.

The data also show significant divergence in the ratio of concentrations in the skeleton to that of the liver. **Figure 20** shows a cumulative frequency distribution graph for the ratio of vertebrae results to those of liver for all autopsy cases that had data for both organs. Four sets of data are shown, with two sets also fit to an exponential distribution. The two data sets with fitted exponentials are for Denver and Los Alamos. The other data sets are discussed in the next section.

The curves and data regarding vertebra to liver ratios were not reported by McInroy et al. The information in **Figure 20** was computed as an element of this calculation. In general, the cases with positive results for both liver and skeleton would be the cases with highest reported data. The results from Denver appear to be log-normally distributed about a median ratio of 1.73. One individual (out of 38) had nearly twenty-five times as much plutonium in their vertebrae as in their liver.

The Los Alamos data (with a median ratio of 2.72) has three of 17 results greater than 25, with one result approaching a ratio of 200 (offscale and not shown in **Figure 20**). The value of 2.72 indicates plutonium exposures that happened longer ago than those associated with the lower ratios. This is due to the difference in clearance time of plutonium from liver vs. vertebrae.

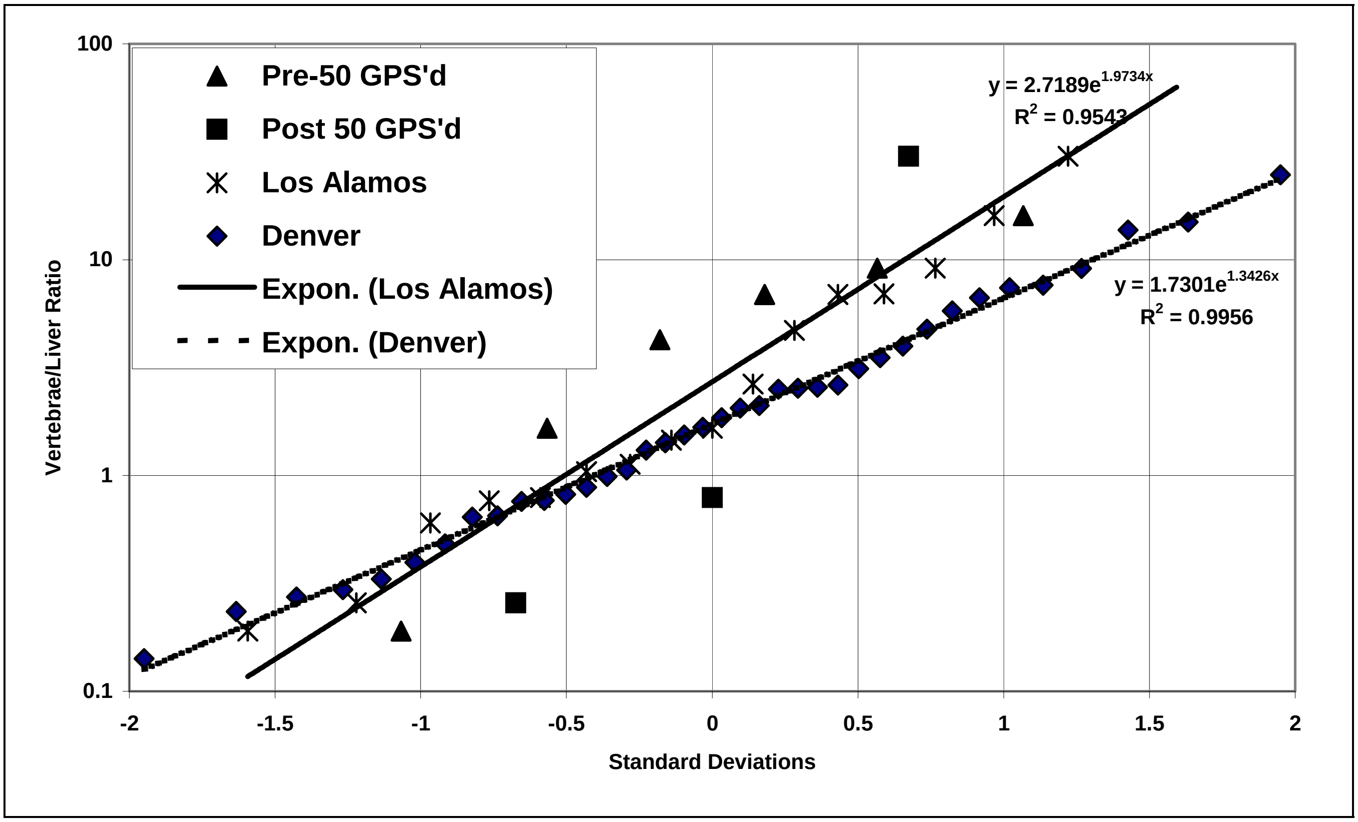

Figure 20: Cumulative Frequency Distribution of Vertebrae-to-Liver

The ICRP model for plutonium behavior in the human body assumes that the skeleton retains plutonium with a biological half-life of 50 years, and the liver retains plutonium for 20 years (McInroy et al., 1979). When coupled to the results shown above, there appears to be an indication that not only is there added plutonium from site releases present in the autopsy samples obtained from Los Alamos, but also that the plutonium in Los Alamos residents appears to be due to exposures to plutonium that were earlier (longer ago) than atmospheric weapons testing exposures in the Denver population. It is important to note that the Denver population was *not* significantly exposed to plant releases from Rocky Flats. The downwind direction from Rocky Flats is predominately east, and although there are persons living in this area, the population density is very low, and the likelihood that those persons included in the Denver study is very low.

A vertebra-to-liver ratio of one would be indicative of recent exposure. Larger ratio values would indicate that the exposure occurred at some point in the past, or that the exposures were higher in the past than more recent ones.

An exponential function provides a good fit to the data shown in **Figure 20**, which implies that the data are log-normally distributed. The median value, read from the chart at zero for the "X-Axis", shows a value of 1.73 for Denver, corresponding to less aged exposures. Los Alamos shows a median value for the vertebrae-to-liver ratio of nearly 2.72. The geometric standard deviation is 2.3 times larger for Los Alamos as compared to Denver. If the air concentration were constant through time, this would be a ratio indicative of exposure that began about 10 years prior to autopsy. Given the large values of the ratio for Los Alamos, these data indicate that exposures in the early years were higher than the later years.

Reduction of the Uncertainty in Autopsy Results

The publicly released autopsy results were published as blind samples, with no information concerning identity or residential history for each case (which might provide years of residence by location, and thus provide the distance and bearing from LANL release points). If one could establish the residential history, confounding variables that impact the uncertainty of the data could be removed. A trial effort was made to see if the data could be found that would permit this refinement.

In a large city such as Denver, knowledge of the individual providing autopsy tissues would not be easily obtained without authorization from the appropriate authorities. This authorization might be possible if appropriate protection was afforded the donor, and would be more likely if an agency that normally deals with public health issues, such as the Centers for Disease Control and Prevention (CDC), was involved with the request. In a small city such as Los Alamos, fewer deaths occur each year. The LANL autopsy data had five attributes that can be used to establish the identity of the donor without obtaining the data from official or private records: (1) year of death; (2) resident of the City of Los Alamos; (3) sex; (4) age; and (5) cause of death. These five attributes were used to match a number of the autopsy cases to Los Alamos area residents.

A review was made of the records for Los Alamos' Guaje Pine Cemetery in the public library, identifying potential matches to various autopsy cases. The sex, age, and year of death were matched, in some cases uniquely. Using the date of death from the cemetery records for potential matches, further review of obituary or other news articles was made using the microfilm records of the local newspaper, the Los Alamos Monitor. These records permitted identification and matching of the cause of death for a number of cases, and often provided additional information about the case. When most or all of the attributes were matched, the residence history was established using the Historical Association's holdings at Fuller Lodge, which included yearly phone books for Los Alamos since the start of the Laboratory.

When the residence history was established, GPS coordinates were taken of many residences to permit the calculation of range and bearing from D Building and DP Site, two dominant release points for plutonium. This effort is incomplete and ongoing. In some cases, the historical address is no longer a residence. These, in many cases, could not have GPS coordinates taken, since the location could not be unambiguously established within 20 meters (the resolution limit of the non-differentially corrected GPS unit that was used). Use of historical maps would be required to obtain these points. The intent in providing the data in this calculation at this point is to show that the information could be used to reduce uncertainty in asserted LANL releases.

There were 97 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 number from the McInroy article, the names have been redacted in this work to protect privacy.

Establishing residence history through the Historical Association's phone book collection was possible for nearly all of these cases. There were 79 residence locations identified in this manner, of which 46 have had GPS coordinates obtained as of this date. There are nine years that lack an entry in the phone book. This was noticed when addresses were available for the preceding and following years, but no address was listed in the missing year. Of the 28 cases, roughly one third have a complete history of GPS coordinates from addresses listed in the phone book for continuous periods that are assumed to represent the entire history of residence in Los Alamos.

Table 22 shows the case number, earliest year of residency in the area, year of death, number of addresses found, number of addresses that currently have GPS coordinate data, a percent GPS completed, and the vertebrae and liver data (McInroy et al., 1979) along with their ratio. It is sorted by earliest year of residence. Two of the cases are indicated as duplicates, as the data could not establish which of the two individuals were associated with the autopsy results. Of the 24 cases, nine had positive results for both vertebrae and liver. Six of the nine were for residents who arrived prior to 1950. With one exception, case 7-042, these appear to be consistent with ratios greater than one. There were three of nine whose residency started after 1950. Two of these had small ratios, with one significant outlier with a high ratio, case 2-145. That case shows a start of residence in 1955.

The addresses that have been identified have an earliest starting year of 1948. Of particular interest, the nine cases indicated with positive vertebrae and liver (and thus, a ratio) comprise nine of the 17 cases in Los Alamos that are shown in **Figure 20**. The longer-term residents may be more likely to be interred at the Guaje Pines Cemetery in Los Alamos. **Figure 20** also shows two sets of data plotted as cumulative frequency distributions: pre-1950 data and post-1950 data. The plot of post-1950 data is uncertain due to there being only three cases with data for vertebrae and liver, one of which is the outlier. The pre-1950 data has a larger median and slightly smaller geometric standard deviation than that shown for all data from Los Alamos.

The seven records highlighted (also marked with an "*" as arrived before 1955) above are the ones used in the final calculation for the mean dpm/kg for vertebrae. Note that for case 2-145, that the vertebrae value is very high, (the ratio is as well) even though the first address is in 1955. It is suspected that since this is a female, she was married in 1955 and had actually been in Los Alamos much earlier. There are two cases, 24-026 and 11-016, for which it was impossible to determine which person is actually the one referenced in the journal article (McInroy et al., 1979). It is not necessary to resolve these duplicates since there are no data for the vertebrae or liver for case number 24-026 and the vertebrae value is <MRL for case 11-016. Subsequently a vertebrae-to-liver (V/L) ratio cannot be calculated for these cases.

Table 22: Known Residence Summary from "Autopsy.XLS" Spreadsheet

Case Number	Start	Stop	Total # Of Addresses	# Of Addresses GPS completed	% Complete for GPS	Duplicate Address?	Vertebrae	Liver	V/L Ratio	Arrived Before 1955
7-014	1948	1971	7	0	0%		4.60	1.08	4.2593	*
11-150	1948	1975	5	1	20%		N/A	4.35		
24-026	1948	1976	3	1	33%	Pair 1	N/A	N/A		
7-042	1948	1972	3	1	33%		1.08	5.68	0.1901	*
3-062	1948	1967	2	1	50%		18.75	2.05	9.1463	*
2-008	1948	1961	5	4	80%		N/A	<MRL		
2-090	1948	1962	1	1	100%		4.12	2.49	1.6546	*
2-102	1948	1962	2	2	100%		20.97	1.31	16.0076	*
5-016	1948	1969	1	1	100%		2.00	0.29	6.8966	*
5-048	1949	1969	7	1	14%		<MRL	5.03		
3-140	1949	1969	3	3	100%		<MRL	1.63		
11-016	1950	1973	3	2	67%	Pair 2	<MRL	1.07		
24-024	1951	1976	4	3	75%		N/A	N/A		
24-020	1952	1976	6	4	67%		N/A	N/A		
24-026	1953	1976	5	2	40%	Pair 1	N/A	N/A		
3-076	1953	1968	1	1	100%		49.80	<MRL		
5-086	1953	1970	2	2	100%		1.44	1.82	0.7912	
5-058	1954	1970	7	3	43%		<MRL	2.54		
2-145	1955	1963	2	2	100%		23.26	0.77	30.2078	*
2-026	1957	1961	2	1	50%		N/A	0.82		
2-140	1958	1963	2	1	50%		<MRL	<MRL		
11-138	1965	1975	4	2	50%		N/A	0.79		
24-022	1966	1976	3	0	0%		N/A	N/A		
5-034	1967	1969	2	1	50%		<MRL	<MRL		
5-014	1967	1969	1	1	100%		0.85	3.30	0.2576	
11-080	1968	1974	3	1	33%		N/A	N/A		
11-016	1970	1973	1	0	0%	Pair 2	<MRL	1.07		
11-134	1975	1975	1	0	0%		N/A	2.40		

<MRL = less than minimum reporting level
N/A = Not Applicable

A Microsoft Access® program was written to calculate distance and bearing for the GPS coordinates captured by SRA personnel. The information is displayed in Table 23 below. There are also several figures below that attempt to relate the data about address information. Figure 21 is a map, with street names, that shows the relative locations of the addresses and the main operational areas. None of the current addresses is outside of a two-mile boundary from D-Building or a 3.2-mile boundary from DP-Site.

Table 23: Distance and Bearing from the D-Building and the DP-Site

Plot_num	Case_Num	Begin_Yr	End_Yr	Address	Lat	Long	Elev (m)	D Dist	D Bearing	DP Dist	DP Bearing
LMK001	24-020	1953	1957	3785 Gold (A-	35.89	-106.32	7335.00	1.26	297.23	3.71	283.24
LMK002	2-090	1948	1962	749 41st	35.89	-106.32	7360.00	1.69	292.01	4.16	282.61
LMK003	5-058	1954	1955	44th Street	35.88	-106.32	7377.00	1.91	285.08	4.41	280.09
LMK004	3-062	1962	1967	674 45th	35.88	-106.33	7397.00	2.01	284.47	4.51	279.93
LMK005	24-020	1974	1976	858 45th	35.89	-106.32	7392.00	2.00	290.79	4.48	282.73
LMK006	5-016	1948	1969	1355 45th	35.89	-106.32	7379.00	2.09	296.74	4.52	285.58
LMK007	24-020	1964	1973	1179 45th	35.89	-106.32	7354.00	1.86	288.90	4.35	281.66
LMK008	2-145	1956	1963	1335 41st	35.89	-106.32	7347.00	1.79	301.32	4.20	286.69
LMK009	3-140	1954	1969	1476 41st	35.89	-106.32	7345.00	1.88	307.19	4.23	289.47
LMK010	11-016	1954	1963	1386-B 40th	35.89	-106.32	7329.00	1.63	299.45	4.05	285.37
LMK011	2-145	1955	1956	1395 43rd	35.89	-106.32	7355.00	1.86	294.15	4.31	283.88
LMK012	5-048	1952	1956	1632 39th	35.89	-106.32	7313.00	1.62	307.90	3.98	288.63
LMK013	24-024	1968	1976	1752 37th	35.89	-106.32	7307.00	1.60	311.41	3.92	289.83
LMK014	2-102	1952	1962	4197	35.89	-106.32	7342.00	1.88	304.20	4.26	288.22
LMK015	11-138	1972	1975	2273 47th	35.90	-106.33	7488.00	2.90	314.39	5.11	296.78
LMK016	5-058	1964	1966	2357-A 45th	35.90	-106.33	7483.00	2.93	318.75	5.07	299.28
LMK017	11-016	1950	1953	2406-D 45th	35.90	-106.33	7473.00	3.00	320.14	5.11	300.28
LMK017	11-080	1968	1969	2406-B 45th	35.90	-106.33	7473.00	3.00	320.14	5.11	300.28
LMK018	24-020	1958	1961	2975 Arizona	35.90	-106.31	7355.00	2.68	349.08	4.18	314.14
LMK019	2-140	1958	1962	4134-D	35.90	-106.32	7436.00	2.90	327.26	4.88	303.78
LMK020	5-034	1967	1968	2184-A 36th	35.90	-106.32	7350.00	2.10	328.65	4.14	299.98
LMK021	5-086	1958	1970	2316 36th	35.90	-106.32	7383.00	2.36	331.92	4.30	303.21
LMK022	5-086	1953	1957	3765-B Villa	35.90	-106.32	7352.00	2.23	325.69	4.30	299.46
LMK023	3-076	1953	1968	3037-A	35.89	-106.31	7266.00	1.49	346.64	3.32	301.34
LMK024	2-008	1950	1951	2140-B 37th	35.89	-106.32	7335.00	2.01	325.42	4.12	298.03
LMK025	2-008	1951	1955	4763 Trinity	35.88	-106.33	7402.00	2.21	281.99	4.71	278.96
LMK026	24-026	1969	1976	3959 Trinity	35.88	-106.32	7316.00	1.46	284.23	3.96	279.21
LMK027	2-008	1957	1961	3745 Trinity	35.88	-106.32	7311.00	1.14	286.06	3.64	279.34
LMK028	11-138	1965	1967	4333-A	35.88	-106.32	7313.00	1.85	275.09	4.35	275.78
LMK029	11-150	1948	1958	4417 Fairway	35.88	-106.33	7355.00	1.93	275.14	4.44	275.79
LMK030	24-026	1950	1956	4469-A	35.88	-106.33	7356.00	2.01	275.21	4.52	275.81
LMK031	3-140	1951	1953	4611 Fairway	35.88	-106.33	7380.00	2.11	275.83	4.61	276.08
LMK032	3-140	1949	1950	4679-A	35.88	-106.33	7380.00	2.14	276.74	4.65	276.50
LMK032	7-042	1948	1952	4679-B	35.88	-106.33	7380.00	2.14	276.74	4.65	276.50
LMK033	2-026	1958	1961	1013 Iris (A-	35.88	-106.30	7299.00	0.76	73.08	1.83	285.67
LMK034	24-026	1953	1954	1203 9th	35.88	-106.30	7283.00	0.87	68.19	1.78	289.63
LMK035	2-008	1956	1957	446	35.88	-106.29	7254.00	1.20	69.47	1.54	296.83
LMK036	24-024	1952	1954	358-C	35.88	-106.29	7239.00	1.30	69.28	1.47	299.79
LMK037	24-024	1955	1967	380 Rim Road	35.89	-106.29	7236.00	1.35	59.73	1.63	305.69
LMK038	5-058	1959	1963	1717-B Peach	35.88	-106.30	7326.00	0.66	33.11	2.29	291.11
LMK039	2-102	1948	1951	963 Canyon	35.88	-106.30	7300.00	0.92	55.01	1.92	294.66
LMK040	2-140	1963	1963	352 Rim Rd.	35.89	-106.29	7270.00	1.35	59.66	1.63	305.74
LMK041	5-014	1967	1969	139 Royal	35.87	-106.30	7303.00	0.71	163.89	2.33	260.00

Note – LMK is an abbreviation for landmark and is assigned from the GPS system

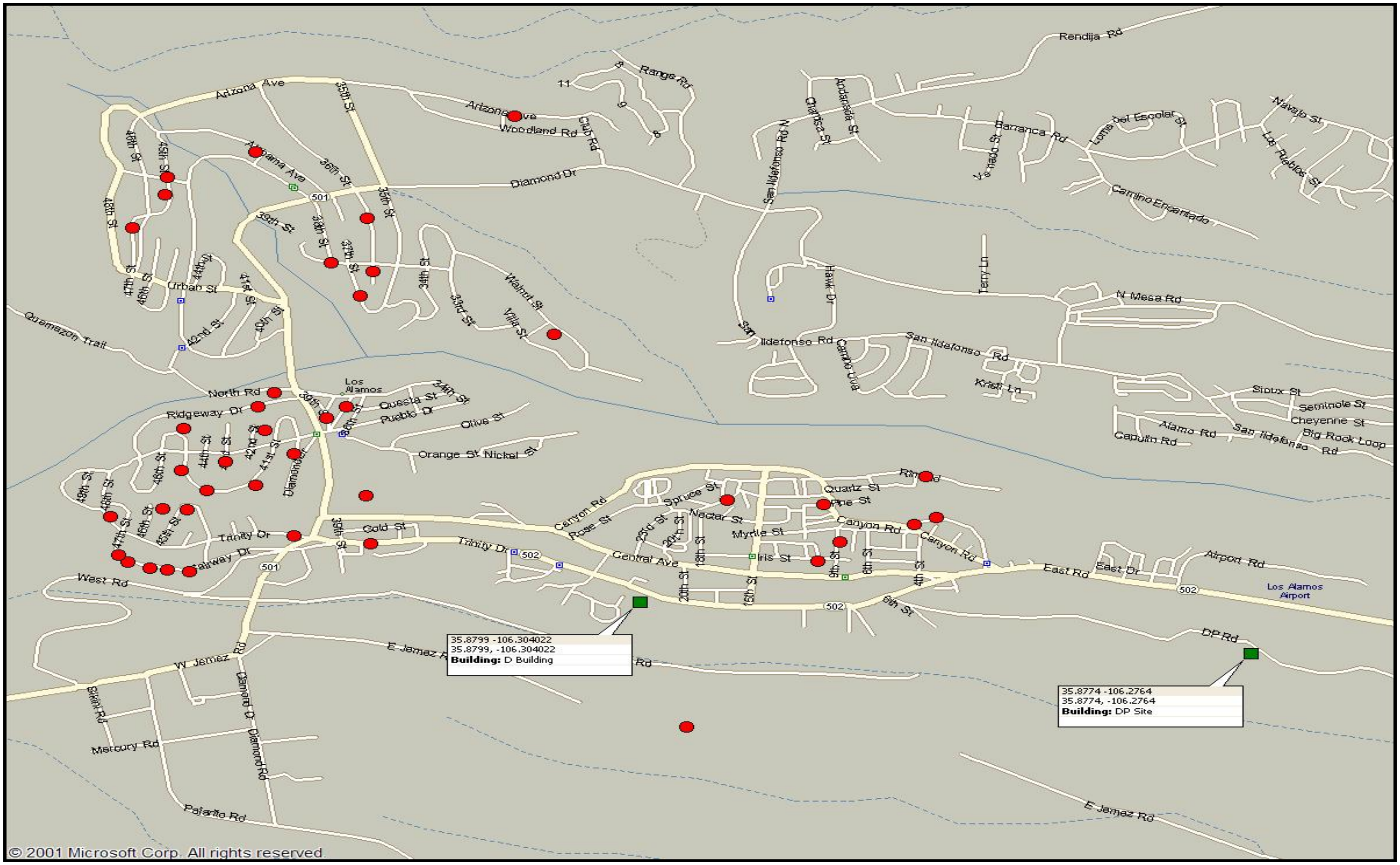

Figure 21: Autopsy Address Overview

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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.

Sources of Information Regarding Historical Chemical Usage

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.

Current Chemical Inventory

LANL maintains an inventory of chemicals present on-site to comply with annual environmental reporting requirements for hazardous chemical emissions. Information on the quantities and types of chemicals used at LANL was collected starting in 1991 and a Microsoft Access® database was completed in 1993 (ESH, 1-6-99). The initial tracking system called the Automated Chemical Inventory System (ACIS) had been updated annually since 1994. Recently, the inventory system was changed to the Injury Illness and Chemical Management Online Application by E3. Although the project team was granted access and training for the new system, the initial analysis of chemical inventory data conducted in 2000 was not repeated due to the limited usefulness of recent chemical inventory data for evaluating historical emissions of chemicals from LANL.

The ACIS database includes the following fields:

- Chemical name, CAS number, and bar code
- Location of chemical (technical area, building)
- Quantity, units of measure, and physical state (solid, liquid, gas)

ACIS is available on the internal LANL Web site using a SecureID card. Access to the database allows the data to be compiled in different ways, and provides details such as the specific locations of chemicals through database search capabilities. A paper copy of the ACIS Microsoft Access® database file was provided to the project team by the ESH-5 group on January 26, 1999. At that time, the database contained approximately 120,000 records. Subsequently, access through a Web interface was granted to allow limited searches to be performed. A request for an official-use-only copy of the database for performing more complex searches was granted. However, the database does not include radionuclides, explosives, beryllium, depleted uranium, or other bulk metals. It contains many trade name products with no information on whether they include any hazardous materials. The database also does not include any information regarding how the chemicals are used or their potential for release to the environment.

Preliminary review of the ACIS database indicates 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. The 37 high quantity chemicals selected from ACIS are shown in Table 24 in order of decreasing estimated on-site quantities.

Of the 37 high quantity chemicals, the 13 with USEPA recommended toxicity values are shown in Table 24 ranked in 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.

LANL personnel suggested that site files of Material Safety Data Sheets could be reviewed for the trade name products to determine if the trade name products contain any hazardous materials. An analysis of the remaining inventory chemicals not included in Table 24 for quantity and location of use information could be conducted in future phases of the dose reconstruction to further prioritize recent chemical use at LANL. For chemicals that could be released to the off-site environment as a result of their use, air dispersion and other transport models and exposure models can be used to estimate an onsite threshold quantity that would not result in adverse health impacts to off-site populations using site-specific assumptions regarding dispersion, transport and exposure. The threshold quantity approach could be used to focus data gathering efforts on those chemicals for which the on-site inventory quantity exceeds the threshold quantity. However, the chemical inventory database only contains information on selected chemicals present at LANL since 1991.

Historical Chemical Inventories

Harry Schulte, a former Industrial Hygiene group leader, is reported to have conducted a chemical inventory in the early 1970s (ESH, 1999). A draft report was prepared, but was never finalized. It was suggested that the draft report and supporting data might be located in the Industrial Hygiene group files in the Central Records Center. Surviving members of Mr. Schulte's group reportedly do not have any copies in their possession. This 1970s chemical inventory information has not been located by the project team.

For years prior to the initiation of the current chemical inventory program, the project team identified several lists of chemicals used at LANL in years prior to 1980s environmental reporting requirements. The lists represent the years 1947-50 (Repos. No. 296), 1971 (Rep. Nos. 756, 883, 997), and 1970s (Rep. Nos. 279, 284, 1380, 2015). Quantities and locations of use are typically not provided in these lists. The project team identified considerable documentation related to chemical use in specific areas for the 1980s and 1990s as LANL began collecting these data in response to regulatory requirements.

Table 25 is a list of chemicals documented as having been used at LANL at some point in time. This list was compiled from the LANL documents that have been reviewed to date, entered into the project database, and released to the public. Copies of many of the reviewed documents have not yet been obtained by the project team from LANL as of the preparation of this report. Classification, privacy act, and legal privilege reviews are required prior to public release. Documents used to identify the chemicals in Table 25 are included in the reference section and are described below.

Table 24: Selected Data from a Current LANL Chemical Inventory

Chemical	Onsite Quantity	Toxicity Ranking
Nitrogen	4.2×10^{7} litres	--
Argon	3.8×10^{7} litres	--
Helium	3.7×10^{7} litres	--
Hydrogen	1.6×10^{6} litres	--
Oxygen	1.6×10^{6} litres	--
Propane	1.3×10^{5} litres	--
Sulfuric acid	2.2×10^{4} litres	--
Toluene	2.1×10^{4} litres	8
Sodium hydroxide	1.5×10^{4} kg	--
Sodium chloride	8.6×10^{3} kg	--
Ethyl alcohol	7.1×10^{3} litres	--
Sodium carbonate	6.8×10^{3} kg	--
Hydrochloric acid	6.6×10^{3} litres	--
Acetone	6.2×10^{3} litres	7
Ethylene glycol	5.1×10^{3} litres	12
Chlorodifluoromethane	4.8×10^{3} litres	14
Methyl alcohol	2.8×10^{3} litres	10
Nitric acid	2.6×10^{3} litres	--
Isopropanol	2.2×10^{3} litres	--
Hydrogen peroxide	7.8×10^{2} litres	--
Buffer solutions	6.3×10^{2} litres	--
Acetic acid	5.8×10^{2} litres	--
Hexane	5.4×10^{2} litres	5
Methylene chloride	4.9×10^{2} litres	4
Miscellaneous chlorofluorcarbon	4.6×10^{2} litres	--
1,1,1,2-Tetrafluoroethane	4.4×10^{2} litres	--
Photographic developer products	3.9×10^{2} litres	--
Dimethyl sulfoxide	3.8×10^{2} litres	--
Chloroform	3.4×10^{2} litres	1
Benzene	2.1×10^{2} litres	2
Ether	2.0×10^{2} litres	9
Dichlorodifluoromethane	1.5×10^{2} litres	6
Photographic fixer products	1.2×10^{2} litres	--
Tetrahydrofuran	6.0×10^{1} litres	3
Ethylenediamine tetraacetic acid	3.8×10^{1} kg	--
Ethyl acetate	2.1×10^{1} litres	11
1,1-Difluoroethane	8.5×10^{0} litres	13

Table 25: Chemicals Historically Used at LANL

Elements aluminum antimony arsenic barium beryllium bromine cadmium chromium copper dioxane fluoride gallium iron lanthanum lead lithium manganese mercury molybdenum nickel niobium platinum samarium silver tantalum thallium uranium (normal and depleted) vanadium zinc zirconium **Volatile Organic Compounds** acetone benzene carbon tetrachloride chloroform chlorodifluoromethane dichlorodifluoromethane difluoroethane ethanol ether isopropanol kerosene methanol methyl chloride (chloromethane) methyl ethyl ketone (2-butanone) methylene chloride (dichloromethane) tetrachloroethylene tetrabromoethane tetrahydrofuran toluene (toluol) trichloroethane trichloroethylene xylene	**Inorganics** asbestos (magnesium silicate) bromide cyanide hydrochloric acid hydrofluoric acid nitric acid oxalic acid/ oxalate perchloric acid/ perchlorate phosphoric acid sodium hydroxide sodium thiosulfate sulfuric acid **Semi-Volatile Organics** n-butyl acetate ethyl acetate ethylene glycol hexachlorobutadiene naphthalene PCB (polychlorinated biphenyls): Aroclor 1242 **Explosives** Baratol (mixture of barium nitrate and TNT) Comp. B (mixture of 60% RDX and 40% TNT) Cyclotol (mixture of 70-75% RDX and 25-30% TNT) Explosive D (ammonium picrate; ammonium-1,3,5-trinitrophenol) HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine) nitrobenzene nitrocellulose nitromethane NQ (nitroguanidine; Picrite) Octol (mixture of 70-75% HMX and 25-30% TNT) PBX Pentolite PETN (pentaerythritol tetranitrate) picric acid PTX-2 (2,6-bis-picrylamino-3,5-dinitropyridine) RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) Saltex TATB (1,3,5-triamino-2,4,6-trinitrobenzene) Tetryl (1,3,5-trinitrophenyl-methylnitramine) TNT (2,4,6-trinitrotoluene) Torpex

Table 26 is a compilation of data located by the project team regarding quantities of chemicals used or released historically from LANL. Five documents report quantities of primarily volatile organic solvents that were used at LANL from 1971 until 1985. Three documents identify chemical quantities as "released or lost to the atmosphere". One of the three documents, Repos. No. 1197, is a third source of the same numbers provided in Rep. Nos. 610 and 1324. It states that the amount of airborne solvents is taken from LASL stock issue records. However, it is often reasoned that all of the volatile solvents will in time become airborne no matter what the disposal method. Therefore, it appears that 100% volatilization was assumed. The chemicals listed in Table 26 are in the order of quantity used or released. Selection of the chemicals addressed in these documents was based on State and Federal air pollution requirements at the time of reporting. From Table 26, it can be concluded that trichloroethane and trichloroethylene were the most used volatile organic chemicals at LANL in the early 1970s. However, trichlorethylene appears to have been replaced by Freons in the early 1980s. Methyl ethyl ketone was also used in high quantities until 1982.

Site Documents

In the late 1980s, the Senate Committee on Armed Services asked the Office of Technology Assessment to evaluate what was known about the contamination and public health problems at the Nuclear Weapons Complex (U.S. Congress 1991). Contaminated sites and initial cleanup activities at LANL were described in this report. A summary of hazardous substances released to the environment at LANL formed the basis for our initial list.

For each of the over 600 solid waste management units (SWMUs) identified in the 1990 Solid Waste Management Units Report (LANL 1990), the unit, waste and releases information sections were reviewed by the project team to identify additional chemicals that may have been released from LANL.

An additional 480 SWMUs were added by the EPA in 1994, and another 1,000 Potential Release Sites (PRSs) were included in the investigation by the Department of Energy, for a total of 2,120 areas of concern. The 1996 Baseline Environmental Management Report (USDOE 1996) describes historical activities at the potential release sites involving the following chemicals: asbestos, barium, lead, depleted uranium, beryllium, and PCBs. High explosives, organic solvents, and ordnance are also cited but specific chemical names are not provided.

The project team has been following Environmental Restoration (ER) activities at LANL since the project began in early 1999. Numerous press releases and fact sheets regarding environmental investigations and surveillance activities have been provided by the ER Project and have supplied some relevant information. For example, oxalic acid was used to purify uranium and plutonium in early operations at TA-1 and TA-21. Oxalate has been detected in a groundwater monitoring well in Lower Los Alamos Canyon (LANL ,1998). Recently, perchlorate was detected in a groundwater monitoring well in Mortandad Canyon, in a water supply well in lower Pueblo Canyon, and in the CMR Building ductwork (LANL 2000). Perchloric acid is used in high-explosive (HE) formulation (Dobratz, 1995) and in nuclear chemistry analyses conducted in CMR Building.

Table 26: Reported Quantities of Chemicals Historically Used or Released at LANL *(page 1)*

	1971 [1]	1972-73 (12 mo.) [2]	1972 [3]	1973 [3]	1974 [3]	1975 [3]	1976 [3]	1977 [3]	1978 [3]
CHEMICAL	**(kg released)**	**(kg issued)**	**(kg used)**	**(kg used)**	**(kg used)**	**(kg used)**	**(kg used)**	**(kg used)**	**(kg used)**
ORGANICS									
Methyl chloroform (trichloroethane)	26,571	19,138	25,600	18,300	25,800	22,900	34,000	28,300	24,100
Trichloroethylene	27,719	17,007	20,400	15,500	16,200	9,400	13,200	10,200	7,400
Acetone	15,610	--	18,800	9,200	12,400	16,100	15,500	12,700	10,600
Freons	16,825	6,531	10,900	13,300	15,000	10,200	12,400	13,800	8,200
Perchloroethylene	10,540	680	3,400	680	1,000	820	680	1,000	1,400
Kerosene	7,338	--	8,100	5,000	5,900	4,800	4,600	4,400	3,800
Methyl ethyl ketone	--	--	--	--	--	2,300	9,400	10,600	14,300
Ethanol	--	--	--	--	--	--	1,088	9,200	10,900
Toluene	2,063	--	2,300	2,100	1,200	2,700	3,300	1,600	2,100
n-Butyl acetate	--	--	--	--	--	3,311	5,170	2,222	10
Ethyl acetate	--	--	--	--	--	--	104	2,404	180
Methanol	1,125	--	590	540	1,500	1,700	6,600	4,300	2,600
Methylene chloride	1,669	--	820	820	310	1,000	820	2,200	250
Isopropanol	--	--	--	--	--	--	218	952	950
n-Hexane	--	--	--	--	--	209	304	290	210
Chloroform	3,088	--	360	250	500	380	370	190	160
Carbon tetrachloride	558	--	300	290	250	100	250	230	200
Xylene	--	--	--	--	--	--	86	227	290
Benzene	--	--	181	127	110	45	141	32	40
Tetrahydrofuran	--	--	--	--	--	--	--	--	--
Dioxane	--	--	--	--	--	--	14	32	15
INORGANICS									
Cadmium	1.E-02	--	--	--	--	--	--	--	--
Beryllium	3.E-05	--	--	--	--	--	--	--	--
Mercury	--	--	--	--	--	--	500	290	180
ACIDS									
Nitric acid	20,200	--	--	--	--	--	--	--	80,000
GASES									
Helium	--	--	--	--	--	--	--	--	--
Sulfur hexafluoride	6,812	--	17,400	6,700	10,300	11,400	12,200	13,700	9,200

Table 26: Reported Quantities of Chemicals Historically Used or Released at LANL *(page 2)*

CHEMICAL	1979 [3] (kg used)	1980 [5] (kg used)	1981 [5,6] (kg used)	1982 [6] (kg used)	1983 [6] (kg used)	1984 [6] (kg used)	1985 [6] (kg used)
ORGANICS							
Methyl chloroform (trichloroethane)	23,800	28,200	39,300	25,600	31,100	27,674	29,665
Trichloroethylene	6,900	3,400	3,200	390	4,200	2,204	3,041
Acetone	8,300	7,900	10,200	10,700	10,900	10,118	6,735
Freons	9,200	12,800	12,500	32,200	28,400	22,006	27,097
Perchloroethylene	340	1,400	9,100	340	--	2	32
Kerosene	4,100	5,800	5,300	5,500	2,800	1,315	614
Methyl ethyl ketone	22,000	11,400	21,000	400	6,200	5,805	4,238
Ethanol	9,900	9,400	11,800	12,800	13,500	7,024	9,420
Toluene	2,100	650	60	60	190	337	83
n-Butyl acetate	--	--	--	--	--	--	--
Ethyl acetate	--	--	--	--	--	--	--
Methanol	3,300	2,400	3,400	3,100	730	3,298	1,607
Methylene chloride	170	180	230	430	100	1,876	2,028
Isopropanol	--	--	--	--	--	--	--
n-Hexane	--	--	--	--	--	--	--
Chloroform	200	310	250	320	500	177	208
Carbon tetrachloride	280	100	180	190	60	103	238
Xylene	--	--	--	--	70	59	135
Benzene	--	--	--	--	70	12	78
Tetrahydrofuran	--	--	--	--	--	30	79
Dioxane	--	--	--	--	--	--	--
INORGANICS							
Cadmium	--	--	--	--	--	--	--
Beryllium	--	--	--	--	--	--	--
Mercury	140	140	200	210	60	24	1
ACIDS							
Nitric acid	58,100	71,900	99,500	70,500	52,100	55,976	54,212
GASES							
Helium	--	--	--	--	--	--	--
Sulfur hexafluoride	11,400	6,900	10,600	8,800	14,200	9,507	14,560

Notes to Table 26:

-- Not reported.

C known or suspected human carcinogen

1 1971 Pollutant Inventory. Releases estimated by group leaders using chemical stock issue records. (Rep. No. 756 / 997).

2 Response to Sept. 6 TWX Concerning Use of Trichloroethylene. H-5 Division. September 14, 1973. (Rep. No. 2816).

3 Attachment II to Air Quality Regulation Review #3: NAAQS. Chemical and gas usage. June 9, 1980. (Rep. No. 610); Volatile and/or dangerous chemicals checked out of the storeroom (Rep. No. 1324); Airborne effluents 1973: airborne releases, nonradioactive 1972-73 (Rep. No. 1197).

4 Atmospheric Emissions of Non-Radioactive Materials. Losses estimated by LASL groups using >1500 lb/yr. January 17, 1979. (Rep. No. 610).

5 Attachment I to Nitric Acid and NOx Emissions. November 30, 1982. (Rep. No. 511).

6 Table G-12, p. 140, of the HSE-8 Annual Report. Attachment to Chlorinated Hydrocarbon Solvents. December 2, 1986. (Rep. No. 280).

Explosives including HMX, RDX, and TNT that have been detected in a groundwater monitoring well at TA-16 (S Site) and at Material Disposal Area-P reflect machining and subsequent disposal activities that occurred at TA-16, the center for research in high explosives since the 1940s. Prior to the construction of the High-Explosives Wastewater Treatment Facility at TA-16 in the 1990s, over 12 million gallons of water per year were used to keep the surface of high explosives cool and wet while machining. Following settling of the solids and heavier materials, the remaining water was discharged to the environment via outfalls. The wet solids were trucked to a burning ground, separated from liquids with a sand filter, then dried and ignited. The filtrate was treated before being discharged. Solvents such as acetone, methanol and ethanol were released to the atmosphere by volatilization from the water discharged at the outfalls (LANL 1998,1999).

Detonable quantities of explosives have been removed from MDA-P during RCRA clean-closure excavation activities (Santa Fe New Mexican 1999). A document located on microfiche in the Central Records Center at LANL (author and date unknown) states that quantities of explosives burned at TAs-14, 15, 16, 36, and 40 range from 100-300 lb/yr at TAs-14 and 33, to 96,300 lb/yr at TA-16. Normal uranium, HE-contaminated solvents (unidentified) and other combustibles are also disposed of by burning at these locations.

Project team review of X-Division Progress Reports from 1944 through 1945 has yielded reported estimates of quantities of high explosives used during that time period. These data are presented in Table .

A 1981 memorandum from R. W. Ferenbaugh to H. S. Jordan dated January 27, 1981 states that 20,000 – 30,000 kg (91,000 – 136,000 lbs) per year of waste explosives were disposed of at TA-16 by open burning. Explosive burning experiments conducted at LASL several years prior to 1981 estimated annual emissions of 600-800 kg of NO_x, 100-200 kg of carbon monoxide, and 300-500 kg of unidentified particulates from this open burning process (Ferenbaugh 1981).

An effluent material summary for group GMX-7 (Drake 1971b) includes several explosives dispersed at TA-40 as gaseous detonation products during the period July – September 1971 (Table). Toxic material reports for December 1979 through September 1980 (Dinegar 1980) report the approximate amounts of HE exploded per month in WX-7 shots at TA-40 and TA-22.

Table 27: Reported Quantities of High Explosives Used per Month (lbs)

DATE >	Aug-44	Sep-44	Oct-44	Nov-44	Dec-44	Jan-45	Feb-45	Mar-45	Apr-45	May-45	Jun-45	Jul-45	Aug-45	Sep-45	Oct-45	Nov-45	Dec-45
EXPLOSIVE																	
Barium Nitrate						3,250	3,170	19,850	42,750	35,000	57,500	60,000					18,000
Composition B					23,523	27,600	47,150	80,850									17,000
Composition B-1	6,800	5,366	7,510														
Composition B-2			3,900						20,600	87,500	90,250	66,850					
TNT		650	131		1,250	2,935	2,475	7,500	9,200	12,800	20,400	20,150					6,000
Aluminum-TNT 60/40					937	1,008	1,390	1,750	200								
Torpex[1]	1,100	1,250	6,953														
Saltex		463															
Pentolite						500	0										
Cyclotol 70/30							250										
PTX										150	100	150					
RDX											6						
Sum	7,900	7,729	18,494		25,710	35,293	54,435	109,950	72,750	135,450	168,250	147,150					41,000
Reported TOTAL	8,900	12,434	18,494	--	23,523	34,793	54,185	109,950	72,550	135,300	168,150	147,000		--	--	--	41,000
Waste (lbs)	1,200	1,518	2,160														
Rejected Castings																	28%

Source: X-Division Progress Reports 1944-47 (Rep. Nos. 2931, 2915, 2916, 2917, 2918, 2919, 2920, 2921, 2936, 2935, 3128, 3272, 2937).

[1] Torpex is 5:1 Comp B :TNT

-- Quantities of explosives used are not reported in the monthly X-Division Progress Report for November 1944.

Table 28: Reported Quantities of Explosives Dispersed

Explosive	July – Sept 1971	Dec 1979 (kg)	Jan 1980 (kg)	Feb 1980 (kg)	Mar 1980 (kg)	Apr 1980 (kg)	May 1980 (kg)	June 1980 (kg)	July 1980 (kg)	Aug 1980 (kg)	Sept 1980 (kg)
Nitromethane	450 kg (990 lbs)	--	--	--	--	--	--	--	--	--	--
Comp B	34 kg (75 lbs)	0.1	3.1	10.8	22.4	13.2	6.7	19.6	--	52.8	9.6
Baratol	--	0.1	2.9	17.1	63.7	21.1	16.4	25	--	89	3.4
TATB	--	0.4	0.7	0.25	0.1	0.4	0.4	0.03	0.6	0.7	0.7
TNT	--	--	--	2.7	5.4	13.5	2.7	5.4	--	25	2.7
Octol	--	--	12	6	3	--	6	3	--	6	--
PETN	7 kg (15 lbs)	0.02	0.09	0.06	0.05	0.1	0.01	0.13	0.03	0.05	1.2
PBX	0.9 kg	0.1	0.4	0.4	0.3	0.4	0.3	0.05	0.4	0.3	0.5
Tetryl	0.05 kg	--	--	--	--	--	--	--	--	--	--
TOTAL	492 kg	1 kg	19 kg	37 kg	44 kg	49 kg	32 kg	54 kg	1 kg	174 kg	18 kg

-- not reported

Research, development, and testing of high explosives were conducted at more than 25 different Technical Areas of LANL (Goldie 1984; LANL 1990). Many new formulations of the conventional explosives HMX, RDX and TNT were synthesized and tested at LANL since the 1940s (Dobratz 1995). Other high explosives such as Baratol, Comp B, Pentolite, Torpex, and Tetryl were tested at the firing site at TA-14 (IT Corporation 1989).

Uranium and other metals such as lead, beryllium, aluminum and cadmium (HAI 1993; Johnson and Dahl 1977) were released to the environment as a result of test shots conducted at LANL since the 1940s. Drake and Eyster (1971) estimate that between 75,000 and 95,000 kg of uranium have been expended in experimental shots at LANL from 1949-1970. Normal uranium was used until 1954, then depleted uranium was used exclusively. The estimate does not address where the uranium went, only that they don't have it any longer. A 1952 AEC report states that test shots at LASL routinely dispersed 300 lbs of uranium per month and 200 lbs of barium per month (English 1952). Two 1971 memoranda (Drake 1971a) report toxic materials dispersed by GMX Division shots for April and May 1971 as shown in Table 29.

Table 29: Materials Dispersed by GMX Division Shots for April and May 1971

Toxic Material	April 1971	May 1971
Uranium-238	171 kg (376 lbs)	142 kg (312 lbs)
Beryllium	0.7 kg	3 kg
Tritium	125 cm^3 STP	208 cm^3 STP
Lead	0.042 kg	0.8 kg
Bromine	0.165 kg	--

-- not reported

Most of the documents describing PCBs at LANL that have been identified by the project team to date are logbooks of analytical results with unidentified sampling locations. Several documents describe storage and disposal of PCB wastes at TAs-21 and 54 (Santa Fe Engineering 1995). PCB cleanups were conducted at TAs-3, 53, and near groundwater production wells in the mid 1980s and 1990s as a result of leaking transformers and capacitors (Unknown 1997; LANL 1993). Aroclor-1242 was used as a coolant in CMB-11 division in 1961 (Enders 1969).

A 1973 document, "Summary of wastes and effluents for Omega Site TA-2", estimates that 1.4 lbs/day of hexavalent chromium were released to the air in cooling tower effluent. The Omega West Reactor (OWR) primary water was cooled via a 5 MW evaporative cooling tower. Trichloro-s-triazinetrione ($C_3N_3O_3Cl_3$), a common microbicide, was added to the secondary-side water in the tower to control algae growth. A second product containing polyacrylate polymer, polyoxylated aliphatic diamine, and tolyltriazole was added to control scale and corrosion. Cooling tower water was discharged to the environment via entrainment in the exhaust air stream and through discharges of blowdown water to Los Alamos Canyon Creek. These blowdown discharges were another measure used to control scale and corrosion in the secondary (sump) water by eliminating solids. Repos. No. 645 reports that these discharges totaled approximately 60,000 gallons per week in 1973. Another 300 gallons per week of blowdown water came from the heat exchanger for the primary water in the OWR's demineralizer loop. Like the main OWR exchanger, the cooling water for this heat exchanger came from the municipal water supply.

Repos. No. 645 also reports the exhaust air stream from the OWR cooling tower included entrained secondary water that was discharged to the environment at a rate of 3.9 gpm. The document states this resulted in the discharge of 20 pounds of sulfuric acid and 1.4 pounds of hexavalent chromium to the atmosphere per 24 hour period.

Draft CEARP documents from 1986 (Repos. No. 525) report a staff member recalling the use of potassium dichromate in the cooling tower water prior to a time when the heat exchanger components were changed from aluminum to steel. The employee stated that mist from the tower would drift about the site and turn things green. This "greening" effect went away with the switch to steel components (and the subsequent reduction in use of potassium dichromate). The use of potassium dichromate as a corrosion inhibitor is confirmed in Repos. No. 645, which states that the blowdown discharges from the cooling tower (~60,000 gallons per week) included approximately 14.5 pounds of hexavalent chromium. This same document reports that the blowdown also included 3 pounds of chlorophenol biocide and 200 pounds of sulfuric acid in the form of sulfate salts (used for pH control). The blowdown from the demineralizer loop heat exchanger contributed another 20 pounds of sulfuric acid and 0.5 pound of chlorophenol biocide. Repos. No. 645 also says it was planned to make the switch from aluminum to stainless steel components in fiscal year 1974 to reduce to amount of corrosion inhibitor required and thus reduce the amount of hexavalent chromium in the blowdown water. An inventory of pollutant releases to the environment for 1971 (Repos. No. 883) states that use of chromates will be discontinued once the aluminum heat exchanger is replaced with a stainless steel unit. This same document reports the average concentration of hexavalent chromium in the TA-2 blowdown to be 25 mg/l, which was 2500 times the quality standard of 0.01 mg/l for that era. The same effluent stream is reported to contain total dissolved solids at an average concentration of 800 mg/l, which also exceeded the applicable quality standard of 500 mg/L.

The Water Boiler's cooling tower used potassium dichromate by the hundreds of pounds; waterborne effluent ran down the nearby creek, and sometimes chromium "rained from the sky," and windshields on people's cars had to be replaced (G. Neely, 1999 personal communication). Condensate poured on the ground; there was a tree in the area with Cs-137 in its leaves as a result. There was reportedly also asbestos in some TA-2 buildings.

Repos. No. 2211 reports that a "very serious" mercury spill took place at the Clementine site on December 31, 1948 that required a "prolonged period" of cleanup. This report also mentions that routine monitoring for mercury vapor had been going on at the Clementine site prior to this incident.

Rep No. 2201 reports that a mercury spill occurred at the Clementine site between January 20, 1951 and February 20, 1951. Air samples were collected and analyzed for mercury vapor and urine samples were collected from three exposed workers. The report states that "the results obtained showed all exposures below hazardous levels."

In late 1952, it was reported that members of H Division had been participating in conferences relative to the large quantity of contaminated mercury to be pumped from the fast reactor at Omega Site. Since the material was contaminated with plutonium, it appeared to the participants that the plutonium hazard was more serious than that of the mercury vapor. [Repository No. 124]

Perchlorate was identified in shallow groundwater in Mortandad Canyon at concentrations ranging from 80 to 220 ppb. Perchlorate was also found in groundwater characterization wells at 12 ppb and in drinking water supply wells at 2 to 3 ppb, just above analytical detection limits. It is assumed that the perchlorate contamination was discharged in effluent from the TA-50 Radioactive Liquid Waste Treatment Facility, and also from legacy waste that was discharged into Acid Canyon from the TA-45 treatment plant which operated from 1943 to 1964.

In August 2002, benzene was identified in soil at TA-48 from historical solvent use.

Accident/ incident files from the Health Divisions were identified for 1944-1991 (Rep. Nos. 3461-3496) . However, the files primarily document chemical spills and indoor exposures to workers. Operations related to the presence of the chemical are not described. The documentation of a few incidents that could have resulted in releases to the off-site environment was extracted and entered into the project database. A document titled "Chronological Record of Accidents at LASL" lists a fatality due to asphyxiation by methyl chloroform at "New" Sigma Building on February 14, 1961 (Unknown 1979). Details of the accident are not provided.

Many of the Health/ Industrial Hygiene Division reports and correspondence files include memoranda regarding the presence of numerous solvents, metals, and acids in various LANL divisions. However, details regarding building locations, quantities used, or the operations involved are rarely provided. All of the chemicals mentioned are included in Table H-1.

Preliminary Prioritization for Chemicals

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 (USEPA 2002). 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.

Table shows a ranking of Los Alamos chemicals based on PRGs for soil, while Table presents a ranking based on PRGs for air. 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.

Table 30: Ranking of LANL Chemicals Based on PRGs for Soil

Chemical	PRG for soil [mg/kg]	Rank
RDX (hexahydro)	4.40E+00	1
Thallium	5.20E+00	2
Perchlorate	7.80E+00	3
TNT (2,4,6-trinitrotoluene)	1.60E+01	4
Uranium	1.60E+01	5
Nitrobenzene	2.00E+01	6
Arsenic	2.20E+01	7
Mercury	2.30E+01	8
Antimony	3.10E+01	9
Molybdenum	3.90E+02	10
Silver	3.90E+02	11
Lead	4.00E+02	12
Vanadium	5.50E+02	13
Acetone	1.60E+03	16
Lithium	1.60E+03	14
Nickel	1.60E+03	15
Manganese	1.80E+03	17
HMX (octahydro)	3.10E+03	18
Copper	3.10E+03	19
Fluoride	3.70E+03	20
Barium nitrate	5.40E+03	21
NQ (nitroguanidine; Picrite)	6.10E+03	22
Iron	2.30E+04	23
Zinc	2.30E+04	24
Aluminum	7.60E+04	25
Bromine	N/A	
Gallium	N/A	
Lanthanum	N/A	
Niobium	N/A	
Platinum	N/A	
Samarium	N/A	
Tantalum	N/A	
Zirconium	N/A	

Table 31: Ranking of LANL Chemicals Based on PRGs for Air

Chemical	PRG for air [microgram / m^3]	Rank
Chromium (total)	1.60E-04	1
Beryllium	8.00E-04	2
Cadmium	1.10E-03	3
Polychlorinated biphenyls- Aroclor 1242	3.43E-03	4
Trichloroethylene	1.70E-02	5
Hexachlorobutadiene	8.60E-02	6
Carbon tetrachloride	1.30E-01	7
Benzene	2.30E-01	8
Dioxane	6.10E-01	9
Tetrachloroethylene	6.70E-01	10
Tetrahydrofuran	9.90E-01	11
Chloromethane	1.10E+00	12
Chloroform	3.10E+00	13
Naphthalene	3.10E+00	14
Cyanide	3.10E+00	15
Methylene chloride	4.10E+00	16
Phosphoric acid	1.00E+01	17
Xylene	1.10E+02	18
Dichlorodifluoromethane	2.10E+02	20
n-Hexane	2.10E+02	19
Toluene	4.00E+02	21
Ether	7.30E+02	22
Methyl ethyl ketone	1.00E+03	23
Methanol	1.80E+03	24
Trichloroethane (methyl chloroform)	2.30E+03	25
Ethyl acetate	3.30E+03	26
Ethylene glycol	7.30E+03	27
1,1-Difluoroethane	4.20E+04	28
Chlorodifluoromethane	5.10E+04	29
Ethanol	N/A	
Isopropanol	N/A	
Kerosene	N/A	
Tetrabromoethane	N/A	
n-Butyl acetate	N/A	
Asbestos (magnesium silicate)	N/A	
Bromide	N/A	
Hydrochloric acid	N/A	

Chemical	PRG for air [microgram / m^3]	Rank
Hydrofluoric acid	N/A	
Nitric acid	N/A	
Oxalic acid	N/A	
Sodium hydroxide	N/A	
Sodium thiosulfate	N/A	
Sulfur hexafluoride	N/A	
Sulfuric acid	N/A	
Baratol (barium nitrate+TNT)	N/A	
Comp B (60% RDX; 40% TNT)	N/A	
Cyclotol (70-75% RDX; 25-30% TNT)	N/A	
Explosive D (NH3 picrate; NH3-1,3,5-trinitrophenol)	N/A	
Nitrocellulose	N/A	
Nitromethane	N/A	
Octol (70-75% HMX; 25-30% TNT)	N/A	
PBX	N/A	
Pentolite	N/A	
PETN (pentaerythritol tetranitrate)	N/A	
Picric acid	N/A	
PTX-2 (2,6-bis-picrylamino-3,5-dinitropyridine)	N/A	
Saltex	N/A	
TATB (1,3,5-triamino-2,4,6-trinitrobenzene)	N/A	
Tetryl (1,3,5-trinitrophenyl-methylnitramine)	N/A	
Torpex (83%Comp B; 17% TNT)	N/A	

Table 32: Ranking of LANL Chemicals Based on Toxicity Parameter and Annual Usage

	A	B	C	(A or B) * C	
Chemical	**(Slope Factor)$^{-1}$**	**Reference Dose**	**Annual Use**	**Tox * Quantity**	**Rank**
	[mg/kg-d]	**[mg/kg-d]**	**[kg]**	**[mg/kg-d*kg]**	
Methylene chloride	6.25E+02		2,200	1.38E+06	1
TNT (2,4,6-trinitrotoluene)	3.33E+01		37,950	1.27E+06	2
Tetrachloroethylene	1.00E+02		10,540	1.05E+06	3
Chlorodifluoromethane		1.40E+01	32,200	4.51E+05	4
Trichloroethylene	2.50E+00		27,719	6.93E+04	5
Trichloroethane (methyl chloroform)		6.30E-01	39,300	2.48E+04	6
Tetrahydrofuran	1.47E+02		79	1.16E+04	7
Carbon tetrachloride	1.89E+01		558	1.05E+04	8
Barium nitrate		7.00E-02	108,873	7.62E+03	9
Methyl ethyl ketone		2.90E-01	22,000	6.38E+03	10
Benzene	3.45E+01		181	6.24E+03	11
Methanol		5.00E-01	6,600	3.30E+03	12
Dioxane	9.09E+01		32	2.91E+03	13
Acetone		1.00E-01	18,800	1.88E+03	14
Dichlorodifluoromethane		5.70E-02	32,200	1.84E+03	15
Xylene	2.50E+00		290	7.25E+02	16
Toluene		1.10E-01	3,300	3.63E+02	17
n-Hexane		5.70E-02	304	1.73E+01	18
Uranium		2.00E-04	47,500	9.50E+00	19
Chloroform		8.60E-04	3,088	2.66E+00	20

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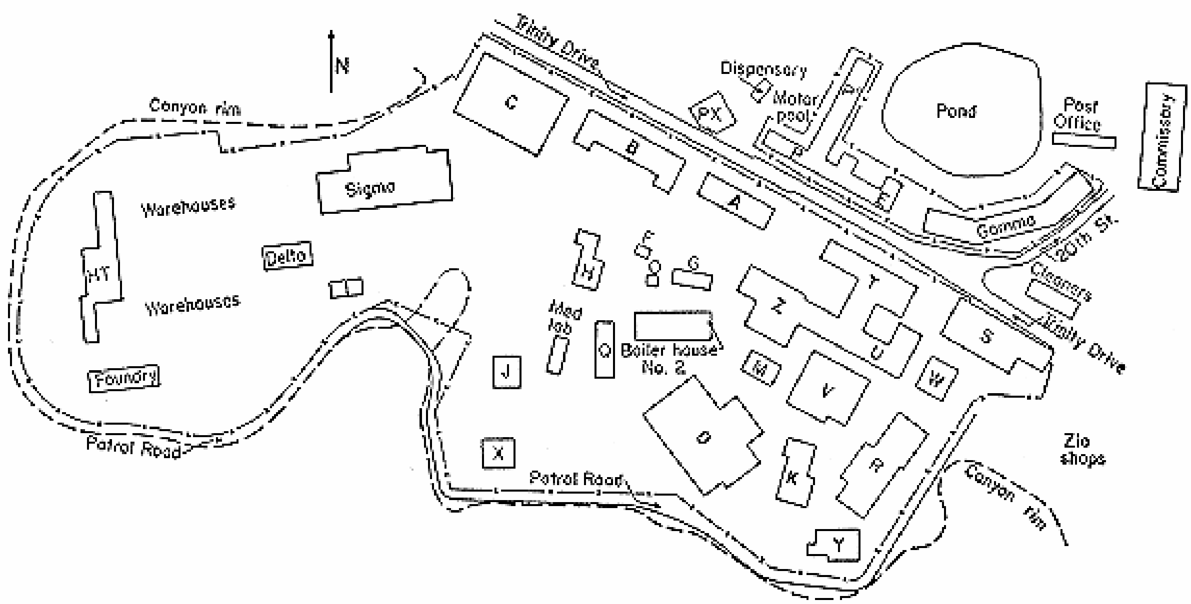
APPENDICES

Appendix A: Key Operational Area– Plutonium Processing

One of the important early roles of the Los Alamos laboratory was the processing of the newly created and largely unknown material plutonium. The assignments given to Los Alamos in the early 1940s were to:

- Perform the final purification of the plutonium received at Los Alamos,
- Reduce the plutonium to its metallic state,
- Determine the metal's relevant physical and metallurgical properties, and
- Develop the necessary weapon component fabrication technologies (Hammel, 1998).

Los Alamos was the first site in the world to receive quantities of plutonium large enough to manufacture weapon components. Plutonium processing was originally performed in TA-1, the original Los Alamos technical area that was located near Ashley Pond as shown in Figure A-1.



Key to Selected Buildings:

C- Shops
D- Plutonium Purification Plant
E- Theoretical Division Offices
G- Graphite Fabrication
J- Research Laboratories
Q- Medical Offices
R- Laboratories
S- Stockroom
U- Chemistry and Physics Labs
V- Shops
W- Van de Graff Machines
X- Cyclotron
Y- Cryogenics Laboratory
Z- Cockroft-Walton Generator
Gamma- Research for M Division
Sigma- Metal, Plastics, Ceramic Fabrication

Figure A-1: Map of the Original Technical Area, TA-1

Early Plutonium Processing at TA-1

The initial handling and processing of plutonium that took place at TA-1 involved the following main facilities:

- D Building- housed plutonium chemistry, metallurgy, and processing
- D-2 Building- housed contaminated laundry and glassware decontamination
- D-5 Sigma Vault- was a storage facility for ^{239}Pu and ^{235}U.
- ML Building- Housed the Medical laboratory, site of human uptake and excretion studies by H-4 and H-5 groups and urine assay.

In January 1945, a serious fire broke out in “one of the shops” at TA-1, namely C Building. This raised concerns about the possibility of a fire in D Building. This, plus a dramatic increase in the amounts of plutonium handled in D Building and concerns about the need to house plutonium and polonium safely, led to planning of new facility, to be called DP Site and TA-21.

TA-21 (DP Site) Historical Operations- DP West

DP West was the location of the plutonium facilities that replaced the original plutonium facilities in Building D of TA-1. Most of these facilities were constructed in 1944-1945 from used warehouses. The necessary process equipment was installed during this time as well. Operations appeared to have started by the end of November 1945 (Repos. No. 139).

The primary functions of the facility were: 1) to produce metal and alloys of plutonium and other transuranic elements from nitrate solution feedstock; 2) to fabricate these metals into precision shapes; 3) to provide and install protective claddings; 4) to measure the chemical and physical properties of these metals and alloys; and 5) to permit recycling of scrap or materials used in experiments so that these materials could be reused rather than discarded (Repos. No. 2344).

In Figure A-2, the early layout of DP West is shown with the main buildings (Repos. No. 2346). Buildings 2 and 3 housed wet chemistry processes, and Buildings 4 and 5 housed dry chemistry processes (LAB-CMR-12-60). Building 12 was the main filter building.

Following are summaries of the activities performed in each major building at DP West:

<u>Building 2 (TA-21-2)</u>– housed numerous gloveboxes used for dissolution and recovery of plutonium and storage of ^{241}Am wastes. The building also housed a scrap incinerator, solvent extraction columns, and a liquid-waste loading area. On December 30, 1958, a criticality accident occurred in Building 2 South involving separated phases in a plutonium process tank, under unshielded operation. The operator (Cecil Kelley) died 36 hours later.

<u>Building 3 (TA-21-3)</u>– housed the oxalate precipitation operations.

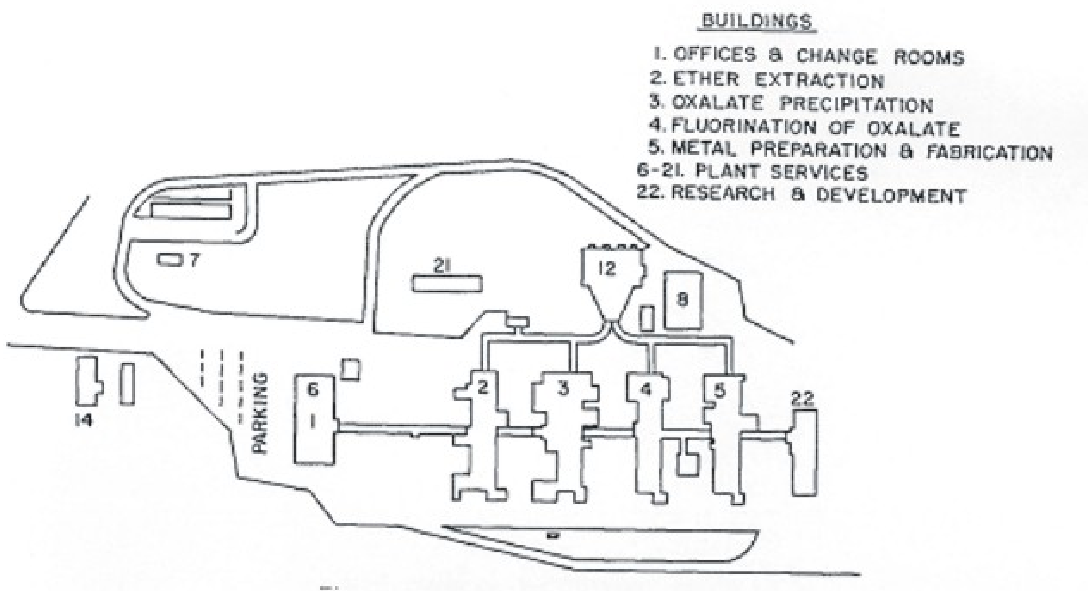


Figure A-2: Early DP West Layout

Building 4 (TA-21-4)– housed some development laboratories for plutonium research from 1945 to 1948 at which point the laboratories were converted to production areas for enriched uranium hydride. In 1960, the hydride equipment was removed so that a hot cell could be added for the examination of irradiated plutonium and enriched uranium fuel elements. In 1965, two glovebox lines were added to support the ^{238}Pu metal production. The above programs were part of Rooms 401 and 401E on the north end of the building (Repos. No. 2344). Rooms 403, 404, 405, 406, and 407 also had gloveboxes that were used for Pu-239 and Pu-238 metal preparation during these early years.

Building 5 (TA-21-5)– was the plutonium metal fabrication facility. Work centered around the production of plutonium metal and metal alloys and the fabrication of precision plutonium parts for nuclear devices. In 1963, Room 506 was constructed to house electro-refining equipment needed to produce high purity plutonium metal. Also added in 1963, Room 500A housed an air-drying system for air supplied to the conveyor tunnels and gloveboxes. In 1964, Rooms 530-534 were added to provide additional fabrication and testing facilities (Repos. No. 2344). Until 1974, all work in Building 5 was with ^{239}Pu for the weapons program. In 1975, ^{238}Pu was introduced into one glovebox line in Room 500 for limited research work on the testing of HEPA filters.

Building 12 (TA-21-12)– was the filter building that was put into service in May 1945. The plutonium process buildings, Buildings 2, 3, 4, and 5, were ventilated with a 60,000 m^3/min central air exhaust system. This system handled air from rooms and fume hoods, sparging of dissolvers, and venting of solution tanks. At that time it was not believed necessary to exhaust the air from the gloveboxes, but several years later gloveboxes were vented. This air was exhausted, without filtering, through the room air exhaust system. Electrostatic precipitators backed up by a single bank of American Air Filter Company type PL-24 filters removed the particulates from the exhaust air. This system was considered the best available for air cleaning at that time (Repos. No. 2349).

Building 12 continued in service for room and process air until July 1, 1959. In that year, another system was installed for the process air, and Building 12 then handled only room air. Building 12 continued in service until February 1973, when new room air filtration systems were completed, one for each process building (Repos. No. 2349). Building 12 had four stacks.

Building 21 (TA-21-21)– was a vault for storage of uranium and plutonium metal.

Building 33 (TA-21-33)– housed research efforts into collecting additional plutonium from waste streams.

Building 150 (TA-21-150)– was built in 1963 as a plutonium fuels development building (Repos. No. 2344). This building was built next to Building 5. Some of the programs the building supported included: 1) the development of Pu-238 heat sources for space electric power applications; 2) investigations of various ceramic materials containing plutonium for use in the Liquid Metal Fast Breeder Reactor (LMFBR) program; and 3) the development of Pu-238 fuels for isotopic powered heat sources for powering artificial organs (Repos. No. 2344).

In an incident in DP West Building 150, on 10/7/70, a sealed capillary broke, resulting in the release of a reported 10 ug of ^{238}Pu up a vent. Estimated to be 2800 times the AEC maximum permissible concentration (MPC) for insoluble ^{238}Pu. Air samples were analyzed from the DP fence line, near private housing just west of the west end of the airport runway, and at the airport terminal air particulate sampler. Maximum reported air concentrations were 1.27 E-14 µCi/mL ^{238}Pu (at housing near the runway) and 0.29 E-14 µCi/mL ^{239}Pu (DP fence). [10/14/70 memo from Wm. R. Kennedy to George L. Voelz, Health Div. Leader; See repository nos. 246 and 247]

Building 210 (TA-21-210)– housed additional research activities on the properties and uses of plutonium.

DP West Air Handling and Stack Air Sampling

Buildings 2, 3, 4, and 5 each had an intake air fan. The air was filtered and then distributed by a system of ducts that entered the rooms of the buildings at the ceiling. The exhaust air left the rooms by another system of ducts that lead into a large common duct located on the roof of each building. All dryboxes and hoods for each building were vented into this common exhaust duct (LAB-CMR-12-60).

These common ducts converged into a large manifold in Building 12 where the air was supposed to mix to a uniform concentration. The air then passed through the precipitrons. The precipitrons were electrostatic units that used electric fields to ionize and capture particles. The air then passed through a single bank of American Air Filter Company type PL-24 filters. This system was considered the best available for air cleaning at that time (Rep. 2349). The air was finally discharged by exhaust fans out of four 57-foot stacks.

In the early days of DP West, the exhaust air was sampled in the common exhaust ducts, the Building 12 manifold, and in each stack. Filter Queens sampled the exhaust air at these locations.

More Recent Plutonium Processing

In 1969, the decision was made to build a new facility, TA-55, the Plutonium Facility Site. Processing of plutonium and research on plutonium metallurgy are done at this site, which is also known as "PF Site." Operations at TA-55 include processing and recovery of Pu-239 from scrap materials, recycle, metal production, metal fabrication, and R&D. This is the site of special isotope separation research. The SIS-III was designed to provide special plutonium isotopes for LANL weapons research. The site also has responsibility for manufacturing heat sources for weapons-related programs. [Nuclear Weapons Databook, Vol. III]

Plutonium has also been processed at TA-3, the new Core Area: [a.k.a. "South Mesa Site"]. The Lab's main technical facilities moved here from TA-1 in 1953.

Areas at TA-3 that likely involved plutonium processing include:

- TA-3-29 Chemical and Metallurgical Research (SM-29) (has Wings 1-9).
- TA-3-32 Cryogenics
- TA-3-34 Cryogenics
- TA-3-35 Press Building
- TA-3-39 Technical Shops
- TA-3-40 Physics
- TA-3-65 Source Storage (SM-65)
- TA-3-66 Sigma Complex
- TA-3-102 Tech Shops (handles beryllium, uranium, lithium per Repos. No. 225)
- TA-3-141 Rolling Mill
- TA-3-184 Occupational Health
- TA-3-216 Weapons Test Support
- TA-3-700 Acid Neutralization and Pump Bldg. (also known as SM-700)

As of 1969, the CMR Bldg, except for its Wing 9, was used for laboratory work on small quantities of uranium and plutonium. Effluents were filtered through Aerosolve 95 filters. Wing 9 contained hot cells handling irradiated uranium and sometimes plutonium. Effluents may also have contained mixed fission products including iodine. HEPA and charcoal filters were reportedly used for treatment. Filters were counted for both alpha and beta radiation.

Stack FE-19 of the CMR Building serves the glove box processes and rooms on the south side of Wing 3. As of March 1980, had a demister, one stage of M-80 prefilters, and one stage of American Air Filter Continental 2000 filters (i.e., bag filters; published 85% efficient for 0.3 µm DOP). Had Aerosolve 95 filters instead prior to July 1976.

Since early 1974, FE-19 has been major source of plutonium at LASL (up to 99% of the total in 1980). Releases from FE-19 began to increase during Feb 1979, when two filters tore. During filter change-out, flow reversal sent 143 µCi of Pu up FE-20 stack. [Repos. No. 512] February 1980 testing showed FE-19 filters were only 29.3% efficient. The release from FE-19 from Jan 19 – Jan 26, 1979 was 91 µCi, which was greater than the total release for this stack in 1978.

Alpha activity in liquids flowing into the TA-50 waste treatment plant rose sharply in the years leading up to 1973 because of increased use of ^{238}Pu at the SM 29 building in TA-3. Concentrations at times reached 0.001 µCi/cc. [pages from fiche: TR7831, Envelope 51, dated 5/9/73].

Appendix B: Key Operational Areas– Uranium, Fission Products, Radium, Polonium, and Barium/Lanthanum

Processing of Uranium

Facilities at TA-1 that housed uranium operations included:

- C Building– housed a normal machine shop with a uranium machine shop in southeast section. Became operational in October 1943.
- G Building– housed the uranium and graphite "Sigma Pile", plus leak-testing of radium sources. Removed 6/59.
- HT Building– heat treatment and machining of normal and enriched uranium.
- HT Barrel House– contained storage areas for ^{239}Pu and ^{235}U.
- M Building– housed processing, metallurgy, and recovery of enriched uranium.
- Sigma Bldg– housed casting, machining, powder metallurgy of normal and enriched uranium, thorium (eastern part was normal; western part was enriched).
- TU Building– housed machining of normal uranium ("tuballoy").
- TU-1 Building– housed recovery of enriched uranium.
- V Building– contained the original machine shop; some uranium and beryllium was machined there.

During later years, the Sigma Complex at TA-3 housed large-scale metallurgy and fabrication of normal and fully enriched uranium.

Processing of Fission Products

TA-1 facilities housing fission-product operations included:

- J-2 Building- Used by Group J-2 for radiochemistry work on weapons test debris, processing of plutonium. Uranium also present. ^{239}Pu, ^{235}U, ^{238}U.
- H Building- Radiochemical and radioactive tracer processing. Initially used for work with ^{210}Po (source preparation), later used by CMR-10 for office and work space. Some ^{140}Ba/^{140}La/^{90}Sr contamination. Demolished in 1957.
- Gamma Building- ^{210}Po, ^{137}Cs; a ^{137}Cs contamination incident occurred. Removed 2/59.

Operations Involving Radium

TA–1 Facilities housing radium operations included:

- O Building- Storage of sealed radium and radium/beryllium sources; some leaked. In front of building, radon was cooked off radium sources on a hot plate before resoldering. Demolished 11/56.

- Q Building- Used by medical and health-monitoring group. Some film calibration operations with ^{226}Ra sources*;* a spill occurred. Building removed 2/59.

Polonium Operations

Polonium was used in initiators, utilizing the (α,n) reaction of ^{210}Po and ^{9}Be. In February 1945, schedule for polonium delivery from Monsanto [to TA-1] was increased to 100 Ci per month by June and 500 Ci per month by December [Hoddeson et al., 1993]. At TA-1, polonium was handled in H Building and Gamma Building.

DP East began operation in September 1945 and contained buildings 151, 152, and 153. Building 155 was completed in December 1949. These buildings were used to process polonium and actinium and to produce initiators. Building 209 was built in 1964 to house research efforts in high-temperature and actinide chemistry. Bldg 155 most recently housed the Tritium Systems Test Assembly (TSTA), which conducted research for developing and demonstrating effective technology for handling and processing deuterium and tritium fuels for use in fusion reactors.

It is reported that "the well-designed DP polonium plant went into operation sooner than did the Pu plant." [TR 6704, Box 6 of 8].

A building similar to TA-21-12 was Building 153 at DP East. This building exhausted the air from several buildings at DP East and was determined to have been constructed similarly to Bldg. 12 (Repos. No. 2343). Bldg. 153 was in service until March, 1970. The primary radioactive contaminant of this filter house was ^{227}Ac. Bldg. 153 had transitional plenums and filter housings for electromatic filters. There were two blowers and two stacks.

Operations Involving Radioactive Lanthanum (RaLa)

TA-10, Bayo Canyon Site, was used between 1944 and 1961 for a set of experiments using conventional high explosives, radioactive lanthanum (RaLa), and depleted or natural uranium for implosion diagnostics. A total of 254 of these "hydrodynamic tests" or "hydrotests" were done, 71 by the end of 1946 (see Table B-1). The shots used RaLa sources ranging in size from ~25 Ci to 7090 Ci (Dummer et al., 1996 [LA-13044-H]). The explosions resulted in the dispersion of uranium, ^{140}La and ^{90}Sr in the form of aerosols and debris to the atmosphere and onto the ground. Radiochemical operations conducted at the site resulted in the generation of liquid and solid radioactive wastes, which were disposed of in subsurface pits and leaching fields. The site was decommissioned by 1963 and transferred to Los Alamos County on 7/1/67. [DOE/EV-0005/15, UC-71, June 1979; Rad. Survey of Bayo Canyon].

Table B-1: Quantities of Radioactive Lanthanum Used

Year	Curies of RaLa Used in Bayo Canyon Shots	Number of Shots
1944	1,112	10
1945	18,363	36
1946	20,556	24
1947	22,734	27
1948	12,236	19
1949	28,255	26
1950	19,788	12
1951	0	0
1952	6,370	4
1953	1,065	4
1954	15,580	13
1955	40,763	21
1956	35,976	21
1957	17,358	9
1958	9,845	7
1959	8,322	8
1960	5,560	5
1961	24,312	5
1962	13,607	3
Totals	301,802 Curies	254 Shots

During the 18 years of the RaLa series of experiments in Bayo Canyon, about 226 millicuries of ^{90}Sr was reportedly released; over 80% of the 226 mCi was released in seven shots in 1945 (Dummer et al., 1996 [LA-13044-H]). In a dose assessment conducted by LANL personnel, the highest annual dose from the RaLa shots (17 millirem) was calculated to have occurred in 1955; if an individual had been in Los Alamos throughout all of the experiments, the calculated dose to that hypothetical individual would have been approximately 110 millirem (Dummer et al., 1996 [LA-13044-H]).

The RaLa sources were prepared at the TA-10 Chemical Process Building from 1944 to 1950. This function moved to the TA-35 "Ten-Site" facility for 1951-1963). The name of the site is likely tied to this TA-10 connection, and/or to the operating group, CMR-10.

CMR-10 group relocated to Ten-Site (TA-35) some time between April 1950 and December 1950. [12/27/50 memo C.M. Perry of H Div to R. Phillip Hammond of CMR-10 re: "Ten-Site Maximum Permissible Dose Limits." They had been given special permission in early 1950 to raise the worker dose limit at TA-10 to 0.6 r gamma over a two-week period. Once located at TA-35, the limit was set back to 0.3 r/2 wk.

The Chemical Processing Plant in Idaho became the source of purified ^{140}Ba in 1956, and a typical shipment was about 40,000 Ci ^{140}Ba. The ^{140}La sources prepared at Ten Site were usually in the range of 2,000 to 4,000 Ci. Almost 2 million Ci of ^{140}Ba had been handled at Ten Site by 1963 when the RaLa program was terminated [LA-UR-79-3091].

Results of a resurvey of the area show that residual surface contamination of ^{90}Sr in Bayo Canyon averaged 1.4 pCi/g, or approximately 3 times the levels attributable to worldwide fallout. DOE calculations show individual consuming 50 kg/y of vegetables and fruits grown in the contaminated soil of Bayo Canyon would reportedly receive a 50-year dose of about 46 mrem to the bone, which is 3% of the guides and 25% of annual exposure from natural radiation in the Canyon. [”Potential Environmental Issues at Los Alamos Scientific Laboratory” c. Oct. 1979]

The [TA-35] RaLa cell and control room have been completely dismantled [Repos. No. 72].

Appendix C: Key Operational Areas– Reactors

When it was first established, Technical Area 2 (TA-2), also known as Omega Site, was used for both nuclear criticality experiments and as the location for the Water Boiler reactor. Assembly of the first Water Boiler (the LOPO model) began in late 1943. In April of 1946, nuclear criticality experimentation was relocated from TA-2 to TA-18 (Pajarito Site). Construction of the plutonium fast reactor (Clementine) began in August of that year, and from then on Omega Site was used primarily as the location for reactors for neutronics experiments and isotope production. Over its history, three reactors have operated at TA-2: the Water Boilers (three different versions), the plutonium fast reactor (Clementine), and the Omega West Reactor (OWR). No reactors have operated at TA-2 since the shutdown of the OWR in December of 1992. The Water Boiler was deactivated in June of 1974, and the Clementine reactor was deactivated in December of 1950 following four years of problematic operation.

The Water Boiler Reactors

[Much of the following was adapted from "Early Reactors" by Merle E. Bunker (Los Alamos Science, Winter/Spring 1983). Other references are as cited.]

During the Manhattan Project, a reactor was needed for confirming critical mass calculations, measuring fission cross-sections, and determining the neutron scattering and absorption properties for materials being considered for moderators and reflectors in the first atomic bombs. Enrico Fermi advocated the construction of a homogeneous, liquid-fueled reactor, using enriched uranium. Three versions were eventually built, all based on this concept. For security reasons, these reactors were all referred to as "water boilers." The name was appropriate, since dissociation of the fuel solution would occur in the higher-power versions, giving an appearance of boiling.

The first water boiler was assembled in late 1943 at Omega Site. At that time, the fuel for this reactor (14%-enriched uranium) consumed the Nation's total supply of enriched uranium. Two machine gun posts were therefore placed at the site to ensure its security. The first water boiler was called LOPO (for low-power) because its power output was virtually zero. This allowed for a simple design and eliminated the need for shielding. The fuel for the LOPO was an aqueous solution of enriched uranyl sulfate. The fuel was contained in a one-foot diameter spherical shell of stainless steel, surrounded by a reflector consisting of beryllium blocks on a graphite base. Control and safety rods passed through the reflector assembly. The fuel solution (known as the "soup") was pumped into the steel shell from a conical storage basin located beneath it. Since the system was intended for low power, no provisions for cooling were included. The LOPO achieved initial criticality in May of 1944.

The purpose of the LOPO was to determine the critical mass of a simple fuel configuration and to test the water boiler concept. With these goals met, the LOPO was dismantled to make way for a second design that could be operated at a power level of up to 5.5 kW and thus serve as a neutron source needed for cross-section measurements and other studies. This second version was called the HYPO (for high power). The fuel solution was changed from uranyl sulfate to uranyl nitrate, and cooling coils were added within the shell. A tube passing through the shell (called the Glory Hole) was also added to allow for placing samples in the region of maximum neutron flux. The reactor was surrounded with a concrete shield. The HYPO began operation in December of 1944, and was used for many of the key neutron measurements needed in the early days of atomic bomb design.

In March of 1951, significant modifications to the HYPO were completed in response to demands for higher neutron flux and more research capability. These modifications allowed the water boiler to operate at power levels up to 35 kW. This modified version of the HYPO was dubbed the SUPO. Modifications made in the conversion of the HYPO to the SUPO included:

- Installation of additional cooling coils within the fuel vessel for greater cooling capacity.
- A significant increase in the enrichment of the uranyl nitrate fuel solution, from 14% ^{235}U to 88.7% ^{235}U.
- The beryllium oxide portion of the reflector was replaced with graphite to allow for more rapid shutdown.
- A gas recombination system was connected to the reactor vessel to eliminate the explosion hazard posed by the radiolytic dissociation of hydrogen and oxygen from the fuel solution. The water formed in the recombination chamber of this system was returned to the fuel vessel.

To reduce the emission of short-lived radioactive gasses from the Water Boiler, a delay line was installed. Before the installation of the delay line, it reportedly could not be determined how much ^{131}I was present because of masking by Rb-88. Charcoal samples reportedly showed that essentially no ^{131}I was present before or after the delay line was installed [3/98 memo J. Margo Clark to Ken Silver].

The SUPO Water Boiler experienced a water leak into its moderator shield, and had to shut down in 1973. Its stack was found to be contaminated with ^{137}Cs (Site Tour, 1998). Contamination in the reactor had migrated to the bioshield. SUPO was operated almost daily until its deactivation in 1974. Like its predecessors, it was used extensively for cross-section studies and other neutron measurements. However, it was also used for studying reactor physics (perturbation effects) and for biological research.

Planning for Decontamination and Decommissioning (D&D) of the SUPO facility began in July of 1988. The physical decommissioning process was completed in April of 1990, with the facility (TA-2-1-122) subsequently being released to the Isotope and Nuclear Chemistry division (Montoya, 1991; LA-12049).

The Plutonium Fast Reactor (Clementine)

[Much of the following was adapted from "Early Reactors" by Merle E. Bunker (Los Alamos Science, Winter/Spring 1983). Other references are as cited.]

The plutonium fast reactor was proposed and approved in 1945 as a high-intensity fission neutron source that could also be used to assess the suitability of plutonium as a reactor fuel. Since a fast reactor requires no moderating material, the reactor could be of small size. The site chosen for the fast reactor was adjacent to the water boiler building at Omega Site. Construction began in August of 1946, during which time the reactor was dubbed Clementine, after the song "My Darling Clementine." The fuel for the fast reactor was in the form of small rods clad in steel jackets. The rods were installed in a steel cage through which the coolant, liquid mercury, flowed at a rate of approximately 9 liters per minute. Flow was maintained via an electromagnetic pump. The fuel cage was surrounded with a 6-inch thick natural uranium reflector, most of which was plated with silver to reduce corrosion. The uranium reflector was surrounded by an additional steel reflector 6 inches thick, and finally by a 4-inch thick lead shield. Reactor (reactivity) control was effected via insertion of uranium fuel rods into the cage – a positive reactivity control method as opposed to the negative reactivity control method typically used in reactors.

Initial criticality of the fast reactor was achieved in late 1946, though its design power of 25 kW was not reached until March of 1949. During this interim period, measurements were made at low power, including determination of the neutron energy spectrum, reactivity effects, cross sections, etc. Changes in the control system were also made during this time as experience in the operation of a fast reactor was gained.

In March of 1950, following nearly a full year of operation, the fast reactor was shut down to correct a malfunction in the operation of the control and shim rods. During this shutdown, a ruptured uranium rod was discovered and replaced. Operation resumed in September of 1950, and continued until late in December of that year when it was determined that a plutonium fuel rod had ruptured and released plutonium into the mercury coolant. The hazard created by this condition and the identification of serious abnormalities in the uranium reflector prompted the decision to permanently shut down and disassemble the reactor. One of the lessons learned from experience with the fast reactor was that mercury was unacceptable as a coolant due to its poor heat transfer properties and other concerns.

When Clementine was decommissioned, its parts were stored in a hutment at Area C, and are believed to have been subsequently buried there (Repos. No. 525). The disposal location of the mercury coolant is not known (per Repos. No. 525).

The Omega West Reactor (OWR)

[Much of the following was adapted from "Early Reactors" by Merle E. Bunker (Los Alamos Science, Winter/Spring 1983). Other references are as cited.]

With the early demise of the plutonium fast reactor, a replacement was needed to meet the needs for neutron measurements for various laboratory activities. Evaluation of the options available at that time led to a conclusion that a design patterned after the Materials Test Reactor (MTR) at the Idaho National Laboratory was the most attractive. A reactor designed to use the MTR's plate-type fuel elements, which had already undergone extensive testing, meant core design and licensing could be expedited. The conceptual design for the new reactor was completed by the end of 1953. The core was to sit at the bottom of a water tank 8 feet in diameter and 24 feet high. The reactor would be cooled by water flowing at 3500 gpm. The proposed power level was 5 MW, but the shield was designed so that a power level of 10 MW could be tolerated. To save time and money, the reactor was built in the same room that had housed the plutonium fast reactor.

The OWR reportedly got an exemption from 10 CFR 100 reactor-siting criteria. The OWR was a small, low pressure, low temperature research reactor. Natural convective circulation of the reactor pool water was reportedly sufficient to cool the reactor. The maximum credible accident that was assessed would release 822 Ci of ^{131}I to the air, along with 10,900 Ci of other iodines, 168 Ci of ^{131}Xe, and 153,000 Ci of other rare gases. Doses were calculated at a Residential Area (0.4 mi cross canyon), Skating Rink (1.9 mi up canyon), and State Road 4 (4.0 mi Down Canyon). Maximum doses calculated by LANL personnel for this accident were reportedly 57 rem to thyroid and 22 rem whole body at State Road 4. ["Potential Environmental Issues at Los Alamos Scientific Laboratory" c. Oct. 1979, Repos. No. 615].

Construction of the new reactor began in mid 1954. Initial criticality was achieved in July of 1956, and a few months later the Omega West Reactor (as it became known) was operating at 1 to 2 megawatts. [Repos. No. 2387 states that the OWR achieved initial criticality on June 29, 1956.] In May of 1966, new operating limits were established that allowed the maximum operating power level to be increased to 6.5 MW (LA-UR-93-579). A modification to the OWR's cooling system allowed its maximum operating power level to be increased to 8 megawatts in August of 1967. The technical specifications for the OWR prescribed a Limiting Safety System Setting (LSSS) of 11 MW. The OWR's safety limit was 14 MW (LA-UR-93-579).

The OWR reportedly had an iodine-125 production loop, and at times the reactor was operated essentially around the clock on an "Iodine Production Loop schedule."

"OWREX" capsules were placed in the reactor (e.g., OWREX-5 insert, OWREX-8 insert around 1966). These capsules evidently contained fuel and sodium. Fission gas traps and sweep-gas monitor detected leaks of capsules on several occasions [e.g., LA-3582-MS].

The combination of an unusual occurrence that resulted in a challenge to a safety system and the discovery of coolant leaks in underground piping prompted the shutdown of the OWR in December of 1992. The unusual occurrence took place on December 11, 1992 when human error resulted in the reactor power rising to an administrative control limit of 9.6 MW, prompting an automatic shutdown of the reactor. The investigation report compiled for this event identified three root causes for the incident, but drew an overall conclusion that conduct of operations at the OWR facility was inadequate (LA-UR-93-579). The three root causes specifically identified in the report were task performance errors on the part of various personnel, inadequate procedures for removal of samples from the reactor, and inadequate procedures and policies for ensuring reactor control is not compromised in the event of off-normal conditions (LA-UR-93-579).

In 1994, all of the fuel and control blades were removed from the OWR and the facility was placed in a safe shutdown mode (Burns et al., 1993; LA-UR-95-4294). Inspection of the fuel elements conducted during the defueling operation showed that no fuel damage had occurred. All coolant was drained from the reactor vessel. A preliminary characterization in support of planning decommissioning activities was conducted in 1995 (Burns et al., 1993; LA-UR-95-4294).

The Omega West Reactor (OWR) operated routinely operated 120 hours a week during its first 16 years. Usage dropped off to around 40 hours per week thereafter until the reactor was permanently shut down. Research conducted at the OWR included: cross-section studies, measurement of weapon yields (via comparison fission counting), neutron radiography, condensed matter studies (via neutron scattering), testing of power reactor components, testing of power reactor fuels, tests of plasma thermocouples, neutron activation analyses, and radioisotope production.

The Omega Stack

A memo from Hornberger to Hoffman dated May 25, 1945 (Repos. No. 510) describes the offgas line from the Water Boiler (HYPO) and reports exposure rate readings made beneath and to the sides of the line. These readings are given in terms of the time in hours one would need to be at a location to receive an exposure equal to the daily limit at that time. The first part of the line (see Figure C-1) is described as being hung on tree supports and ascending the canyon wall. The last half of the line had four points where it sagged to the ground. Breaks in the line were noted at 75 yards and 25 yards from its exhaust end. There is no mention of a stack. The memo includes a hand-drawn figure (Figure C-1) showing the offgas line relative to the Water Boiler building and the mesas north and south of Los Alamos Canyon.

Los Alamos document LAMD-155-I, "Manhattan District History, Volume II," states that "External radiation hazards [at LANL] were, for the most part, well controlled. However, arrangements for discharge of fission products from the Water Boiler were most unsatisfactory and represented a potential and serious health hazard. The gaseous materials were merely discharged near ground level at the top of the mesa just to the south of Los Alamos Canyon. Warning signs were inadequate and the area was accessible to any casual visitor. Intensities in excess of 50 r/hr were repeatedly measured near the discharge point when the boiler was in operation."

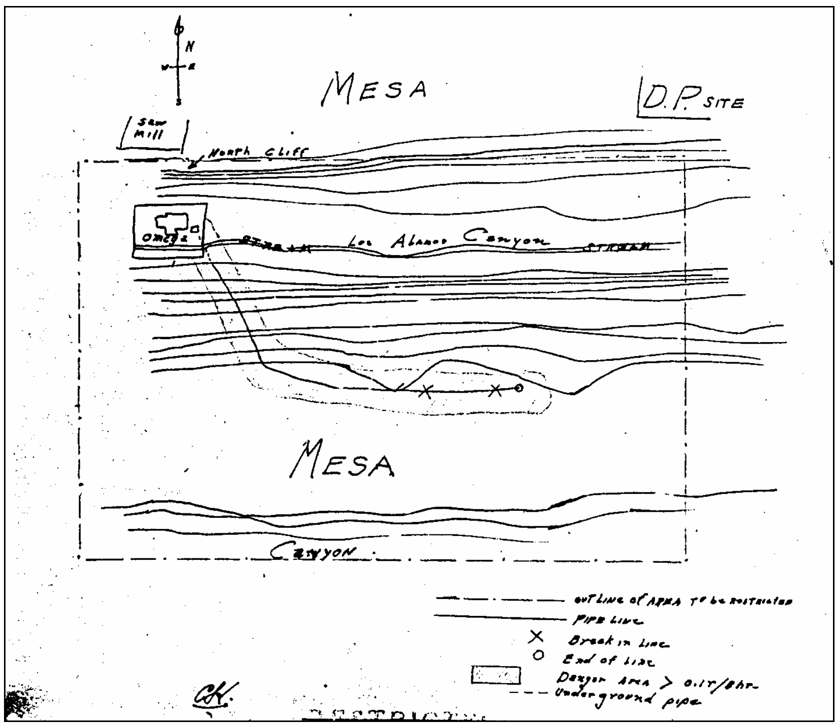


Figure C-1: Sketch of the Omega Site Off-Gas Line

Repos. No. 510 includes a memo from Blackwell and Littlejohn to Hempelmann dated April 24, 1947 reporting their discovery that the offgas line from the Water Boiler (HYPO) was "shattered" at about 100 feet prior to the "outlet" (stack), which was located in the top of a pine tree. It is surmised that the line became brittle from the off- gas and was broken due to swinging caused by recent high winds.

In later years, a 150-ft tall stack on the south mesa was used to ventilate the OWR thermal column region and experiment. The flow rate in this stack was reportedly 880 cfm. Approximately 600 Ci of ^{41}Ar was reportedly discharged per year. [Repository No. 645]. In 1968, a charcoal filter was added in the vent line from the OWR surge talk to the 150-ft stack [Repository No. 648].

The original stack for OWR effluents was also described as a “flexible pipeline” that ran up the mesa and was attached to a tree. Exposures to a nearby “Trailer Village” were a concern. [Repos. No.. 510; has sketch of line to mesa top]. This original effluent line was tygon tubing that was laid on the ground or draped on trees. It led to a pipe that was fastened to a pine tree. Eventually a buried stainless steel line and a stack were put into place.

Repos. No. 177 includes a memo from D. D. Meyer to D. Ritter (ENG-4) dated June 11, 1957 that requests removal of the barbed wire exclusion fence that kept people 50 feet or so away from the Omega stack. It also states that the “old” Omega stack is still located in the top of a dead tree just outside the fence surrounding the current stack. It is requested that the old stack be taken down and sent to the “contaminated waste pit.” A second memo included in Repos. No. 177 (from D. D Meyer to Carl Buckland), also dated June 11, 1957; states that P-2 plans to connect the offgas system for the OWR to the existing system for the Water Boiler (SUPO). Per Repos. No. 2414, this action was completed between September 20, 1957 and October 20, 1957.

A charcoal filter was installed in the vent line for the OWR surge tank air space in 1968 (Repos. No. 648). The filter was installed as a precaution against a large radioiodine release that might otherwise have occurred in the event of a fuel element or experiment failure.

Hankins (1963) describes the Omega stack as being 150 feet long and having an inside diameter of 8 inches. The 2 inch (inside) diameter vent pipe from the reactor to the stack was 1100 feet long. The vent pipe included a settling tank and two water traps to collect water that condensed out of the effluent. The delay time of gas in the vent pipe was originally 2.3 days, but the addition of the vent line from the OWR cut this time to about 8 to 10 hours. The effluent in the vent pipe flowed to the stack at a rate of about 100 to 200 cc/min, resulting in a dilution factor of about 100,000 in the stack. The stack flow rate was measured to be 845 cfm at a velocity of 2400 fpm.

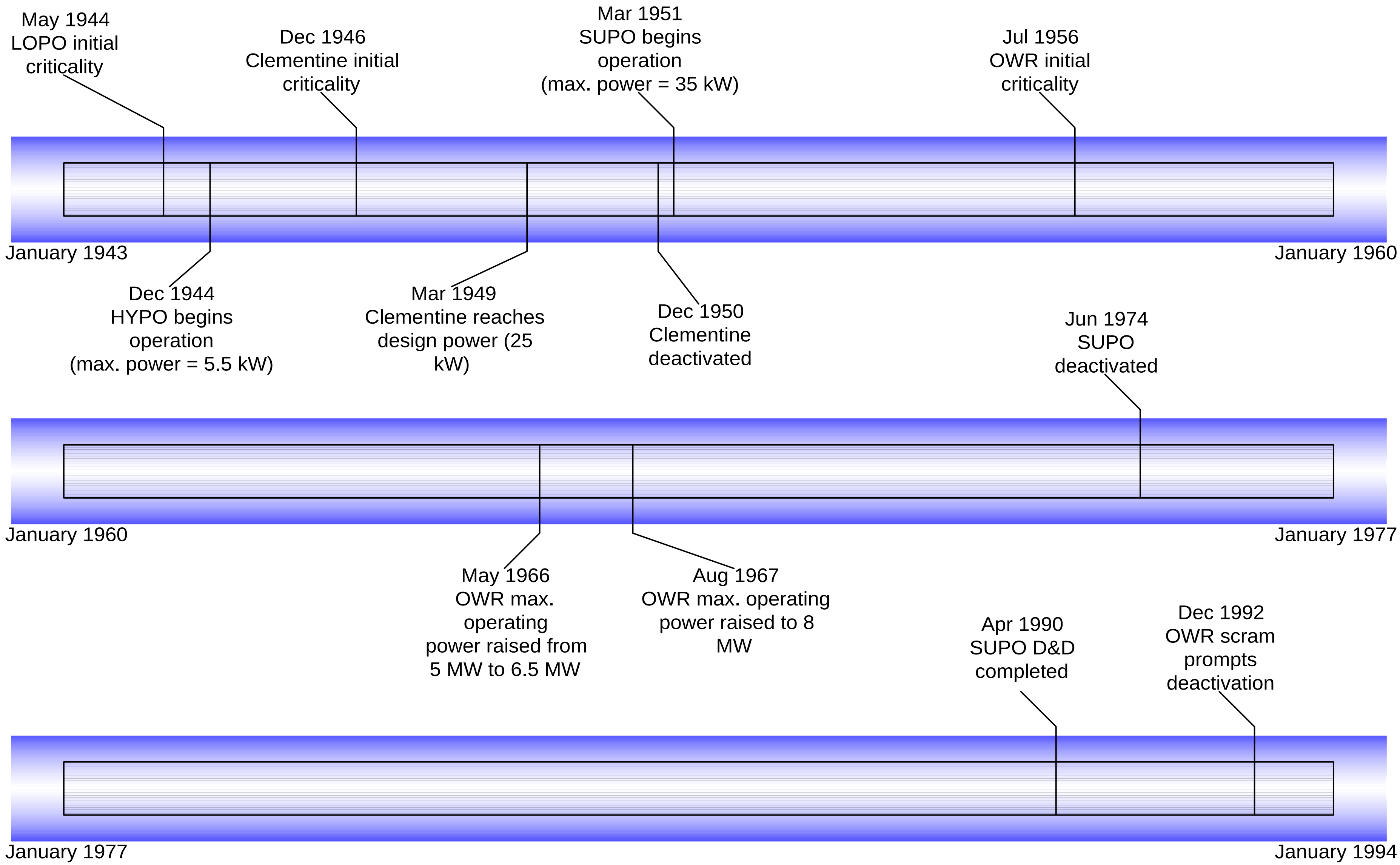
Per Hankins (1963), the combination of the recombiner, the long length of the vent pipe, and the low flow rates resulted in the particulate component of the effluent consisting of very small particles. It is reported that 65% were less than 0.05 µm, 93% were less than 0.1 µm, and none were larger than 1.0 µm.

A timeline of events of operational significance for Omega Site reactors is presented as Figure C-2.

LAPRE I and LAPRE II

The Los Alamos Power Reactor Experiment (LAPRE) explored the use of a homogeneous reactor fuel consisting of highly-enriched UO_2 (93.5% ^{235}U) dissolved in 95% phosphoric acid. Such a reactor system was thought to show promise for portable power sources for military applications if a method for containing the highly-corrosive fuel solution could be found. Consequently, two test reactors (LAPRE I and LAPRE II) were constructed and operated at Ten Site (TA-35) by K-division personnel between 1955 and 1960. LAPRE I was located in one of the hot cells of the main laboratory building. LAPRE II was located outside the main building in an underground enclosure tank.

Figure C-2: Timeline of Operational Events for Omega Site Reactors



The purpose of the LAPRE I reactor experiment was to study the use of phosphoric acid solutions of uranium for a high-temperature reactor fuel in a simple, compact design in which the reactor core and the heat exchanger were contained in a single vessel (LA-2292). Protection of the reactor internals from the highly-corrosive fuel solution was supposed to have been achieved by coating the exposed surfaces with a thin layer of gold. While it was known that the problem of pinholes in the gold plating could not be completely eliminated (despite the use of multiple layers of gold), it was thought that the corrosion rate of the stainless steel under a pinhole in the plating would be tolerable (LA-2292).

The first critical experiments with LAPRE I began on February 15, 1956 (LA-2292). The reactor power was raised to a level of 20 kW and held there for five hours. Radioactivity was then detected in the steam line, and shortly thereafter criticality could not be maintained without dropping the temperature. The experiment was terminated with the fuel being transferred to an external tank. After nine days, the reactor was disassembled to determine the cause of the failure. It was found that some of the gold plating on the heat exchanger tubes had been damaged during assembly of the reactor, which allowed the hot fuel solution to come into direct contact with the stainless steel tubing. The fuel solution corroded several of the tubes, prompting failure. The corrosion rate observed was unexpectedly high relative to what had been predicted on the basis of laboratory tests (LA-2292). Chemical attack was also noted at imperfections in the plating of the vessel and the boron poison can (LA-2292).

Since the failure of LAPRE I was not due to the reactor itself, components were repaired or replaced as thought necessary and a second attempt at operating the reactor was made (LA-2292). This second experiment was conducted on October 15, 1956. The reactor reached a power level of 160 kW and had been held there for approximately 2 hours when radioactivity was detected in the feedwater and steam systems, prompting a shutdown. Activity in the steam line rose rapidly, resulting in dose rates of 300 mR/hr in the control room (LA-2292). This was thought to be due to gaseous activity released from the end of the steam line and drawn into the building ventilation system (LA-2292).

Post-mortem inspection of the reactor determined the failure was again due to the heat exchanger tubes having been eaten away by the fuel solution. Since construction of LAPRE II was already underway at this time, further work with LAPRE I was abandoned (LA-2292).

LAPRE II utilized a different fuel solution than LAPRE I. This new solution had a lower vapor pressure than the LAPRE I fuel, at the expenses of less uranium solubility and thus the requirement for a larger vessel to achieve a critical mass. LAPRE II was also to make use of bonded components, in hopes of solving the failures associated with the protective gold plating.

Construction of LAPRE II was begun in February of 1956 (Clark, 1960; LA-2465). The reactor was located in an underground enclosure tank on the south side of the main laboratory building at TA-35. This arrangement provided a prudent means by which to provide the necessary radiation shielding. The design thermal power of the reactor was 800 kW. The primary purpose of the LAPRE II experiment was to demonstrate containment of phosphate fuels through suitable corrosion protection techniques.

Operation of LAPRE II was begun in February of 1959 and continued into May of 1959 (Clark, 1960; LA-2465). Full power operation was achieved on April 22, 1959. The fuel solution was kept in the reactor vessel at a temperature above 200 F for 46 days. A maximum temperature of 826 F was achieved. Like LAPRE I, LAPRE II experienced problems with the leakage of volatile fission products into the steam system. At full power, dose rates of several thousand R/hr were present adjacent to the feedwater heater (Clark, 1960; LA-2465). Though it could never be determined for certain, it was suspected that the leakage occurred via containment problems with the heat exchanger, ala LAMPRE I. Dismantlement of LAPRE II began on May 8, 1959 with the transfer of the fuel solution back to the storage tanks (Clark, 1960; LA-2465). The LAPRE program was terminated in 1960.

LAMPRE I

The following was adapted from "Early Reactors" by Merle E. Bunker (Los Alamos Science, Winter/Spring 1983) except where otherwise noted:

The purpose of the Los Alamos Molten Plutonium Reactor Experiment (LAMPRE) program was to explore the issues associated with using plutonium fuel in fast breeder reactors using a reactor fueled with molten plutonium and cooled by molten sodium. While the original design of the LAMPRE I reactor called for a design power level of 20 MW, the researchers concluded that the knowledge base required to develop such a system was not yet sufficient. The design of the LAMPRE I therefore underwent substantial changes, going from a 20 megawatt system down to a 1 megawatt test reactor. The LAMPRE I core matrix was such that it could accommodate up to 199 separate fuel elements. Each element consisted of plutonium-iron fuel material in a tantalum thimble. The core matrix allowed several fuel element designs to be tested simultaneously.

The 1 megawatt design power for the LAMPRE I allowed it to be placed in an existing building at Ten Site (TA-35). A gas-fired 2-megawatt sodium cooling loop was also included to gain experience with high-temperature sodium-to-water heat exchangers. LAMPRE I achieved initial criticality in early 1961 and operated for several thousand hours thereafter. One of the problems encountered was corrosion of the tantalum fuel thimbles by both the fuel and the coolant.

By mid 1963 LAMPRE I had achieved its intended purpose and was shut down. LAMPRE II, which was to be the 20 megawatt system first conceptualized for LAMPRE I, was never funded, with the AEC instead opting to pursue uranium-oxide-fueled reactors rather than plutonium-fueled systems.

LAMPRE was in the Ten-Site cell adjacent to the one used for La-140 separation. It used molten Pu contained within dozens of tantalum capsules, located within a sodium-cooled cylindrical core region about 40 cm high by 44 cm diameter. The LAMPRE fuel was transferred to Wing 9 at TA-3 (LA-UR-79-3091).

LAMPRE experienced three separate fuel failures during operation; official reports say that these fuel failures did not cause any *operational* problems. [LADC-5936, CONF-258-1 by Robert A. Clark and Review of LAMPP by Argonne NL (PRO-P-1; 4/20/66)]

The Rover Program

In 1955, the United States initiated a program to develop a nuclear rocket engine to be used in defense systems and space exploration (Koenig, 1986; LA-10062-H). The plan was to carry large payloads into deep space, by essentially passing hydrogen through a very high temperature nuclear reactor, where it would expand and be blasted out of the reactor at high velocity. Conducted with NASA, this program was called Project Rover. Los Alamos was given the roles of establishing the basic reactor design and leading the fuel development effort (Koenig, 1986; LA-10062-H). A series of test reactors were designed and built at Los Alamos prior to being tested at the Nevada Test Site. These reactors were intended to first demonstrate proof of principle, then to establish and test the requisite design considerations. In 1962, Rover was the second largest program at LASL. The Rover program was cancelled in January of 1973.

The Rover reactors were developed by the Los Alamos Critical Experiments Group using the facilities of the Pajarito Site (TA-18). In general, each new Rover reactor was developed following the same basic progression. First, parametric studies were performed using the Honeycomb assembly to establish the appropriate dimensions. The design then proceeded to the mockup phase, where details for controls and internal structures were worked out. Finally, the completed reactors were assembled and checked out prior to being sent to NTS for testing. Adjustments were made if any deviations from specifications were noted during checkout (Paternoster and Kirk, 1991; LA-UR-91-2434). Each Rover program reactor developed at Los Alamos is listed in Table C-1 below, along with the date the reactor was tested at NTS (Paxton, 1983; LA-9685-H).

Table C-1: Rover Program Reactors Developed at Los Alamos

Reactor	Date(s) Tested at Nevada Test Site
Kiwi-A	July 1, 1959
Kiwi-A′	July 8, 1960
Kiwi-A3	October 19, 1960
Kiwi-B1A	December 7, 1961
Kiwi-B1B	September 1, 1962
Kiwi-B2A	test cancelled
Kiwi-B4A	November 30, 1962
Kiwi-B4D	May13, 1964
Kiwi-B4E	August 28 and September 11, 1964
Kiwi-TNT	January 13, 1965
Phoebus-1A	June 25, 1965
Phoebus-1B	June 26, 1968
Phoebus-2A	June 26, 1968
Pewee-1	November 21, 1968
Pewee-2	test cancelled
NF-1 (Nuclear Fuel Furnace)	June 29 and July 12, 21, and 27, 1972

Before shipment to NTS, the Kiwi-TNT reactor was operated at Pajarito Site beside the PARKA reactor (essentially a Phoebus 1 reactor set up as a critical assembly) to measure their interactions at various separating distances.

A 1969 waste management plan says that the DP East facility processes new Rover fuel elements containing enriched uranium. Air from the exhaust systems handling radioactive materials was reportedly passed through HEPA filters. All four stacks from these systems are monitored but concentrations were reportedly below detectable levels. [Repos. No.. 113].

UHTREX

The Ultra-High Temperature Reactor Experiment (UHTREX) involved the construction and operation of a test reactor to advance the technology of high-temperature, graphite-moderated, gas-cooled reactors. The reactor was constructed in the late 1960s at Technical

Area 52, and operated for approximately one year before being shut down in February of 1970 (Salazar and Elder, 1993; LA-12356). The UHTREX was cooled by helium gas in a system consisting of a primary and a secondary loop, and a single heat exchanger. Gas pressure in the two loops ranged from 475 psi to 545 psi, with the secondary loop kept at higher pressure than the primary in case leakage occurred within the main heat exchanger (K-division, 1967; LA-3556 Revised). Under maximum conditions, the gas temperature at the core inlet was 1600 F, and the exit temperature was 2400 F (Salazar and Elder, 1993; LA-12356). The secondary loop coolant entered the heat exchanger at 200 F and exited at 1000 F (Salazar and Elder, 1993; LA-12356). A regenerative heat exchanger called the recuperator was used to re-heat the primary coolant on its way back to the core. The recuperator also served to lower the primary coolant temperature from 2400 F to 1400 F prior to it reaching the main heat exchanger. The secondary loop rejected heat to the atmosphere in a building outside the main reactor building. This heat dump building housed finned tubes cooled by large fans. The reactor produced no power. The UHTREX utilized 93%-enriched uranium fuel in the form of small spheres of UO_2 coated with 3 layers of pyrolytic carbon and bound in a graphite matrix (K-division, 1967; LA-3556 Revised). Fuel for the UHTREX was fabricated at the CMR Building (K-division, 1967; LA-3556 Revised). The UHTREX was designed with a rotating core that allowed the reactor to be fueled while operating. The design thermal power for the UHTREX was 3 MW.

The UHTREX utilized a gas cleanup system on the primary coolant loop to remove fission products and outgases from the (unclad) fuel. The UHTREX reactor, primary cooling system, and the gas cleanup system were contained in a gas-tight secondary containment provided by the main reactor building (Salazar and Elder, 1993; LA-12356). The gas cleanup system consisted of metallic filters (to remove particulate matter), a copper oxide bed (to oxidize reducing agents), molecular sieve beds (to adsorb carbon dioxide and water), and water-cooled beds of activated carbon (to either trap volatile fission products or to delay fission gases to allow for radioactive decay) (K-division, 1967; LA-3556 Revised). Delay times for the carbon bed were 1.2 hours for krypton and 20 hours for xenon (K-division, 1967; LA-3556 Revised). Under maximum conditions, 13 kW of decay heat were produced in the charcoal bed (K-division, 1967; LA-3556 Revised). Tritium produced in the primary coolant via the ^{3}He (n,p) ^{3}H reaction accumulated in the cleanup system in the copper oxide bed and in the molecular sieve beds (K-division, 1967; LA-3556 Revised). This tritium was eventually discharged up the 100 foot high main stack during regeneration of the sieve beds (K-division, 1967; LA-3556 Revised). This process also resulted in the discharge of entrained fission gases (K-division, 1967; LA-3556 Revised).

Air from the secondary containment, the fuel handling and gas sampling areas, and the change rooms and other such potentially contaminated areas passed through absolute (HEPA) and activated charcoal filters prior to being exhausted up the main stack (K-division, 1967; LA-3556 Revised). Stack releases were monitored via a Tracerlab model MAP-1B/MGP-1A combination gas and particulate monitor (K-division, 1967; LA-3556 Revised). The particulate monitor utilized a moving filter and a plastic scintillation detector. The gas monitor utilized a sodium-iodide detector. A removable charcoal filter was located between the particulate and gas monitors to allow for periodic assay of radioiodine concentrations via gamma-ray spectrometry. The stack monitor did not provide for “real-time” radioiodine monitoring. Air from the control room, offices, laboratories, equipment rooms, and other such “clean” areas was exhausted through rooftop vents (K-division, 1967; LA-3556 Revised). The UHTREX facility was designed so that air flow was from clean areas to potentially contaminated areas.

Spent fuel from the UHTREX was loaded into casks and transported by truck to Wing 9 of the CMR Building where it could be evaluated utilizing the hot cell facilities there (K-division, 1967; LA-3556 Revised). Liquid radioactive wastes were carried by contaminated waste lines to the TA-50 treatment facility.

Decontamination and Decontamination (D&D) of the UHTREX site and facilities began in the late 1980s. All radioactively-contaminated solid waste was buried at the laboratory's central waste disposal facility (TA-54) (Salazar and Elder, 1993; LA-12356).

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Appendix D: Key Operational Areas– Tritium

Following are some indications from LANL documents of the nature of operations that have involved tritium processing:

- Building 155 at DP East most recently housed the Tritium Systems Test Assembly (TSTA), which conducted research for developing and demonstrating effective technology for handling and processing deuterium and tritium fuels for use in fusion reactors.

- As of April 1990, the TSTA had operated for 70 months. Throughput totaled >10 billion Ci of tritium; the maximum inventory was 1,300,000 Ci; and stack releases were reportedly 110 Ci. Monthly releases from the TSTA stack for January 1985 through June 1990 are given in Repository No. 242, in Ci of HTO and Ci of HT and totals.

- An equipment failure in the CMB-3 tritium facility resulted in the release of ~13.8 Ci of tritium from the DP East Bldg 209 stack FE-10 from 4/11/81 thru 4/14/81. The highest daily average was 57.5 times the MPC for tritium oxide. [Repos. No. 235]

- “An enormous amount” of 3H went up the stack from this “tritium filling” facility at TA-33 per Neely/Elliott [12/98 tour]. Used alumina sieves; once saw a puddle of tritium on the floor. It has been reported that gram quantities were released over decades. These quantities reportedly dwarf the tritium used in accelerators at LANL. They did pressurized filling of tritium containers at TA-33 from the early 1950s to the late 1980s. This facility was replaced by the WETF facility at TA-16. Hot cells here opened to the environment (no double containment). Oil served as infinite sink for tritium (e.g. in vacuum pumps). There is a tritium outfall from this facility. TA-33 also has some firing points; can find depleted uranium on the ground. “The people just turned off the lights and left” this facility.

- Research at TA-33 released the largest amount of airborne tritium from routine LASL operations. Releases in 1978 were considerably higher than previous years. From 1973 to 1977, the average routine release of tritium gas from TA-33 was 3050 Ci (range 615 to 5916 Ci). An accidental release of 30,800 Ci occurred on October 6, 1977. The total for 1977 was 615 Ci, not including the accidental release. Releases in 1978 totaled 17,780 Ci (1.85 g), which represents 95% of all routine tritium releases at LASL in 1978. A new replacement facility was proposed for funding; it would have been at TA-41 and would have a system that captures and recycles tritium, limiting routine releases. [”Potential Environmental Issues at Los Alamos Scientific Laboratory” circa Oct. 1979].

- Whenever firing experiments proposed by GMX Division would result in the release of >100 Ci of tritium in a single shot or would raise the annual total above 5000 Ci, set up a system for review by GMX and H Division leaders. Prior to this policy, used about 180 Ci per shot and had no annual total. Only one year 1967-1971 would have exceeded 5000 Ci. [3/24/72 memo E.H. Eyster to D.P. MacDougal, Subject =”Release of Tritium in GMX Shots.”]

- The WETF facility at TA-16 replaced the tritium facility at TA-33 (after TA-41 was considered but rejected as a replacement site). The construction proposal for the Target Fabrication Facility at TA-35 says: “The facility (called the TFF) will make targets in support of the laser fusion target experimental program that will use Helios, a 10-kJ eight beam CO_2 laser system that recently achieved full operational status, and Antares (High Energy Gas Laser Facility), the 100-kJ CO_2 laser system now under construction. Special laboratories for filling laser-fusion targets with deuterium-fusion gas in tritium-handling dry boxes. The facility also includes laboratories for development of cryogenic targets. The tritium facility was designed to be a “zero release” system, with secondary containment dry boxes, an air scrubbing line, cryogenic handling capability, and a stack for accidental release protection.”

- On 24 May 1977, there was a release of up to 800 Ci of tritium from the Van De Graff accelerator [Repos. Nos. 593, 829]. On May 25, 1979, 3,000 Ci of tritium (probably as oxide) was released at roof level from SM-34 cryogenics area [Repos. No. 594].

In recent work by the LAHDRA team, the knowledge of tritium was extended and a more exhaustive search was accomplished due to the recent availability of the project information database with full text search capability.

In preparation for the calculation for prioritization of airborne releases of radionuclides, there were no effluent data found for tritium prior to 1967. For the years 1967 to 1971, the tritium releases were of the magnitude of 10^4 curies per year. As tritium was used at LANL prior to 1967, a search of the LAHDRA documents database was conducted for records previous to 1967.

The LAHDRA documents database currently contains 4006 Document Summary Forms (DSFs). The database was searched and the findings are described in Table D-1.

Table D-1: Results of a Search for Tritium Information in the LAHDRA Database

Search or Filter Criteria	Number of Records
"Tritium" in the TITLE	115
"Tritium" in the ABSTRACT	293
"Tritium" in the ANALYST COMMENTS	41
"H-3" in the TITLE	1
"H-3" in the ABSTRACT	61
"H-3" in the ANALYST COMMENTS	0
"H-3" or "Tritium" as a KEYWORD	265
UNION of all above searches with duplicates removed	408
filtered for START_DATE between 12/31/1939 and 01/01/1971	155

Of these 155 records, 61 are not on file. Either LANL has not reviewed them or they remain classified. A careful review of these 155 records and a review of the DSFs for incident files resulted in the creation of the “Findings_Log.MDB” Microsoft Access database. This findings database was used to catalog the knowledge garnered by the review of the literature and allows searching to ensure cross cataloging of similar findings. It was designed to be used for all types of findings logging and could be used for chemical, radiological, or other types of incidents. A summary table for these findings is shown in

Table D-2 below and a graph of early tritium release data can be seen in Figure D-1 below. A more detailed summary of tritium findings is presented in Table D-3.

Several incidents were found but only three appear significant: 1958, 1965, and 1969. The highest of these was 60,000 curies. No stack monitoring data or routine release data was found.

Table D-2: Annual Sums of Tritium Releases Identified To Date in LAHDRA Documents

Finding Year	Sum of Tritium (Ci)
1957	
1958	39000
1961	30
1962	7860
1963	20
1965	64890
1966	1210
1967	655
1968	260
1969	14898
1970	10
1971	

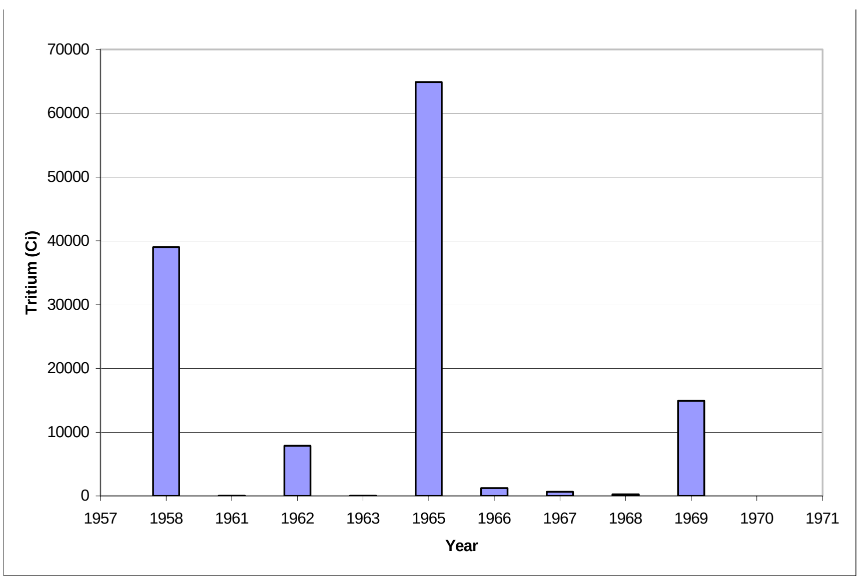

Figure D-1: Pre-1970 Annual Tritium Releases

The main findings of this preliminary look at tritium operations are as follows:

Tritium was used as early as 1946 - Tritium is mentioned in the memos and literature from LANL as early as 1946. In October of 1946 a memo to General Groves (Repos. No. 3330) noted they needed 500 ml of tritium (1,300 curies).

It is not known when stack monitoring for tritium was accomplished - There are several notations in the records that stack sampling did not occur until 1967; however there are conflicting statements as well. In the Joe Graf Binder (Repos. No. 1734a) page 19 referring to 1967-1969 data it states: ***"****The information on radioactive gaseous effluents for the following two facilities were obtained by reviewing accountability records for the maximum and average concentrations for these facilities. Since the stacks were not monitored, we have no values for the maximum and average concentrations for these facilities."* So it might be that some facilities had monitored stacks and some did not. At this time it is still difficult to put bounds to the releases of tritium to the environment. However, if the 10^4 curies/yr number is correct for 1967 then it is probable that in the 1946-1967 era LANL had annual releases that were of that order of magnitude or larger, and the incident reports indicate that this is true.

No routine releases for tritium were found - The documents found pre-1967 are all incidents. There was nothing found on routine releases. Even in the reading of the incidents, it is easy to see that the health and safety personnel are concerned about dose to workers, but largely unconcerned about the environmental releases.

Some important documents are not released from LANL - For the period of 1946-1967, there are some documents that were marked as category 2 or 3 in the LAHDRA Documents Database that are not on file. These category 2 and 3 documents were deemed not important to dose reconstruction. The DSFs indicate that these documents contain tritium inventories, which may provide insight to provide an upper bound for tritium releases since no stack monitoring data was found. A list of these documents is in the Findings Summary in below. There are seven of these documents that have not been cleared by LANL for public release. Repository documents 6, 26, and 99 have not been reviewed by LANL. Documents 3344, 4060, 4061 contain four incidents that are referenced in these documents, but whose contents were removed and point to classified files that are housed elsewhere.

Incident releases are estimated - The incident releases are usually stated as volume releases and sometimes are in question. In one case in 1958 (Repos. No. 4057) the document states: *"The estimate of the tritium loss ran from 15. liters on July 25th to a final 5. liter estimate on July 29th or 13,000. curies at STP."* Since the specific activity of tritium is 2,600 curies/liter, small differences in the reported volume could be quite significant.

LANL tritium releases often came from human error – In an incident in 1966 (Repos. No. 4064) a memo states that there were four human errors that contributed to the incident: *"An error was made in connecting the collecting system. Two valves were left in the wrong position. No 2nd person check was made."* Furthermore it should be noted that LANL is not a production facility run by chemical engineers, it is a research facility and experiments are being run where configurations are constantly changing. The propensity for human error is high and when many valves are present, if administrative procedures are not followed rigorously, then accidents and releases occur.

LANL had many tritium releases - After stating in an incident report in 1965 that they *"could have lost 10,000 curies of tritium"* it was mentioned (Repos. No. 4063) that: *"This incident is typical of a high pressure tritium target loss which has been happening for 13 years at this Site. This incident as well as all tritium target losses has been recorded in the operating books".* So it is certainly possible that 10,000 curies or more were lost annually. These logbooks have not been located.

Tritium measurements in early years were difficult - In another report dated 1953 (Repos. No. 3049), it stated: *"The tritium sniffer developed by Group P-1 and a slightly different unit by CMR-7 gave information about relative concentrations but no calibrations had been carried out. Late in 1953, Group H-5 was asked to attempt such a calibration".* This indicates that instrumentation for measurement of tritium was probably not present, or in various stages of development, 1946 to 1953.

Tritium releases may be both episodic and routine – In the LAHDRA prioritization calculation for airborne releases, there are 276 records on tritium from 1967 to 1996. In general, there are around 5 to 12 entries per year with a minimum of 4 and a maximum of 18. It is not documented if these are consolidated numbers from stack monitors or if these are records of episodic (incident) releases.

Tritium was used in many areas at LANL – TA-3, TA-9, TA-15, TA-16, TA-21, TA-33, TA-35, TA-41, TA-53, and TA-55 are areas where tritium was used.

Tritium warrants lower priority than plutonium – The prioritization (in Log_{10} of dilution volume) for tritium in the LAHDRA airborne effluent prioritization calculation ranges from approximately16 to 17.5. In the event that the pre-1967 annual tritium releases were on the order of 10^6, then the priority would be as high as 19. This conjecture would estimate pre-1967 releases as amounting to 100 times the post-1967 releases. Plutonium priority pre-1967 is between 18 and 19.5. The analysis of soil measurements for "back-calculation" of airborne plutonium releases indicates that plutonium priority could be as high as 20 or 21 in the pre-1950 era.

Table D-3: Tritium Findings Summary

Finding ID	Rep #	Document Title	Finding Yr	Finding Type	Reviewed	Classified	Ext Ref	Doc Cat	File Qty	Finding	Contaminant	Qty	Units
51	6	Notebook: P-3 Tritium Inventory		Other	FALSE	FALSE	FALSE	2	None	Describes losses of tritium to the atmosphere	Unknown		
52	26	Notebook: Shot Results (Title redacted)		Other	FALSE	TRUE	FALSE	2	None	This notebook chronicles classified experimen	Unknown		
53	99	Notebook		Other	FALSE	FALSE	FALSE	2	None	This is the health physics log for the liquid triti	Unknown		
19	186	General Decontamination - LASL		N/A	TRUE	FALSE	FALSE	1	Complete	N/A - some comments about high counts in ro			
4	3049	Health Division Annual Report 1953	1953	Memo	TRUE	FALSE	FALSE	1	Complete	Page 11 - "Tritium and litium were two mater	H-3		
20	3194	Geology and Hydrology of Technical Area		N/A	TRUE	FALSE	FALSE	1	Complete	N/A - Tritium used to date age of water…hydr			
21	3315	Letter Concerning Tritium Production in O		N/A	TRUE	FALSE	FALSE	2	Complete	N/A - production of H-3 in ORR			
1	3330	Directors Office Files: Correspondence R	1946	Memo	TRUE	FALSE	FALSE	1	Complete	Memo to Graves - Needs 200 cc now 500cc/m	H-3		
22	3334	Spent Fuel and Radioactive Waste Invent		N/A	TRUE	FALSE	FALSE	1	Complete	N/A - Spent fuel inventory			
27	3344	Hazards Associated with AEC Materials P	1969	Incident	FALSE	TRUE	TRUE	2	Complete	MCA From an Air Release of Tritium Memo	H-3		
28	3344	Hazards Associated with AEC Materials P	1965	Incident	TRUE	FALSE	FALSE	2	Complete	Exposure Due to Release of 60,000 Curies of	H-3	60000.00	Ci
29	3369	Radiation Incidents at P-9	1963	Incident	TRUE	FALSE	FALSE	1	Complete	Vaccum leak	H-3	20.00	Ci
30	3370	Reappraisal of Current Radiation Safety P	1962	Incident	TRUE	FALSE	FALSE	1	Complete	Target rupture	H-3	60.00	Ci
31	3503	Fissile Material Burial		N/A	TRUE	FALSE	FALSE	1	Complete	Burial records			
32	3724	Accidental Loss of Tritium at TA-33	1969	Incident	TRUE	FALSE	FALSE	1	Complete	5.73 Q(t)* liters also in Rep # 4067	H-3	14898.00	Ci
24	4055	Incident Reports - 1956		Incident	TRUE	FALSE	FALSE	1	Complete	Vaccum Oil Tritium accident tiny atmosphe	H-3		
25	4056	Incident Reports - 1957		N/A	TRUE	FALSE	FALSE	1	Complete	N/A			
33	4057	Incident Reports - 1958	1958	Incident	TRUE	FALSE	FALSE	1	Complete	estimated release from 5 to 15 liters "SCRA	H-3	39000.00	Ci
26	4058	Incident Reports - 1959		N/A	TRUE	FALSE	FALSE	1	Complete	N/A			
35	4059	Incident Reports - 1961	1961	Incident	TRUE	FALSE	FALSE	1	Complete	Tritium gas target rupture	H-3	30.00	Ci
34	4059	Incident Reports - 1961	1961	Incident	TRUE	FALSE	FALSE	1	Complete	alarm sounded in "Greenhouse hood" Sniff	H-3		
37	4060	Incident Reports - 1962	1962	Incident	TRUE	FALSE	FALSE	1	Complete	loss of 7800 Ci	H-3	7800.00	Ci
36	4060	Incident Reports - 1962	1962	Incident	FALSE	TRUE	TRUE	1	Complete	look in HSE-1 classified incident file	Unknown		
38	4061	Incident Reports - 1963	1963	Incident	FALSE	TRUE	TRUE	1	Complete	Classified Secret Restricted Data (H-1-M-246	Unknown		
39	4061	Incident Reports - 1963	1963	Incident	FALSE	TRUE	TRUE	1	Complete	Memo Confidential Restricted Data (H-1-M-24	Unknown		
40	4062	Incident Reports - 1964		N/A	TRUE	FALSE	FALSE	1	Complete	N/A			
43	4063	Incident Reports - 1965	1965	Incident	TRUE	FALSE	FALSE	1	Complete	Accident at P-9	H-3	10.00	Ci
41	4063	Incident Reports - 1965	1965	Incident	TRUE	FALSE	FALSE	1	Complete	vented H-3 collection tank	H-3	100.00	Ci
42	4063	Incident Reports - 1965	1965	Incident	TRUE	FALSE	FALSE	1	Complete	Value malfunction released up stack Don C	H-3	4780.00	Ci
44	4064	Incident Reports - 1966	1966	Incident	TRUE	FALSE	FALSE	1	Complete	No real mention of Tritium released 10 curies	H-3	10.00	Ci
45	4064	Incident Reports - 1966	1966	Incident	TRUE	FALSE	FALSE	1	Complete	states "large" release on 15 and 16 April. Han	H-3	1200.00	Ci
46	4065	Incident Reports - 1967	1967	Incident	TRUE	FALSE	FALSE	1	Complete	Rm4134 CMR glass bulb cracked releas	H-3	650.00	Ci
47	4065	Incident Reports - 1967	1967	Incident	TRUE	FALSE	FALSE	1	Complete	5 curies is an estimate.. No estimates for env	H-3	5.00	Ci
48	4066	Incident Reports - 1968	1968	Incident	TRUE	FALSE	FALSE	1	Complete	broken liquid nitrogen trap	H-3	260.00	Ci
49	4067	Incident Reports - 1969		N/A	TRUE	FALSE	FALSE	1	Complete	duplicate of 21 Aug 69 incident			
50	4068	Incident Reports - 1970	1970	Incident	TRUE	FALSE	FALSE	1	Complete	10 Curies is an estimte based on previous inc	H-3	10.00	Ci

Appendix E: Key Operational Areas– Beryllium

Beryllium has been used in various operations related to weapons production, including machining, fabrication and testing of components, at Los Alamos National Laboratory since 1943.

Records Search for Beryllium Information

The project team has identified few reports written during the period of historical beryllium operations at LANL other than H-Division Progress Reports. Most of the early H-Division reports mention beryllium air sampling in specific LANL buildings, but no details regarding the associated beryllium operations are provided. Several documents were located in the LANL Records Center and Report Collection that provide summaries historical monitoring activities associated with beryllium metal machining and firing site operations (e.g., Becker and Vigil 1999; Mitchell and Hyatt 1957). The Johns Hopkins report (JHSPH 1999) was recommended to the project team by a former LANL worker, and a copy was provided by M. Cadorette, Project Coordinator after initial contact with the Former LANL Workers Program Office in Española, NM.

Very little historical stack monitoring data for beryllium have been located by the project team. If stack releases of beryllium were not routinely monitored, indoor air monitoring data may be used to estimate source terms for beryllium releases to the environment.

Operations Involving Beryllium Release to the Environment

Two types of operations at LANL, machining and firing tests, have resulted in releases of beryllium to the environment. The first is the machining, grinding, sanding and general handling of beryllium components, which occurs in a machine shop or experimental laboratory setting. The second type of operation is dynamic testing activities, where beryllium is used during detonation activities.

IH records indicate that activities involving beryllium have been performed at 20 different Technical Areas between 1948 and 1980. Beryllium metal was processed in the shops and metallurgical labs, and soluble beryllium salts were handled in the chemical labs (JHSPH 1999).

Machining Operations

Until 1948, beryllium was machined in the center of a large machine shop located at TA-1 known as V-shop (JHSPH 1999). Flexible exhaust ducts were placed near the cutting tool and the captured dust was exhausted into the shop’s atmosphere. Due to the use of coarse fiberglass filter media, the Industrial Hygiene Group recommended that the filtered air be exhausted outside the shop (Mitchell and Hyatt 1957).

In 1949, an addition was built onto the main shop where only beryllium would be machined. All machines were equipped with local exhaust hoods. Each machine hood was exhausted by a blower-filter unit equipped with a wool-felt filter. The air was exhausted outside the building through a common stack. The quantity of air exhausted by each unit was approximately 200 cubic feet per minute (cfm). In 1951, the concentrations of beryllium in stack effluent ranged from 0.1 to 2.0 µg/m^3.

In 1952, the local exhaust system was enlarged to provide a larger quantity of air for each machine and to add an additional lathe and mill to the shop. The blower was capable of exhausting 2,000 cfm through the five local exhaust hoods in the shop, thus providing approximately 500 cfm for each hood.

During early 1952, a cloth tube filter was installed outside the old beryllium machine shop to maximize collection efficiency for air cleaning prior to release to the environment. The unit consisted of two steel chambers each containing 32 cloth tubes (cotton bags containing asbestos floc as a filter aid) operating continuously with a total capacity of 2,000 cfm. The collection efficiency determined by isokinetic sampling during normal machining operations was 98.8%. The mass median diameter particle size in samples collected with a cascade impactor in the duct before the filter was 4 microns (µm).

In August 1953, the shop was closed down and all machines and equipment were cleaned to prepare for the move to a new shops building at TA-3, SM-39 (JHSPH 1999). Operations in the new beryllium shop were started in October 1953. The cloth tube filter was moved to the filter room above the machine shop in the new building. A dynamic separator was installed before the cloth tube filter and dampers were installed on all machine hoods. Orlon bags with no filter aid were used instead of cotton bags and the collection efficiency increased to 99.9%.

Continuous stack samples were collected downstream of the dust tube filter in both the old and new beryllium shops. Of the 309 samples collected between 1952 and 1956, 53% were below 0.05 $\mu g/m^3$, 67% were below 0.10, 77% were below 0.2, 94% were below 1.0, 99% were below 2.0, and 100% were below 25 $\mu g/m^3$. All rags and waste from housekeeping activities are disposed of in the burial pit (Mitchell and Hyatt 1957).

Beryllium work was also initially performed at the Delta, Gamma, I, M, and [old] Sigma buildings at TA-1. Work activities at old Sigma included extrusion, welding, heating beryllium in a furnace, and flame plating beryllium onto substrates. Beryllium metal was welded and machined at Delta building, and beryllium oxide materials were used at M Building. V-shop was a foundry and machine shop where a variety of metals, including beryllium were processed (JHSPH 1999).

As summarized in Table E-1 and Table E-2, industrial hygiene records indicate that sampling for beryllium has been conducted at numerous buildings at TA-3 and at 19 other Technical Areas.

Table E-1: Beryllium Operations At TA-3 Buildings

Bldg No.	Building Name	Beryllium Operation
SM-16	Van der Graaf Lab	sanding
SM-29	new CMR Bldg	chemical synthesis, vaporization, purification
SM-30	Warehouse	unknown
SM-39	Shops Bldg	machining, milling, brazing, heat treating, cutting
SM-32	Center for Material Science	unknown
SM-43	Admin Bldg	foils, mirrors, BeO rods
SM-49	Physics Bldg	thin foils
SM-66	new Sigma Bldg	casting, etching, brazing,
SM-141	Rolling Mill Bldg	Coating
SM-184	Old Occupational Health Lab	unknown
SM-218	Magnetic Energy and Storage	unknown
SM-287	Scyllac Bldg	unknown

Source: JHSPH 1999.

Table E-2: Beryllium Operations at Other Technical Areas

TA No.	Technical Area Name	Beryllium Operation
TA-6	Two-Mile Mesa	Foils
TA-8	Anchor Site West	storage of BeF and BeO
TA-9	Anchor Site East	BeF fusion furnace
TA-14	Q Site	test firing
TA-15	R-Site	test firing with kg quantities of Be
TA-16	S-Site	laundry, burn pit
TA-18	Pajarito Site	Processing Be-U blocks and BeO rods, ultrasonic cleaning
TA-21	DP Site	Machining, milling, arc melting, palletizing
TA-33	HP Site	Machining using a method X machine
TA-35	Ten Site	high temperature Be salts
TA-39	Ancho Canyon	test firing
TA-40	DF Site	milling, test firing
TA-41	Icehouse	test firing
TA-46	WA Site	Heating
TA-53	LANSCE	targets and beam stops
TA-11	K Site	Unknown
TA-43	Health Research Lab	Unknown
TA-48	Radiochemistry	Unknown

Source: JHSPH 1999.
BeF = beryllium fluoride
BeO = beryllium oxide
Be-U = beryllium uranium alloy

The Sigma Complex at LANL is made up of three large buildings and several smaller buildings totaling over 200,000 square feet. These facilities, built in the 1950s and 1960s, house extensive laboratory areas for materials synthesis, and processing, characterization, and fabrication of materials such as beryllium, uranium, thallium, and aluminum alloys. The Sigma Complex is home to two groups of the Materials Science and Technology Division, Ceramics (MST-4) and Metallurgy (MST-6). The three main buildings of Sigma Complex are:

- Sigma Building (SM-66) 170,000 square feet built in 1959;
- Rolling Mill Building (SM-141) built in the early 1960s is 20,000 square feet;
- Press Building (SM-35) 10,000 square feet built in 1953.

One-third of Sigma Building space contains the mechanical and ventilation equipment necessary to protect the health and safety of personnel. The remaining area includes laboratories, as well as offices and administrative areas. The Rolling Mill Building contains laboratories for beryllium processing, powder metallurgy, ceramics research and rapid solidification research. The Press Building houses a 5,000-ton capacity hydraulic press with a 12-foot maximum opening and laboratories for hazardous materials research (LANL 1995).

Two 1992 files regarding permits for beryllium operations mention historical beryllium cutting operations at DP West, Building 5 in the 1960s and possibly 1950s, and existing beryllium operations in Sigma building (TA-3-66), and at TA-16-450 and TA-55-4. The operations at Sigma Building and TA-16-450 have existed since the 1950s (Gutierrez 1992; Tiedman 1992). An H-1 Division notebook discusses procedures associated with monitoring beryllium in stack effluent from the CMR Building Wing#5 Filter Tower in February 1954 (Enders 1954).

A 1945 LA report describes experiments to produce specially-shaped beryllium oxide bricks for the Water Boiler using beryllium oxide powder and cold and hot pressing techniques (Smith 1945).

<u>Dynamic Testing Operations</u>

Air samples and fallout trays were used to monitor beryllium during explosive tests starting in 1948, although beryllium was involved in relatively few tests until 1954 (Voeltz 1970).

Becker and Vigil (1999) reviewed the historic beryllium expenditure in dynamic tests conducted by the DX Division at LANL, present data on known beryllium concentrations in soil at firing sites, beryllium air concentrations measure onsite and beyond LANL boundaries, and beryllium concentrations in swipe samples. Records for beryllium use in dynamic testing activities at Los Alamos date back to 1955 and include shot records in the form of internal LANL memoranda, DX Division office records and published annual beryllium expenditures in LANL Environmental Surveillance reports. It is presumed that beryllium was expended in dynamic testing activities before 1955, although there has been no compilation of these data. They assumed that 160 kg of beryllium was used prior to 1955, but no explanation for this estimate is provided.

Becker and Vigil (1999) calculated a total beryllium expenditure for the period 1955 through 1997 of 1,064 kilograms (kg) (see Table E-3). The greatest annual use of beryllium (over 100 kg) occurred in 1964. Significant annual beryllium use occurred between 1957 and 1971. Beryllium use since 1985 has been extremely low; a total of 25.5 kg of beryllium was expended between 1985 and 1997.

Dynamic testing at firing sites is conducted at TA-40, -14, -15, -36, and -39. An evaluation of available records by Becker and Vigil (1999) determined that the majority of beryllium expenditure occurred at three firing sites: PHERMEX, E-F, and R-44, all located at TA-15.

Table E-3: Beryllium Expenditure at LANL Firing Sites

Site	Status	Beryllium (kg)
R-44 (TA-15)	Closed	346
PHERMEX (TA-15)	Active	332
E-F Site (TA-15)	Closed	321
R-306 (TA-15)	Active	43.6
All other firing sites at TA-15, -36, -39	--	21.4
TOTAL		1,064

Using a mass balance approach and the following assumptions, Becker and Vigil (1999) estimated soil concentrations of beryllium for three firing sites.

- 160 kg of beryllium expended prior to 1955
- more shots at E-F Site during years prior to 1955
- 2% of beryllium becomes aerosolized
- uniform soil concentration to a depth of 6 inches

They concluded that the observed beryllium concentrations measured in soil at firing sites are lower than expected concentrations. Possible explanations suggested for this discrepancy are that soil sampling is not representative of actual onsite contamination, or that other processes such as mass movement and erosion have removed contamination from the firing sites.

LANL conducts open-air dynamic experiments in which weapons components are either detonated or impacted against a target, which results in soil contamination with beryllium (Sauer et al. 2001). Monthly reports written by the LANL Dynamic Testing Division from December 1975 through December 1987 document fugitive emissions from explosive test shots, including quantities of beryllium released (M Division 1975-1987). During this 13-year period, 178 kilograms of beryllium were released as a result of test shots conducted at TA-15, TA-36 and TA-40. According to the monthly reports, 98% of the total beryllium emissions occurred between 1977 and 1982, and in 1984. However, about one-third of the monthly reports for the 13-year period are missing from the collection identified by the project team, and 75% of the missing reports are from the years 1983, 1985, 1986, and 1987. In the reports that are available, 55% of the monthly values are reported as zero kilograms. The average monthly release is 1.65 kg with a standard deviation of 2.42 kg. The median monthly release is 0.02 kg, the 95% upper confidence limit on the mean is 2.04 kg, and the maximum monthly release is 10.6 kg (for November 1976).

LANL Director's Office Files for 1944 describe a request for four alpha detectors from Chicago for 0.05 d/cc/s air in a 14" x 25" duct flowing 800 CFM and others. The detector is for B Building annex which was used for testing initiators and was an unmonitored release point for beryllium/polonium (Bainbridge 1994).

Air Monitoring for Beryllium

Air concentrations of beryllium have been monitored at LANL for both outdoor firing tests and indoor machining operations since 1948 (Voeltz 1970; Mitchell and Hyatt 1957).

Beryllium Metal Machining

The Industrial Hygiene Group at LASL made periodic surveys of beryllium machining operations from early 1948 through August 17, 1951. The first beryllium samples were collected with an electrostatic precipitator until August 1951. Beryllium samples were sent to the University of Rochester for analysis until June 1950 (Mitchell and Hyatt 1957).

After September 1951, daily air samples were collected whenever beryllium was being machined. From September 1951 through 1955, a sampling rate of 20 L/min and a filtering velocity of 130 feet per min with Whatman #41 filter paper resulted in a collection efficiency of 70%. In 1956, a sampling rate of 10 L/min and a filtering velocity of 65 fpm with Whatman #44 filter paper resulted in a theoretical collection efficiency of 99.8%

A continuous air sampler with a sampling rate of 20 L/min and a filtering velocity of 130 feet per min using Whatman #4 filter paper was used to monitor beryllium air concentrations for short periods of exposure. The sampler was set to collect hourly general air samples in the vicinity of the machining operations. The reported collection efficiency was 80%. Starting in 1954, the hourly samples were only analyzed when an 8-hour BZ sample approached the tolerance level of 25 $\mu g/m^3$.

Beginning in June 1951, the LASL Industrial Hygiene Laboratory analyzed all beryllium samples using a method based on the fluorescence of morin with beryllium in alkaline solution. The analytical range of this method was 0.05 to 300 µg of beryllium.

During the period from 1950 to 1953, filter type respirators were occasionally used on special jobs. In a number of cases the filters from these respirators were analyzed for beryllium content. Samples were also collected in the exhaust ducts with a cascade impactor to determine the particle size of the beryllium. The results were reported to be unsatisfactory because small pieces are carried into the impactor and plug orifices due to the lightness of the metal (Mitchell and Hyatt 1957).

Firing Sites

A 1970 letter report from the LANL Health Division Leader to the Deputy Director of Military Application, USAEC, describes the historical air sampling of beryllium near explosive tests at LANL (Voeltz 1970). Air samples and fallout trays were used to monitor beryllium during explosive tests starting in 1948, although beryllium was involved in relatively few tests until 1954. In 1954 there was beryllium exposure during test firing of beryllium pieces in conjunction with explosives at TA-39, Ancho Canyon. Most of the samples were collected between 1956 and 1959 when all tests occurred at R Site and were conducted by the GMX-4 group. In 1955 Group W-3 conducted an experiment at TA-33 where a device exploded and large pieces of beryllium were thrown all over the firing area. Tests involving beryllium after 1959 were conducted at Ancho Canyon by GMX-6 and at Phermex by GMX-11. Table E-4 summarizes the data described in the 1970 letter report.

Table E-4: Beryllium Concentrations During Explosive Tests

Site	Shots	Samples (N)	Samples >0.05	Max Onsite	Offsite
R-Site	39	156	11	0.66 (0.34) [1]	0.05 [2]
Ancho Canyon	8	24	1	0.004 [3]	NR
Phermex	2	NR	0	NR	NR

All concentrations are reported in µg/m^3. The detectable quantity reported was 0.05 µg/m^3.
NR = Not reported.
[1] Measured 800 yards directly downwind from the shot. Maximum value reported (2nd highest value reported).
[2] Measured at Ten Site.
[3] Measured 150 yards from the shot.
No additional details on the dates of shots or sampling events, or additional data were provided.

The letter report also states that a few of the fallout trays "showed beryllium in the collected material" but no additional details on the results are provided. The report concludes, "Because of our experience with these results, shots containing beryllium are not monitored regularly but only when some special conditions of testing are planned."

Air sampling for beryllium was performed by the LANL Environmental Surveillance program in the early 1970s and resumed in the 1990s. Data collected on the roof of TA-59-1 during 1971 and 1972 measured beryllium air concentrations between 0.06 and 0.4 ng/m^3 (0.00006 and 0.0004 µg/m^3). Quarterly Airnet samples of beryllium collected onsite, at the Lab perimeter, and regionally in northern New Mexico in 1990, 1992, 1993 and 1994 ranged from 0.002 to 0.061 ng/m^3. When quarterly sampling was resumed in 1998, quarterly Airnet beryllium values ranged from 0 to 0.1 ng/m^3 (Becker and Vigil 1999). Area air samples collected in 1998 at two firing sites during dynamic shots ranged from 0.013 to 0.381 µg/m^3 of beryllium (Becker and Vigil 1999).

Beryllium concentrations in surface water samples collected from the E-F Firing Site (TA-15) in March 1985 ranged from <1 – 2 part per billion (ppb) in the dissolved fraction, and from 1.2 – 11.5 ppb in the suspended fraction. The range of beryllium concentrations in nine soil samples collected in February 1985 at the E-F Site was 2.3 – 14.4 part per million (Cokal and Rodgers 1985).

The environmental fate of beryllium released from disposal of neutron sources containing beryllium metal that cannot be recycled or reused is a research interest of the Off-Site Source Recovery Program at LANL. A 2000 progress report describes the experimental use of beryllium-contaminated soils obtained from LANL Dynamic Experimentation Division firing sites. Two samples (locations not specified) contained 74 and 29 mg/kg of beryllium (Sauer et al. 2000).

Aerosolization of beryllium from open-air shots has been studied by groups at LANL (Dahl and Johnson 1977) and at LLNL (Shinn et al. 1989). Dahl and Johnson (1977) determined that 2% of the beryllium mass became respirable (<10 µm) due to aerosolization. For a shot containing 600 g of beryllium, the concentration of beryllium 4,376 yards downwind of the shot would be 0.2 µg/m^3 15-30 minutes after detonation for 1-3 minutes. Shinn et al. (1989) found that 8% of the beryllium mass became aerosolized, and that the beryllium was largely in the form of insoluble, high-fired beryllium oxide. For a shot containing 900 g of beryllium, the concentration of respirable beryllium 55 yards from the shot was 3.2 µg/m^3 for 10 minutes. However, measured soil concentrations at three LANL firing sites were less than predicted assuming 2% or 8% aerosolization (Becker and Vigil 1999), suggesting that aerosolization could be greater than 8% (Sauer et al. 2001).
Beryllium resuspension has been evaluated in three studies, two at LANL and one at Sandia. Luna et al. (1983) estimated a resuspension factor of 1E-7/m for wind blown soil (1 g Be

per square meter of soil = 0.1 μg/m^3 Be in air). Maez (1997) predicted that resuspension of beryllium from a firing site could result in worker exposures to 0.6 μg/m^3 of beryllium. However, measured beryllium concentrations during drilling activities at a LANL firing site were four orders of magnitude lower (Mroz 1995).

Exposure Guidelines for Beryllium

The current OSHA permissable exposure limit (PEL) for occupational exposure to beryllium is 2 μg/m^3 (8-hour time weighted average). A ceiling limit of 5 μg/m3 must not be exceeded during the work shift, except that a 30-minute excursion over the ceiling limit is allowed as long as the air concentration never exceeds 25 μg/m3 during the 30-minute period (NIOSH 2003).

According to Mitchell and Hyatt (1957), in the neighborhood of a plant handling beryllium compounds, the average monthly concentration at the breathing zone (BZ) level should not exceed 0.01 μg/m^3.

The current USEPA Reference Concentration (RfC) for beryllium is 0.02 μg/m^3 (USEPA 2004). The RfC is an estimate (with uncertainty spanning an order of magnitude) of a daily inhalation exposure of the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. The RfC is based on beryllium sensitization and progression to chronic beryllium disease (CBD) identified in the studies by Kreiss et al. (1996) and Eisenbud et al. (1949). The Kreiss et al. (1996) occupational exposure study identified a LOAEL for beryllium sensitization in workers exposed to 0.55 μg/m3 (median of average concentrations). A cross-sectional study was conducted of 136/139 of the then-current beryllium workers in a plant that made beryllia ceramics from beryllium oxide powder. Measurements from 1981 and later were reviewed and included area samples, process breathing-zone samples, and personal lapel samples (the last year only). The Eisenbud et al. (1949) study, using relatively insensitive screening methods, suggests a NOAEL of 0.01-0.1 μg/m3 in community residents living near a beryllium plant. The LOAEL from the Kreiss et al. study was used for the operational derivation of the RfC because the screening method used in the Eisenbud et al. (1949) study was less sensitive than the method used in the Kreiss et al. (1996) study.

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Appendix F: Key Operational Areas – High Explosives

Research, development, and testing of high explosives were conducted at more than 25 different Technical Areas of LANL (Goldie 1984; LANL 1990). Many new formulations of the conventional explosives HMX, RDX and TNT were synthesized and tested at LANL since the 1940s (Dobratz 1995). Other high explosives such as Baratol, Comp B, Pentolite, Torpex, and Tetryl were tested at firing sites such as those at TA-14 (IT Corporation 1989).

The initial plan for the first atomic weapon was for a gun type weapon that would use "slow-burning" propellants. When it became clear in July 1944 that the weapon would have to be an implosion design due to the presence of the plutonium-240 isotope in the active material, high explosives became a key component of the plan.

X-Division

The implosion program began in April 1943 with a proposal by S. H. Neddermeyer on an elementary theory of high-explosives assembly, but there was no established art to follow. Implosion research started as the concern of one small group and grew into the Laboratory's major problem in the early 1940s. The first implosion tests at Los Alamos were made in an arroyo on the mesa just south of the laboratory on July 4, 1943. The test device consisted of tamped TNT surrounding steel spheres. In April 1944, G. B. Kistiakowsky became the leader for the implosion program.

Data from photographing the interiors of imploding devices indicated the need for controlled quality of high-explosive (HE) castings. Special photographic techniques were developed at LANL to study the implosion process, such as rotating pyramid and rotating mirror photography, high-explosive flash photography, and flash x-ray photography. The Anchor Ranch range (TA-9) had been designed for implosion research, but a large casting plant and several widely spaced test sites were needed. Construction of the casting plant was begun in the winter of 1943 at S (Sawmill) Site (TA-16). S-Site was staffed almost entirely by men from the Army's Special Engineering Detachment (SED), because finding men with experience in handling explosives was nearly impossible (Hawkins et al. 1961). At the end of the war, there were over 1,000 SED men assigned to the X-Division (Kistiakowsky 1975).

In July 1944 a new development in the implosion program involved the use of explosive lenses that would convert a multiple-point detonation into a converging spherical detonation wave thus eliminating troublesome interaction. The design of lens molds was a difficult first step and took several months. In the August 1944 reorganization, Division X was formed under G. Kistiakowsky to experiment with explosives and their fabrication and to set up a production system. Three groups from the old Ordnance Division (E-Division) in U Building-Implosion Experimentation, HE Development, and S-Site Group, were transferred to the new Explosives (X) Division. Investigation of implosion dynamics and design of the active core were given to the Weapon Physics (G) Division (Hawkins et al. 1961).

Explosives Production and Testing

X-Division records indicate that about 20,000 experimental quality castings were produced in an 18-month period, and a much larger number rejected for quality control reasons. The principal types of HE used were Composition B, Torpex, Pentolite, Baranol and Baratol. The use of risers and overcasting to concentrate imperfections and minimize the very dangerous task of machining HE resulted in over 50,000 machining operations without a detonation (Hawkins et al. 1961). According to Kistiakowsky (1975), tens of thousands of castings were made, primarily of Comp B and Baratol. Baratols, with a higher percentage of barium nitrate (76%) than TNT was used for the slow component of the lens system, and cyclotols such as

Comp B (60% RDX: 40% TNT) were used for the fast component (Kistiakowsky 1975; Gibbs and Popolato 1980).

As described in Wilder (1973), operations at S-Site consisted of melting HE and pouring it into molds whose shape was determined by theoretical calculations. The initial facilities at S-Site were inadequate especially for machining. As a result, there was continuous planning and construction of new buildings until just before the Trinity test in July 1945. Casting operations in Building 42 used stainless steel candy kettles, jacketed and steam heated. The molten explosive was poured from the kettle into a rubber bucket and then into steel molds. The mold was finished with Cerrotru, a low-melting casting alloy around a master shape supported in the steel weldment. In Wilder's opinion, development of the explosive component of the bomb was greatly facilitated by the use of self-adhesive tape just about everywhere. Building 27, built in 1945, had larger kettles and the temperature of cooling water could be varied.

After casting, the HE was taken by hand truck to Building 43 to be machined. The equipment in Building 43 consisted of one K&T milling machine and several Delta drill presses. Comp B was machined under water, and Baratol was initially machined dry but later water was used. Building 55 housed the one small high-speed hammer mill used for grinding barium nitrate. Buildings 31, 32 and 33, built in 1945, were machining bays for Fosdick radial-arm drills. As S-Site activities expanded, they moved into V-Site (TA-25). Three methods were used to protect the cast HE from chipping. Castings were sprayed with the best "Bar Top" varnish available, felt was glued to one of two mating surfaces, and blotting paper was glued to the sides, in Buildings 519 and 520. Practice assemblies were made in Gamma Building in the main Tech Area. The floors were padded with wrestling mats. The Trinity bomb was assembled in Building 516. All explosive operations produced great quantities of scrap that was collected daily and burned in the area where Building 260 was located (Wilder 1973).

According to Hawkins et al. (1961), S-Site at its peak used over 100,000 pounds of high explosives per month. G. Kistiakowsky's recollection was that about 25 tons (50,000 pounds) were trucked up the hill per month during the most active HE casting period. X-Division Progress Reports indicate that between 140,000 and 170,000 pounds per month of high explosives, primarily Comp B, TNT and barium nitrate (BN), were used during the months of May, June, July and August 1945 (see Table). Precision molds and machining were required, and according to Kistiakowsky (1975), there were over 500 machinists and toolmakers available during the peak period. A full-size casting weighed about 100 pounds. (One gram of HE will reportedly blow off a hand.) Kistiakowsky expressed his concerns about using S-Site since five tons of HE had to be trucked past Oppenheimer's office and T-Division every day on its way to S-Site. He requested that a new site be established in Pajarito Canyon but his request was denied by Captain Parsons (Kistiakowsky 1975).

L-Site (TA-12, akaTA-67) was constructed in the spring of 1945 and used for one year as an explosives test facility, then abandoned in the mid 1950s. Soil tests in 1993 identified RDX, TNT and picric acid at the open firing pit and firing pad 1. Q-Site (TA-14) has been used for development and testing of explosives since 1944. HMX and metals were identified in Q-site soils (Harris 1993). RCRA Facility Investigation plans for OU-1082 (S-Site) and OU-1086 (R-Site)

Sites in the vicinity of TA-16 (S-Site) formerly used in the 1940s for x-ray studies (P and T-Sites) and assembly operations (V-Site), and several storage magazines (TA-28, 29, and 37) were decommissioned and absorbed into the S-Site complex or are still active. S-Site, K-Site and two of the three magazines were still active as of 1994. TA-11 (K-Site) was originally built to study implosion symmetry and was more recently used for drop tests to study impact initiation of explosives. The resulting debris in the immediate vicinity of the drop tower is picked up and removed for disposal at the TA-16 burning ground. These eight sites are the focus of the Remedial Field Investigation for Operable Unit 1082 (LANL 1994).

Between 1944 and 1948 eight firing sites (A-H) were established at TA-15 (R-Site). Experiments using from 50 lbs up to 2 tons of HE were conducted at these firing points. Firing points E and F were the most active. Up to 65,000 kg of uranium and 350 kg of beryllium have been expended at these two firing sites. Hazardous materials, including uranium, beryllium and lead, have largely been left in place at these sites where the materials were deposited by the explosion. Other materials that may have been deposited include steel, aluminum, mercury, boron, cadmium, gold, and tritium reportedly in small amounts. TA-15 is the focus of the Remedial Field Investigation for Operable Unit 1086 (LANL 1993).

Other Uses of Explosives at LANL

During the VJ Day celebration at the Laboratory, Kistiakowsky reportedly borrowed a military jeep with a driver and gave the LANL scientists a “21-gun salute” by detonating 21 boxes of Comp B explosive, although someone attending the party said there were actually 22 explosions. It was also reported that the Pajarito ski hill was cleared of trees using plastic explosives (Kistiakowsky 1975).

Key Facilities for High Explosives at Los Alamos

S Site (TA-16) was initially called Sawmill Site, after a portable sawmill that had been erected on the site, and left huge piles of sawdust behind. Its name was shortened to S Site. [Martin 1998].

Investigations at S Site have included development, engineering design, prototype manufacture, and environmental testing of nuclear weapons warhead systems. TA-16 is the site of the Weapons Engineering Tritium Facility for tritium handled in glove boxes. Development and testing of high explosives, plastics, and adhesives, and research on process development for manufacture of items using these and other materials are accomplished in extensive facilities.

Facilities include a slurry plant with a capacity of 300 lbs of explosive per batch [Nuclear Weapons Databook Vol. III]. The material being cast was a two-phased slurry consisting of a dense solid phase dispersed in molten TNT. [Hoddeson et al. 1993] At first Torpex was used, then PTX-2 (Picatinny ternary explosive 2), Comp B, Pentolite, Baranol, Baratol

Earlier operations centered on using high explosives (HE), and developing HE lenses to bring about implosion. LANL workers melted HE and poured it into molds whose shape was determined by theoretical calculations. Early castings were worked with hand tools, saws, rasps, and planes, to a template. HE compounds included Comp. B, TNT, and Baratol.

Early explosives processing facilities included:

S-24	(a.k.a. TA-16-24?) A casting building
TA-16-42	Casting (stainless steel candy kettles, jacketed and steam heated, with agitator; HE was poured into a rubber bucket, then to molds)
TA-16-43	Machining (K&T milling machine, drill presses, fly cutters. Comp. B was machined under a stream of water. Baratol was initially machined dry because thought water would dissolve the barium nitrate; later machined wet.
TA-16-44	Physical inspection (dimensional inspection)
TA-16-45	X-ray (portable 150- and 220-keV x-ray machines. Dark room, film processing.
TA-16-46	HE storage for X-ray. "Rest House" for castings during dimensional and x-ray inspection.
TA-16-48	"gamma-graph" facility (gamma radiography of large or dense objects).
TA-16-55	Barium nitrate grinding machinery.
TA-16-81	Used to dry nitrocellulose (spread out on trays).
TA-16-260.	Near the east end of this building was area for daily burning of scrap. Sometimes the material exploded instead of burning.
TA-16-27	Built in 1945 to make full-scale castings.
30 thru 34	were built at same time to machine Baratol and Comp. B castings from Building 27.
94 thru 98	were built when it became desirable to machine all surfaces of the HE material.

16-515 thru 520 (called V Site) were under a group other than GMX-3; they had a large mechanical shaker that was used to test the first bomb. The Trinity bomb was assembled in 516. "Active" per 10/2/84 memo from R. Goldie to D. Pinyan; subject was "Areas Containing or Contaminated by Explosives." "Mechanical Testing" done here per Repository No. 225 (c. 1981)

Some of the early work being done was considered too dangerous to be performed at TA-1, so these operations were placed at remote locations. Alpha Site at TA-4 was used as a firing site for high explosives (HE). It was originally used to fire several charges per day of up to 1000 pounds and was then converted to accommodate studies of small equation-of-state tests that used only a few pounds of HE per shot. Beta Site at TA-5 was used extensively in 1945 as a firing site for the pin or electric method for studying implosions. Larger charges could be safely used at TA-5, and shots of several hundred pounds were used. S-Site at TA-16 was developed for production of HE to be used in the various tests. [LA-UR-97-4765]

In 1944 a small control building and two firing sites were established at TA-15; one for quantities of HE up to 50 lbs and the second for larger amounts. These probably became Firing Sites A and B. Firing Site A was probably in use by the end of 1944 and Firing Site B shortly thereafter. In 1946, TA-15 was made into a permanent location for explosives experiments related to nuclear weapons design, involving experiments with up to 3/4 tons of HE. By 1947, Firing Sites C,D,E, and F were in use. In 1948, E and F were designated as one firing site, E-F, and Firing Sites G and H were added. Today Firing Sites A through H are not used, and most structures associated with these firing sites have been decommissioned and dismantled. The hazardous materials used in these explosives tests, e.g. U, Be, and Pb, have largely been left in place at the firing sites where the materials were deposited by the explosion or pushed aside to clean the area. Other materials that may have been deposited in very small amounts include steel, Al, Hg, boron, Cd, gold, and H-3. Many types of HE were used. While they may have left some residues, no unexploded HEs have been found in the analyses of site soils. Site E-F was most heavily used and reportedly contains the largest quantities of hazardous materials. Up to 72 tons of U and approx 800 lb of Be may have been expended in tests at Firing Site E-F. In the 1950s, Firing Sites R-44 and R-45 were completed. These sites have been used for various explosives tests, R-45 for smaller tests and R-44 for larger ones. [1086 RFI Report; 10/30/95]

TA-15, "R-Site," is currently the home of PHERMEX (the pulsed high-energy radiographic machine emitting x-rays) a multiple-cavity electron accelerator capable of producing a very large flux of x-rays for weapons development testing. It is also the site where DARHT (the dual-axis radiographic hydrotest facility) is being constructed. This site is also used for the investigation of weapons functioning and systems behavior in non-nuclear tests, principally through electronic recordings.

TA-9, Anchor Site East, housed exploration of fabrication feasibility and physical properties of explosives. New organic compounds are investigated for possible use as explosives. Storage and stability problems are also studied. Name refers to Anchor Ranch, a small cattle operation that was in the area when the MED took it over in 1943. "Active" per 10/2/84 memo from R. Goldie to D. Pinyan; subject was "Areas Containing or Contaminated by Explosives."

TA-14, Q Site, is a dynamic testing site used for running various tests on relatively small explosive charges for fragment impact tests, explosives sensitivities, and thermal responses. "Active" per 10/2/84 memo from R. Goldie to D. Pinyan; subject was "Areas Containing or Contaminated by Explosives."

Appendix G: Key Operational Areas– Accelerator Operations

During World War II, accelerators were used to determine the critical masses for each proposed atomic bomb design. Two Van de Graaff accelerators were acquired from the University of Wisconsin, a Cockcroft-Walton accelerator was "borrowed" from the University of Illinois, and a cyclotron was purchased from Harvard (Hoddeson et al., 1993).

The machines supplied neutrons for studying the neutron interactions involved in an explosive fission chain reaction. This was important because these interactions had not been studied at all of the neutron energies relevant to a nuclear explosion., from which fast neutrons are emitted with no slowing down or "moderation" as had been the case in the early graphite reactors. The accelerators also supported the effort to find a way of preventing a "fizzle," or predetonation, in the gun-assembled plutonium bomb. A circular electron accelerator called a betatron was later procured to obtain sequences of images of spheres of mock fission fuel as they were being imploded by surrounding high explosives (Reichelt, 1993, Los Alamos Science No. 21).

During the postwar years, the emphasis was on building a foundation of basic scientific research with weapons applications. Three wartime accelerators were purchased and retained by the government– the Short Tank, the Cockroft-Walton, and the cyclotron. The Long Tank was returned to the University of Wisconsin, but was replaced by a high-energy Van de Graaff accelerator with a vertical configuration. The neutrons from that device and those provided by the Cockroft-Walton were used to study neutron interactions relevant to nuclear fusion. The old Harvard cyclotron was upgraded into a variable-energy cyclotron that was used to study the angular distributions of accelerated particles after they scattered off the nuclear of various target elements. (Reichelt, 1993, Los Alamos Science No. 21).

Two electron linear accelerators (linacs) were later built to provide radiographs of the implosion process, in work that led to the 1963 construction of PHERMEX (pulsed high-energy radiographic machine emitting x rays). PHERMEX generates x rays by accelerating an electron beam onto a tungsten target, and the x-ray bursts are sent through model weapons at a remote blasting site to provide three-dimensional images of imploding spheres. (Reichelt, 1993, Los Alamos Science No. 21).

Relatively small accelerators that have been used at Los Alamos include:

- W Building at TA-1 housed a Van de Graaff accelerator. Building W had 2 high-voltage electrostatic generators used to produce variable energy neutrons for cross-section measurements. Protons were accelerated, hit a target (usually lithium), producing neutrons. Some X rays were also produced. There were also hazards from neutrons and X rays.

- TA-3 Building 16 housed a Van de Graaf accelerator (a.k.a. SM-16). On 24 May 1977, there was a release of up to 800 Ci of tritium from the Van De Graaf accelerator. [Repository Nos. 593, 829]

Accelerator Operations at Technical Area 53

The largest accelerator facility at Los Alamos is the one that is housed at TA-53. Following is a list of acronyms that are used in the discussion of TA-53:

LAMPF = Los Alamos Meson Physics Facility; WNR = Weapons Neutron Research Facility; LANSCE = Los Alamos Neutron Science Center; PSR = Proton Storage Ring; MeV = Million Electron Volt (energy unit); MAP = Mixed Activation Products

The primary facility at TA-53 is a large accelerator complex originally called the Los Alamos Meson Physics Facility (LAMPF). The original sections of LAMPF were later renamed the Clinton P. Anderson Meson Physics Facility. LAMPF is a nominal 800 million electron volt (MeV), 1-milliampere intensity proton linear accelerator. Construction was started on LAMPF in 1968. On June 12, 1972, LAMPF first obtained a full energy beam. Originally constructed to study sub-atomic particles, today LAMPF serves as an accelerator generating intense pulses of neutrons (by sending the protons into targets of high atomic number such as uranium) for scattering research at the WNR and LANSCE facilities. The Proton Storage Ring is used to accumulate protons and provide a short duration pulse of protons for targeting onto uranium and other high atomic number targets for neutron production at WNR.

Today, the complex is called the Los Alamos Neutron Science Center, and includes the linear proton accelerator, the Manuel Lujan Jr. Neutron Scattering Center, and a medical isotope production facility. In addition, the Accelerator Production of Tritium Project Office, including the Low-Energy Demonstration Accelerator, and R&D activities in accelerator technology and high-power microwaves are located at TA-53.

LANSCE Release Summary

LANSCE airborne radionuclide releases consist of short-lived radioactive materials that have been activated from air. These radioactive materials are composed of particulates from activated dust in air and gaseous activation products from air constituent gases. Another source of LANSCE radionuclide releases is the cooling water used for cooling accelerator components. Non-radioactive releases at accelerators include solvents, which are used in large volumes for cleaning vacuum components.

LANL documents refer to the mix of short-lived materials as Mixed Activation Products (MAP). Some other acronyms seen in documents are G/MAP for Gaseous Mixed Activation Products and P/VAP which are Particulate Various Activation Products. These radioactive materials are produced when the proton beam from LAMPF is sent through air, or when a fraction of the proton beam is lost through interactions with accelerator components (such as targets). These interactions generate neutrons, which subsequently activate the air gases and the dust in air.

Radionuclide releases from LANSCE occur in two ways 1) from the four stacks located in the facility which are monitored for both particulates with filters, and for gases with Kanne chambers and 2) via unintentional pathways of diffuse release via doors and other exit points. For some periods of time, these combined emissions are the source of the highest priority releases to the environment. The radionuclide releases reported at LANSCE are among the highest of all DOE operations nation-wide. The amount of radioactivity released from LANSCE increases proportionally as the power levels and beam-on time increase. Principal gaseous radionuclides constituents released were ^{11}C (20 min), ^{13}N (10 min), ^{15}O (2 min). A trace amount of ^{41}Ar (1.8 h) was also released. The particulate releases are too numerous to mention and are only present in trace levels since these consist of activation products from dust in air or disintegrated target material.

Cooling water that services accelerator components, including targets, also becomes radioactive, and also accumulates corrosion products from the target and magnet systems. This water has been released by the site after decay in concrete walled cooling water ponds that have bentonite clay on the bottom. The cooling water is held until no short-lived radionuclides are observed in the water, after confirmation measurements, the cooling water from these ponds is then released and becomes surface water.

Prioritization of LANSCE Releases

The releases from LANSCE are cataloged in detail by the LAHDRA team in a two calculations (O'Brien 2003a and O'Brien 2003b). In the airborne prioritization calculation, the priority index (PI) varied from 10^{18} to 10^{16} milliliters of air. The calculation of PI divides the annual release by the Maximum Permissible Concentration (MPC) for non-occupational exposures. The result represents the volume of air required to dilute the releases to the maximum permitted value, and therefore permits comparisons for varying amounts of radioactive material from year to year based on the total quantities of air required to dilute the effluent. The MPC value used for MAP is from the International Atomic Energy Association (IAEA, 1979) and was 2.0E-07 µCi/mL. The prioritization shows that LAMPF dominates site releases to air since the mid-1970s.

Detailed LANSCE Release Data

The LAHDRA project team has spent many hours finding and reviewing LANSCE records. The project team has identified two key document resource centers within TA-53 that provide substantial quantities of historical effluent monitoring data for LANSCE. Those records cover operations from the early 1970s to the present. The locations are:

- Building 3, Room 3R-4 (TA-53-3) - Radiological records that contain mostly exhaust stack and water monitoring data for radionuclides.

- Another location for useful records is the operations group in Building 53. Management staff at the accelerator facility generally opted to retain large portions of their records for historical and operational purposes and has stored these records on-site at TA-53.

Monthly and annual air emission reports from 1976 to the present have been identified and are currently awaiting review for incorporation into the LAHDRA repository. These reports also present backup information pertaining to how LANL staff performed and collected stack monitoring data and calculated air releases. In related reports identified by the project teams, methods for calibration of Kanne "flow-through" ionization chambers and for stack measurements are presented.

Probably the most relevant method of estimating releases is to use the accelerator operation logs to obtain the milliampere-hours (mA-hrs) of beam operation. Then to use the OSR Database to obtain the curies released annually at TA-53. The accelerator logs were found by LAHDRA team members and entered into a spreadsheet (LANSCE Effluents.xls). Data were found from 1976 to 1992. Periods of operation of the accelerator are annotated as "cycles" and these cycles are listed as a sequence number. This data included operations during cycle 3 through 61. Data for cycle 1 and 2 were not found. Data for cycles above 61 are available, but were not captured. In the LANSCE Effluents spreadsheet the beam current was then multiplied by beam-on time to calculate mA-hrs for the beam. These values were then summed and the annual values of beam time in mA-hrs were calculated. See Table G-1 below. The curies per mA-hrs were plotted in Figure G-1 below.

Table G-1: Compiled Annual Beam Current Data for LANSCE

Year	mA-hrs (from log books)	Annual Activity in Curies (from OSR Database)	Curies per mA-hr
1974		1.00E-08	
1975		1.00E-08	
1976	202.66	6.06E+03	2.99E+01
1977	702.27	4.79E+04	6.82E+01
1978	1,259.80	1.17E+05	9.29E+01
1979	1,834.57	1.19E+05	6.49E+01
1980	2,180.00	1.46E+05	6.70E+01
1981	1,010.79	3.53E+05	3.49E+02
1982	2,151.52	2.51E+05	1.17E+02
1983	1,593.71	4.64E+05	2.91E+02
1984	2,420.37	7.37E+05	3.04E+02
1985	3,004.61	1.26E+05	4.19E+01
1986	2,600.06	1.12E+05	4.31E+01
1987	2,534.84	1.50E+05	5.92E+01
1988	1,929.32	1.21E+05	6.27E+01
1989	2,128.43	1.56E+05	7.33E+01
1990	1,966.90	5.00E+02	2.54E-01
1991	721.56	5.75E+04	7.97E+01
1992	744.83	7.19E+04	9.65E+01
1993		2.11E+02	
1994		5.04E+04	
1995		4.37E+04	
1996		1.14E+04	

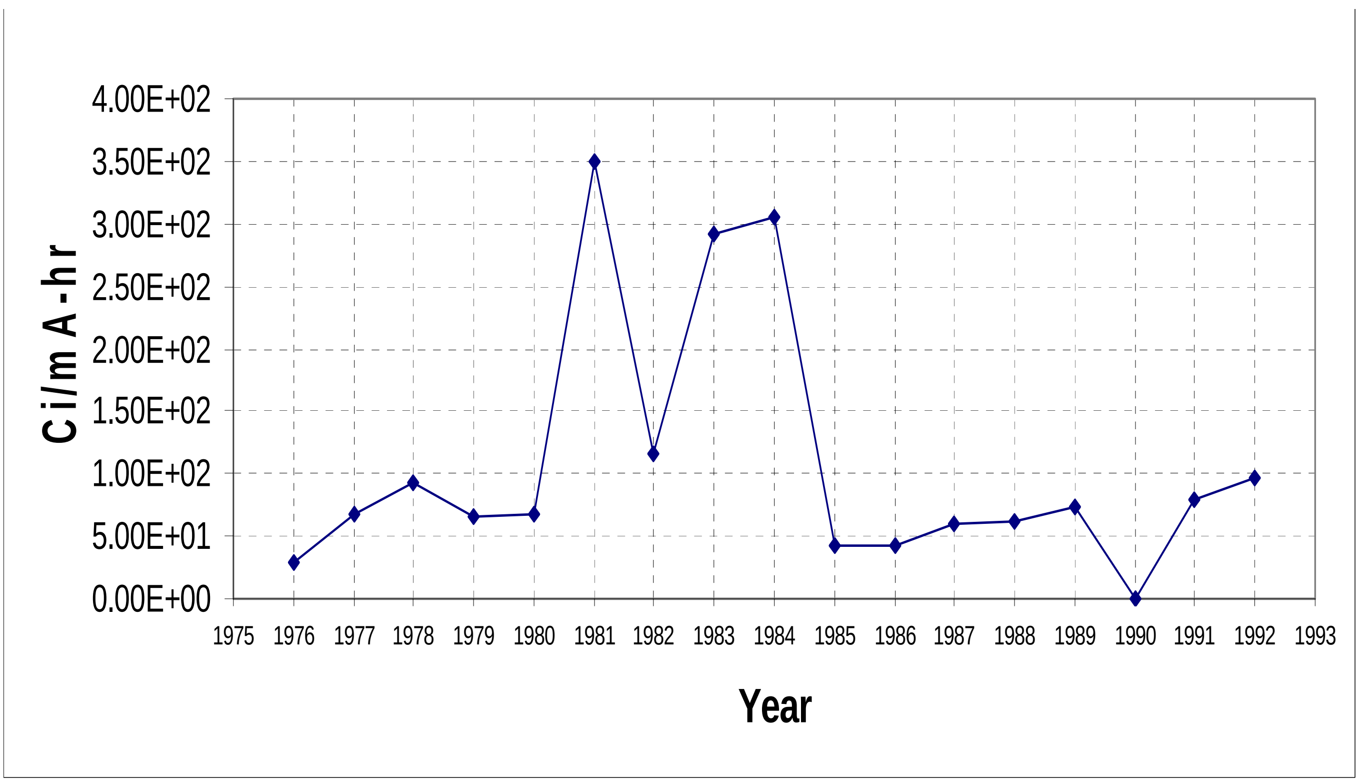

Figure G-1: Ci/mA-hr for LANSCE

There were some columns in the beam operation logs that were not used in these informal calculations since it was not known how to apply them. One column was for “Duty Factor” and two contained additional beam information “Beam Current 2” and “Beam Hours 2”. From verbal conversations with LANL employees it was found that the “Beam Current 2” and “Beam Hours 2” were used only when the beam was run at one current for a certain amount of time and then was run for a second amount of time at a different beam current. Since there were not many times this information was supplied it was ignored for this informal calculation. “Duty Factor” was explained as having something to do with the pulsed nature of the output used sometimes during the operation. Since it was not know how to apply a correction factor for “Duty Factor”, the column was not used.

In addition to point release estimates (i.e., exhaust stack releases) LANL began estimating non-point (diffuse) emissions in their annual release and dose estimates. Documents were found for 1993, 1995, 1996, and 1997. The estimates of diffuse releases were 1,418 curies, 716 curies, 221, curies, and 866 curies for the years listed respectively. These quantities are approximately less than 10% of the annual airborne release values as shown in Table G-1. The vast majority of these releases were estimated to be ^{11}C.

Repos. No. 1071 mentions that short-lived activation gases were not reported at LAMPF for the 1974 to 1978 time frame. One of the documents abstracted (Repos. No. 441) refers to a letter to the AEC concerning LAMPF airborne emission in 1970, so limited operations may also have occurred prior to 1972.

The TA-53 data suggest that there are at least four stacks for which data are available. These stack designations include: FE-3 (North Stack, also called main stack in 1981); FE-4 (South Stack); FE-16; and, FE-2. The FE-3 fan serviced the main accelerator tunnel, and was terminated in 1980. The FE-4 fan was added in 1977. FE-3 and FE-4 have reported emissions primarily of short-lived air activation products such as: ^{11}C, ^{13}N, ^{15}O, ^{41}Ar, and ^{7}Be. FE-2 services the WNR, and was added in 1981. FE-16 services TA-53-1 D-wing, with releases reported for other longer-lived radionuclides such as ^{7}Be.

Cooling water was released to floor drains that fed two 2,500-gallon carbon steel tanks. These tanks were discharged to the cooling water ponds (Repos. No. 503).

The magnitude of releases at LANSCE resulted in continuing studies to estimate the off-site impact. One such study was LA-11150-MS, which documented the releases and modeling of the releases for 1985 (Repos. No. 2145).

Laboratory measurements have been found for lagoon and cooling pond waters, and for long-lived activity that can be collected on filtering media. The short-lived MAP was assessed with on-line monitoring and through TLDs located at various locations.

Repos. No. 1556 (not yet released by LANL) discusses the diffuse releases from LAMPF for 1990, which were 0.21 curies, a small fraction of the 120,000 curies of short-lived gases that were reported. The diffuse emissions were comprised of longer lived nuclides, (since the diffuse emissions are completely unfiltered) and a comparison of curies alone might be misleading, but the magnitude of diffuse emissions is clearly less significant than that of the primary release points.

The LANL assessment of the impact of radioactive releases from TA-53 has changed in many ways over the years. Prior to 1991, the site assessed the releases taking credit for estimated occupancy and the inherent shielding provided by residences. In 1992, LANL was told by the USEPA that no credit should be taken for shielding and residency time factors

(LAHDRA Repository No. 713). This resulted in a changed methodology for reporting impacts from the releases. Care should be taken when comparing LANL reported impacts from TA-53 during different operating periods.

Conclusions Regarding LANSCE Operations

LANSCE is an important major scientific system at LANL. Its operation is important to scientists and researchers from LANL and visiting organizations. Since its inception, LANSCE has been one of the major contributors to airborne releases to the environment. Fortunately, the radionuclides released are short-lived gases or trace amounts of particulates from diffuse emissions. Future iterations that are attempting to create an accurate source term for LANSCE should concentrate on applying the additional beam time corrections, applying the duty factor corrections, locating early operation info (cycle 1 and 2), and ensuring that the curie quantities in the OSR Database are complete and accurate so that Ci/mA-hrs can be calculated accurately for LANSCE.

Appendix H: Key Operational Areas– the LANL Health Division

Although the Health Division at LANL was responsible for monitoring worker health, instances of overexposure to chemicals, explosives and radionuclides in the workplace could indicate a routine or accidental release of materials to the environment as a result or failed containment or increased ventilation as a solution for reducing worker exposure.

The project team has located and reviewed over 150 Health Group (later Division) Progress Reports in the repositories at Los Alamos National Laboratory. The reports were produced on a monthly basis, although several annual and quarterly reports from the Health Division have also been identified. The oldest report is a Health Report dated November 1943, and the most recent report located to date was published in October 1960. No reports for the years 1945 and 1946 have been located to date. However, a document titled “History of the Health Group”, March 1943-November 1945 was identified that included operational information for that period.

History of H-Division

According to the report titled “History of the Health Group” (Hemplemann 1945; Repos. No. 978), a directive from Mr. Oppenheimer, dated November 13, 1943, stated that the medical supervision of technical personnel was to be directed primarily at protection of persons from the hazards of the project. The primary function of the Health Group (A-6) was to establish safe tolerance levels, develop monitoring methods, and to ensure that tolerance levels weren’t exceeded. Routine monitoring procedures were turned over to the group concerned whenever possible (e.g., CM-1).

The original policy of the Health Group was to depend entirely on information gained from health research groups elsewhere. Because that policy did not always provide the proper data in time to establish safe operating procedures, research sections were set up within the Health Group (e.g., instrumentation and biological methods of testing for overexposure) (Hemplemann 1945; Repos. No. 978). For example, approximately half of the 25 to 30 page monthly reports describe various areas of research and papers published on the health effects of radiation by H-4, Radiobiology, and instrument development and performance work conducted by the electronic and biophysics sections of Radiologic Safety, H-1. Accidents are reported in the Occupational Safety group (H-3) section of the division reports.

On June 1, 1947 the Health Group became the Health Division (Hemplemann 1947; Repos. No. 2202). L. H. Hemplemann, MD, was the Division Leader from 1943 until the end of 1948, when T. L. Shipman, MD, took over (Repos. No. 2270). In 1943 the Health Group consisted of 10 people (Hemplemann 1945; Repos. No. 978). In 1949, there were 97 members of H-Division (Repos. No. 2266), and in 1951, there were 158 (Repos. No. 2287).

Documentation of H-Division Activities

The reports of the Health Group are called Health Reports, and the Division reports are called H-Division Progress Reports. The Health Reports are organized in three sections: radiation problems, chemical hazards, and general safety. The monthly progress reports are generally presented in four to seven parts, describing the activities of the four to six numbered groups and the Administration Group that operate within the Health Division:

- H-1 Administrative and Medical Records later became Radiologic Safety; H-Division administrative activities were reported separately but not given an H number; Radiologic Safety included monitoring, electronics, and biophysics sections,

- H-2 Occupational Health included health physics (same functions as the old Health Group), industrial hygiene, and occupational biochemistry sections; later when Radiologic Safety became a separate group called H-1, Occupational Medical was created to maintain responsibility for general clinical functions such as physicals and first aid,

- H-3 Training of Military personnel (animal research) and Medical staff (LANL employee care) later became Occupational Safety and the training function was merged into H-Division Administration,

- H-4 Radiobiology conducted research on clinical aspects of exposure to chemicals and radionuclides including monitoring programs and instrumentation,

- H-5 Industrial Hygiene and Occupational Biochemistry sections were split off from H-2 and formed this group in June 1949,

- H-6 Monitoring (CMR-12) was merged into H-1 and then became Radiologic Physics, including the old Biophysics group (now called Special Problems) and the Meteorology section.

Constructed during 1952-54, the Health Research Laboratory at TA-43 is adjacent to the Los Alamos Medical Center in the townsite. Research performed at this site has included structural, molecular, and cellular radiobiology, biophysics, mammalian radiobiology, mammalian metabolism, biochemistry, and genetics. The Department of Energy Los Alamos Area Office is also located within TA-43.

Health Division Perceptions of Hazards at Los Alamos National Laboratory

In 1943, the hazards of the project were reported to be limited to external radiation from the cyclotron, the Van de Graf, the D-D source and the radium sources. There were also hazards due to uranium and the usual chemical laboratory hazards, but these were not serious, according to Hemplemann (1945). Only one accident occurred during the first year that involved overexposure to radiation from the cyclotron. The main concern of the Health Group at this time was the interpretation of blood counts on exposed personnel. Normal variation in blood counts was not well known at the time (Hemplemann 1945; Repos. No. 978).

In February 1944, plutonium arrived at LANL in significant quantities. The members of Chemistry and Metallurgy (CM) Division and the Health Group became concerned about the dangers of working with this material. Control of alpha radioactive materials worked out well for the first year. After an accident in August 1944 where a milligram of plutonium blew up in someone’s face, a research program to develop tests for detecting overexposure of personnel with plutonium began. A urine test was developed in January 1945; it required a new (free of alpha contamination) laboratory (ML Building). Following the first human tracer experiment in April 1945, results of the urine tests were evaluated with some certainty. Until the urine test was perfected, nose counts were the only index of personnel exposure. Due to the difficult and time consuming nature of the urine test, the most heavily exposed persons as indicated by nose counts had the most urine examinations. Available alpha monitoring equipment lacked either sensitivity or portability, so swipe samples were used to detect contamination of hands and nostrils. A proportional counter using a methane-filled thin windowed tube was developed by D. Froman and R. Watts at LANL and installed in the D-Building washroom as a hand counter in June 1944 (Hemplemann 1945; Repos. No. 978).

In September 1944, the CM-1 group was reorganized and many members of the monitoring and decontamination section were transferred to A-6, the Health Group. The new structure did not lead to cooperation between the two groups and in January 1945, one group, HI (CM-12), was given full responsibility for the entire alpha contamination problem in the CM Division. At this time it was necessary to redesign the existing facilities in D Building in order to safely handle the large amounts of plutonium in that laboratory. The facilities were adequate with one exception. In July 1945, CM-5 handled amounts of plutonium that exceeded the capacity of its safety equipment and four persons exceeded the safe amount of one microgram of plutonium in their bodies according to urine tests.

According to Hemplemann (1945), polonium was never the hazard that plutonium was. Less radioactivity, an easy urine test method, and relatively simple technical operations resulted in polonium never being a serious hazard. Only two persons ever exceeded the tolerance limit for polonium (1500 cpm in a 24-hr urine sample).

The initial external radiation hazard at LANL did not change until September 1944 when the water boiler at Omega Site went into operation. Later when the power boiler went into operation (January 1945) there were several instances of overexposure when the exhaust line developed leaks. There was also an accident that resulted in serious exposure to several chemists during decontamination of the active material. There were two serious accidents that resulted from critical assembly work, also at Omega, one that overexposed four individuals to gamma and neutron radiation, and one fatality (Hemplemann 1945; Repos. No. 978).

During the radioactive barium and lanthanum (RaLa) implosion tests that started in September 1944, members of the chemistry group CM-4 received periodic overexposures to beta radiation (Repos. Nos. 978, 2207, 2261, 2268).

According to Hemplemann (1945), the toxicity and accepted methods for prevention of toxicity from exposure to high explosives were obvious. In certain cases, safe operational procedures were delayed by inadequacies in construction of exhaust systems, washrooms, etc., but no serious trouble was encountered between March 1943 and October 1945.

Although monthly H-Division reports from 1947 forward repeatedly mention the hazards of beryllium (Repos. Nos. 2202, 2262, 2270) there is no mention of beryllium in Hemplemann (1945).

Table H-1 presents a summary of materials of concern in terms of potential health hazard, based on review of H-Division reports.

Table H-1: Materials of Concern from H-Division Reports

Material of Concern (Location of Concern)	Examples of H-Division Reports (Project Repository No.)
Arsine	2275, 2392
Benzol (DP West)	2259, 2266, 2267
Beryllium (V Shop, Sigma, R-Site, CMR)	2202, 2433, 2434, 2258, 2259, 2262, 2300, 2224, 2392
Fluorides (D Building)	2266
Lithium (Sigma, K)	2270, 2275, 2300, 2301, 2298
Mercury spills (Omega Site, U-14, K bldg)	2433, 2434, 2211, 2259, 2298
Polynuclear Aromatic Hydocarbons (scintillation fluids)	2209, 2270, 2275, 2216
Impurities in RaLa source (Bayo)	2207, 2261, 2262, 2263, 2267, 2268, 2301
Trichloroethylene (TU, Sandia, Omega, S-Site)	2259, 2260, 2265, 2267, 2201
TNT (S-Site)	2257, 2433, 2434, 2258, 2260, 2264, 2201
Thorium	2287, 2383
Uranium (TU, Sigma, HT)	2257, 2211, 2263, 2216, 2224

Incidents Documented in H-Division Reports

Following are examples of the type of information contained in the monthly H-Division progress reports. These examples come from reports covering a time period of approximately the mid-1950s to the mid-1960s.

Examples of chronic issues or problems:

- Liquid waste management problems at Ten Site (TA-35) for the liquid waste streams generated by the RaLa program. Problems with plant capacity and equipment lead to several unplanned discharges of large volumes of radiostrontium-bearing wastes to Mortandad Canyon.

- Leakage around improperly installed filtration units site-wide. For example, a report issued on the release of alpha activity from DP West stacks in 1955 states "definitely that the CWS-6 filters are poorly installed and consistently leak contaminated air around the edges of the filters" [Repos. No. 2379]. In 1964, in-place DOP-testing of the filters on top of DP West Building 4 showed their efficiency to be "approximately 15%" [Repos. No. 2507].

- Glove box explosions and fires at DP Site, DP West in particular.

- Emissions of TNT dust from facilities at S-site (TA-16).

- Beryllium contamination of soil at R-site (TA-15). The magnitude of the contamination and the potential for resuspension prompted remediation activities on several occasions.

- Unsatisfactory media and methods for sampling airborne effluent streams for radioiodines (low and unpredictable collection efficiencies). This was a particular problem for quantifying radioiodine releases from Wing 9 of the CMR Building, but it was also an issue at Omega Site and DP West.

- Lack of suitable instrumentation and methods for monitoring airborne effluents from the Omega Stack, and corresponding uncertainty in assessments of exposure to residents of the old trailer court area.

- Lack of appropriate monitoring instrumentation was also a chronic issue at Ten Site, where stack effluents during RaLa runs often could not be assayed due to excessive radioactivity.

- Failures of containment mechanisms for samples being irradiated in the Omega West Reactor. For example, such a failure on August 7, 1961 resulted in contamination being found on cars in the parking lot and in other areas around the building [Repos. No. 2524]. On December 23, 1963 a rather large “sample” was irradiated in the reactor’s vertical port and had to be removed through the roof of the building. The sample was then drug down the road to its storage location. Afterward, the roof of the building and the road read 50 mR/hr and 20 mR/hr, respectively, from contamination by Sb-122 and Sb-124 [Repos. No. 2812].

- Soil and groundwater contamination downstream from the TA-35, TA-45, and (in later years) TA-50 liquid waste outfalls.

<u>Specific examples of contamination being spread to private property:</u>

- A contamination incident at the Water Boiler on August 16, 1950 resulted in contamination being spread to a private home [Repos. No. 2219].

- In 1961 a Cs-137 contamination incident at TA-48 resulted in contamination being tracked off site by workers. Twenty eight homes and forty seven vehicles had to be surveyed for contamination [Repos. No. 2521].

- Sr-90 contamination was spread to a worker’s vehicle on June 2, 1961 from a spill at the H-7 waste treatment laboratory [Repos. No. 2522].

<u>Specific examples of episodic events and sources of fugitive and unmonitored emissions:</u>

- Dust from the demolition of contaminated buildings in the former Tech. Area (TA-1), e.g., Buildings CM, D, HT, J-2, M, ML, and N. Debris from these demolition projects was often burned at the contaminated dump site.

- In 1956, glass vials containing tritium gas were disposed of at Beta Site (TA-5) by placing ten at a time in a barrel and dropping a weight on them. At one point a tritium concentration of 15,000 $\mu Ci/m^3$ was measured at a distance of 100 feet from the barrel.

- Unintentional releases of tritium from Building TA-33-86 required the site to be evacuated and access restricted by road blocks on multiple occasions (e.g., see Rep. Nos. 2422 and 2425).

- A nuclear criticality accident at DP West (Building 2) on December 30, 1958 killed one worker and exposed numerous others [Repos. No. 2512].

- A significant fire started in a plutonium-contaminated CWS filter at DP West Room 501 on July 15, 1959. Afterward, highly-contaminated ash was found both inside and outside the building [Repos. No. 2425]. Another fire occurred later that same year in the incinerator drybox exhaust system in DP West Room 313 on December 8, 1959. Buildup of residues allowed the fire to spread throughout the exhaust system. It is reported that the exhaust stack was red hot for a distance of about five feet above the roof of the building [Repos. No. 2494].

- In 1960, hydrogen sulfide emissions from Building TA-46-1 were high enough to generate complaints from workers about fumes being drawn back into the building through the intake air system [Repos. No. 2429].

References related to the LANL Health Division:

Health Group Reports (1943-44) and H-Division Progress Reports (1947-60). Repos. Nos. 2202-2434.

Hemplemann, L. H. 1945. “History of the Health Group, March 1943-November 1945”. Repos. No. 978.

Appendix I: Key Operational Areas– Environmental Monitoring

This section describes the project team's current understanding of environmental monitoring and research data that may be useful for dose reconstruction studies. The data reviewed thus far represents samples collected in both on-site and off-site areas potentially affected by past contaminant releases from Los Alamos National Laboratory operations.

Areas of Investigation

This investigation of available environmental monitoring and research data focuses on the primary environmental media likely to have been associated with Laboratory releases and contaminant exposures to off-site populations. The following section describes the geographical areas of interest during the investigation. These areas were selected for investigation based on:

- The LAHDRA project team knowledge of the key release sources at the Laboratory,
- Previous environmental studies of on-site and off-site areas,
- Surface waters that have been impacted by past LANL emissions,
- Reported areas of contaminant accumulation in surface water, sediment, and surface and subsurface soils,
- Annual airborne releases and effects from local and regional wind patterns and local and regional topography, and
- Historical environmental surveillance and monitoring and our preliminary review of environmental data availability.

Environmental monitoring within the laboratory boundary and surrounding areas began shortly after the start of Laboratory operations in 1943. Most of the early monitoring involved collection of non-routine air, water, soil, and sediment samples for radioactive analyses. The early environmental monitoring program was used to determine the spread of radioactive contamination to surrounding land areas and to estimate potential radiation exposures that might be occurring as a result of laboratory emissions. The monitoring program grew in size and scope as activities at the laboratory expanded. Increased monitoring over the years meant the collection of a larger number of routine samples for all types of media (air, water, soil) and for a growing list of contaminants. The frequencies for which samples were collected also increased over the years and with the advent of new environmental protection and compliance laws of the early 1970s, LASL saw the need to further increase their monitoring of the environmental conditions both on-site and off-site and enhance the format with which they reported measurement results. The need to do more monitoring was also brought to the LASL's attention by independent reviewers and experts (Parker, 1974).

Based on reports reviewed to date, most of the emphasis for environmental monitoring during the early years was placed on measuring radioactive constituents, however later on beginning in the late 1960s and 1970s some limited sampling was performed for lead, mercury, chromium, and beryllium. A review of early LASL's environmental monitoring of the surrounding areas (e.g., canyons) pointed out the need to increase sampling for all media and to perform radiochemical analyses for isotopic plutonium and specific fission products associated with fall-out from atmospheric weapon tests to better differentiate between global fallout and impacts from LASL (Parker, 1974).

Environmental monitoring of the laboratory and surrounding areas has been conducted primarily by the University of California-Los Alamos National Laboratory, the United States

Atomic Energy Agency and its successors, U.S. Geological Services, and in more recent years the State of New Mexico. From 1955 to 1970 the U.S.G.S. performed radiochemical and metal analyses of samples collected from supply wells, the Rio Grande River, local surface streams, and test monitoring wells.

This investigation is focusing on the availability of sampling and monitoring data for all media of interest including air (air samples and direct radiation), surface water, ground water, soil, sediments in surface water areas of interest, food sources, and biota in the surrounding mesa and canyon areas that have been impacted by historical LANL releases.

The areas of concern for the investigation of environmental data include:

- Los Alamos community
- Espanola community
- White Rock community
- Surrounding Native American Reservations
- Los Alamos Canyon
- DP Canyon
- Pueblo Canyon
- Acid Canyon
- Rio Grande River
- Mortandad Canyon
- Bayo Canyon
- Pajarito Canyon
- Sandia Canyon
- Guaje Canyon
- Area reservoirs

Conditions at LANL and Surrounding Areas

The laboratory site and adjacent communities are situated on the Pajarito Plateau that consists of a series of mesas separated by deep canyons cut by intermittent streams that trend south-eastward from an altitude of about 2400 meters at the Jemez Mountains to about 1800 meters at the eastern margin where they terminate above the Rio Grande Valley. The canyons and mesas areas are underlain by the Bandelier Tuff composed of ashfall and ashflow pumice and rhyolite tuff that form the surface of Pajarito Plateau. The volcanic ash was deposited in the Jemez Mountains to the west about 1.2 million years ago (LASL, 1980).

Surface waters are primarily intermittent streams that begin on the sides of the Jemez Mountains and supply base flow to the upper reaches of some canyons, but the amount is insufficient to maintain flow across the laboratory area before it is depleted by evaporation, transpiration, and infiltration. Runoff from heavy thunderstorms and heavy snowmelts reaches the Rio Grande several times a year. Effluents from the laboratory provided sufficient flow to maintain surface flow in the canyons up to 1.5 kilometers (LASL, 1980).

Groundwater occurs in three modes in the Los Alamos area: (1) water in shallow alluvium in the canyons, (2) perched water in basalt, and (3) the main aquifer of the Los Alamos area. Deposited alluvium in the canyons ranges in thickness from 1 to 30 meters and is quick permeable in contrast to the underlying volcanic tuff and sediments. This results in a shallow alluvial groundwater that moves down gradient in the alluvium and becomes depleted as it moves into the underlying volcanics. In lower Los Alamos and Pueblo Canyons, a small local body of perched water id formed in the basalts by water filtration. This water discharges in the Los Alamos Canyon west of the Rio Grande. The main aquifer capable of municipal water supply rises westward from the Rio Grande within the Tesuque

Formation into the lower part of the Puye Formation beneath the central and western part of the plateau. Depth to the aquifer decreases from 360 meters along the western margin of the Plateau to about 180 meters at the eastern margin. The water is under water table conditions in the western and central part of the plateau and under artesian conditions in the eastern part and along the Rio Grande (LASL, 1980).

Availability of Environmental Data

Much of the environmental monitoring results reported for years prior to 1970 and identified thus far by the project team are published in letter-type reports, and vary widely in content and detail. In some cases, only a portion of a report is available to date for review by the project team. Copies of full reports are preferred and are continually sought by the project team. While environmental monitoring during the early years generated a smaller amount of data when compared to last thirty years of monitoring, many of pre-1970 reports may not be available or will require more research to locate. The project team is focusing their efforts on gathering additional data for these early years and is in the process of organizing it into a format that can be useful in supporting prioritization of releases.

Summary of the Content of Annual Environmental Surveillance Reports

Beginning in 1970, as environmental monitoring increased beyond the sampling that was performed during prior years, Los Alamos Scientific Laboratory began to publish annual reports for environmental monitoring results based on sampling and analyses conducted by laboratory staff and the USGS. These reports contain monitoring results for a variety of environmental sample types, including:

- direct radiation readings for alpha, beta, and gamma radiation,
- outdoor/external thermoluminescent dosimeters (TLDs),
- surface water including drainage ditches, creeks, ponds, rivers, and lakes,
- ground water,
- particulate and gaseous air sampling,
- soil and sediment sampling,
- food sources,
- assorted biota and wildlife, and
- special environmental sampling and research studies.

During this period, environmental samples were collected and analyzed by the Laboratory's Environmental Services Group. Large amounts of environmental samples were collected and analyzed for both radionuclides and chemicals. Table I-1 presents a summary of chemical and radionuclide monitoring data that are available in the annual environmental surveillance reports. Monitoring data summarized in Table I-1 represents chemical and radionuclide concentrations in various environmental media such as ^{239}Pu in air.

Table I-1: Data Availability - LANL Annual Environmental Surveillance Reports (1971 - 1999) (*page 1*)

Sampling	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Airborne releases- rad.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Airborne releases- chem.											•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Air- gross alpha	•	•	•	•	•	•	•	•	•	•	•	•	•									•	•	•	•	•	•	•	•
Air- gross beta	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Air- ^{241}Am			•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Air- ^{238}Pu	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Air- ^{239}Pu	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Air- ^{234}U	•	•																				•	•	•	•	•	•	•	•
Air- ^{235}U	•	•																				•	•	•	•	•	•	•	•
Air- ^{238}U	•	•																				•	•	•	•	•	•	•	•
Air- total U	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Air- ^{131}I	•	•														•						•	•	•	•				
Air- ^{41}Ar		•																											
Air- ^{3}H	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Air- beryllium	•	•																				•	•	•	•	•	•	•	•
Air- lead	•	•																											
Air- cadmium	•	•																											
Air stations (#)	58	35	36	26	26	29	30	25	25	25	25	25	26	26	26	26	26	25	27	28	36	36	52	52	52	52	52	52	52
Fish- ^{238}Pu					•				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Fish- ^{239}Pu					•				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Fish- ^{137}Cs					•				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Fish- ^{90}Sr												•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•
Fish- uranium									•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Fruits- ^{238}Pu					•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Fruits- ^{239}Pu					•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Fruits- ^{137}Cs																•	•	•		•	•	•	•	•	•	•	•	•	•
Fruits- ^{90}Sr									•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•
Fruits- tritium						•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Fruits- uranium					•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Groundwater- Rad.			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Groundwater- Chem.				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Liquid releases- Rad.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Liquid releases- Chem.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Meteorological data[a]	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Milk- Rad.					•	•																					•	•	•
Municipal liq. discharge	•	•	•	•	•	•																							
Sediment- gross alpha	•	•	•	•	•	•	•	•	•	•	•	•									•	•	•	•	•	•	•	•	•
Sediment- gross beta	•	•	•	•	•	•	•	•	•	•	•	•									•	•	•	•	•	•	•	•	•
Sediment- gross gamma													•	•	•	•	•				•	•	•	•	•	•	•	•	•
Sediment- ^{238}Pu	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Sediment- ^{239}Pu	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Sediment- ^{241}Am	•																				•	•	•	•	•	•	•	•	•
Sediment- ^{137}Cs	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Sediment- ^{90}Sr						•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•
Sediment- tritium	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Sediment- uranium	•	•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Table I-2: Data Availability - LANL Annual Environmental Surveillance Reports (1971 - 1999) (*page 2*)

Sampling	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Soil- gross alpha	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•
Soil- gross beta	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•
Soil- gross gamma													•	•	•	•	•				•	•	•	•	•	•	•	•	•
Soil- ^{238}Pu	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Soil- ^{239}Pu	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Soil- ^{241}Am	•																				•	•	•	•	•	•	•	•	•
Soil- ^{137}Cs	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Soil- ^{90}Sr						•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•
Soil- tritium	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Soil- total uranium		•			•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•
Surface water- alpha	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•					•	•	•	•	•	•	•	•
Surface water- beta	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•					•	•	•	•	•	•	•	•
Surface water- gamma													•	•	•						•	•	•	•	•	•	•	•	•
Surface water- ^{241}Am			•	•	•	•	•					•	•	•	•							•	•	•	•	•	•	•	•
Surface water- ^{238}Pu	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Surface water- ^{239}Pu	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Surface water- ^{137}Cs	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Surface water- ^{90}Sr						•				•	•	•	•	•	•						•	•	•	•	•	•	•	•	•
Surface water- tritium	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Surface water- uranium	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Surface water- beryllium	•	•																											
Surface water- cadmium	•	•																											
Surface water- lead	•	•																											
Surface water- mercury	•	•																											
Surface water- chemical	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Vegetables- ^{238}Pu					•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Vegetables- ^{239}Pu					•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Vegetables- ^{137}Cs												•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•
Vegetables- ^{90}Sr									•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•
Vegetables- uranium					•	•	•	•	•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Vegetables- tritium					•	•	•	•	•										•	•	•	•	•	•	•	•	•	•	•
Vegetation- plutonium			•																										
Water (potable)- Rad.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Water (potable)- Chem.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Soild Waste Disposal		•																											
TLD's (onsite/offsite)	58	59	65	22	44	48	50	55	50	61	152	155	155	155	155	155	155	155	155	151	151	151	166	166	166	166	166	95	97
Radiation Dose Ass.			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Special Studies	•	•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Honey bees- Rad.	•	•	•									•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Unplanned releases				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Data contained in the annual reports represent samples routinely collected in air, surface water, ground water, soils, sediments, a variety of biota, and some food sources. The laboratory did not perform any measurements of food sources until the later part of the 1970s. The annual reports also contain information about special studies conducted to provide better coverage of areas of particular interest or to study in detail individual sources of contamination. For example, a study of radionuclide uptake in garden plants grown in the Mortandad Canyon was initiated in 1976 and reported in the Environmental Surveillance at Los Alamos During 1977 report (LASL, 1978). Additional descriptions of the types of monitoring data contained in the annual reports are presented below.

Presented below is a list of the LASL/LANL Annual Environmental Surveillance reports reviewed as the basis for Table I-1, and that are being further evaluated and drawn upon to assemble potentially useful information that could support dose assessment studies.

Examples of Environmental Studies of Interest

This section presents various environmental monitoring and research data that describe the historical presence and behavior of contaminants in off-site areas associated with the LANL. Media addressed include surface water, sediment, ambient air, aquatic and terrestrial foodstuffs, soil, drinking water, and groundwater. Hydrologic and meteorological data are also presented below. Descriptions of additional studies will be added to this section as more information becomes available to the project team.

<u>Historical Surface Water and Sediment Data</u>

Sample of available surface water and sediment monitoring data collected in areas of concern described in the above section are presented below. Due to large volumes of data, not all of the available data have been summarized for this report.

Study #1: Radioactivity in Los Alamos and Pueblo Creek (1945-1947)-- Some of the earliest measurement results for samples collected from wastewaters released from the Technical Area into Pueblo and Los Alamos Canyons are reported. Samples were collected at various points along the creeks and terminated at the Rio Grande River about 0.25 miles downstream of Otowi Bridge (Tribby, 1945; Tribby, 1947). The samples were the analyzed for plutonium and polonium. A detection limit of 20 disintegrations per minute per liter of creek water was reported at that time. One-liter samples were collected at each location and submitted to counting laboratory for analyses.

Study #2: Radioactivity in Los Alamos and Pueblo Creek (1947-1949)-- Samples were collected at various points along streams inside Los Alamos and Pueblo Canyons and analyzed for plutonium, uranium, polonium, and gross beta/gamma (Schnap et al., 1948; Schnap, 1950).

Annual Environmental Monitoring and Surveillance Reports

Starting in 1970, LASL began publishing annual reports that describe annual environmental monitoring results of media sampled both on-site and off-site at the laboratory. The data contained in these reports represent a wide range of sample types and sampling frequencies and to a more or lesser extent vary according to priorities and emphasis placed on monitoring and surveillance during a given year. Annual reports available for review during this and any future health studies are listed below.

- Los Alamos Environmental Monitoring Program; July - December 1970
- Environmental Monitoring in the Vicinity of the Los Alamos Scientific Laboratory; January - June 1971
- Environmental Monitoring in the Vicinity of the Los Alamos Scientific Laboratory; July - December 1971
- Environmental Monitoring in the Vicinity of the Los Alamos Scientific Laboratory; Calendar Year 1972
- Environmental Surveillance at Los Alamos During 1973
- Environmental Surveillance at Los Alamos During 1974
- Environmental Surveillance at Los Alamos During 1975
- Environmental Surveillance at Los Alamos During 1976
- Environmental Surveillance at Los Alamos During 1977
- Environmental Surveillance at Los Alamos During 1978
- Environmental Surveillance at Los Alamos During 1979
- Environmental Surveillance at Los Alamos During 1980
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- Environmental Surveillance at Los Alamos During 1991
- Environmental Surveillance at Los Alamos During 1992
- Environmental Surveillance at Los Alamos During 1993
- Environmental Surveillance at Los Alamos During 1994
- Environmental Surveillance at Los Alamos During 1995
- Environmental Surveillance at Los Alamos During 1996
- Environmental Surveillance at Los Alamos During 1997
- Environmental Surveillance at Los Alamos During 1998
- Environmental Surveillance at Los Alamos During 1999

Study #4: Radioactivity in Rio Grande River (1957–1958)-- During 1957, the U.S. Geological Survey collected water samples from the Rio Grande River. Monthly samples were analyzed for gross alpha, plutonium, and uranium, and gross beta. Samples were collected at stations Embudo, Chama, Otowi, and Cochiti (Abrahams, 1958a; Abrahams, 1958b).

Study #5: Radioactivity, Chromate, and Zinc in DP, Los Alamos, Pueblo, Mortandad, and Sandia Canyons (1969-1970)-- During 1969 and 1970, LASL (H-8 Group) reported measured radioactivity levels for surface water samples collected from streams located in DP, Los Alamos, Pueblo, Mortandad, and Sandia Canyons. Monthly and quarterly samples were analyzed for gross alpha, gross beta, plutonium-238, plutonium-239, americium, strontium, cesium, tritium, and uranium (Kennedy, 1971). A limited number of samples were also analyzed for hexavalent chromium and zinc.

Study #6: Plutonium in Pueblo and Acid Canyons (1970)-- Sediment samples collected along Pueblo Canyon drainage basin show a decreasing trend in plutonium levels as a function of distance from LANL discharge points (Hanson, 1973). Based on a limited number of samples the following plutonium concentrations in sediment are reported:

- 27 pCi/g in lower Acid Canyon
- 4.6 pCi/g in Pueblo Canyon one mile below Acid Canyon
- 1.1 pCi/g in Pueblo Canyon two miles below Acid Canyon
- 1.1 pCi/g in Pueblo Canyon 0.1 mile above junction with Los Alamos Canyon

Detailed survey results are reported in document LA-4561, and will be reviewed by the project team for the next version of this report. The reported estimate of plutonium releases from TA-1 and TA-45 to Pueblo Canyon from 1944 to 1964 is 170 millicuries (Hanson, 1973). Plutonium measured in surface water samples collected in Acid and Pueblo Canyons averaged 20 pCi/L during this period, compared to 1.5 and 0.22 pCi/L in Mortandad and Los Alamos Canyons, respectively.

Study #7: Radioactivity in Bayo Canyon (1977)-- During 1977, LASL collected surface water samples from Bayo Canyon. Radiochemical analysis of samples showed that residual ^{90}Sr concentrations in soil averaged for the time period was 1.4 pCi/g (LASL, 1978b).

Historical Soil Monitoring Data

Samples of available soil monitoring data collected in areas of concern described in the above section are presented below.

Study #1: Radioactivity in Los Alamos Canyon (1947)-- Soil samples were collected along the canyon walls and at various locations along the canyon floor and analyzed for plutonium, polonium, uranium, other unspecified radionuclides, fluorine, and unspecified toxic metals (Tribby, 1947). The available copy of this memo report reviewed by the project team appears to contain limited data for these surveys and/or is missing some of the sample results and warrants further research for data of this time period.

Study #2: Radioactivity in Los Alamos and Pueblo Creek (1947)-- Soil samples were collected at various points along streams inside Los Alamos and Pueblo Canyons and analyzed for plutonium, uranium, polonium, and gross beta/gamma (Schnap et al., 1948).

Study #7: Radioactivity in Bayo Canyon (1973-1977)-- During 1977, LASL collected soil samples from Bayo Canyon and analyzed them for radioactivity. Study results showed that residual ^{90}Sr concentrations in soil averaged 1.4 pCi/g (LASL, 1978b). Previously reported surveys cited in this report include measured soil concentration results for gross alpha, gross beta, cesium, plutonium, and uranium.

Historical External Radiation Monitoring Data

Samples of available external radiation monitoring data collected in areas of concern described in the above section are presented below.

Study #1: Direct Radiation Readings in Los Alamos Canyon (1947)-- Direct radiation measurements with a Geiger Mueller survey meter were collected throughout Los Alamos Canyon as some of the first reported measurements of this type. The discharge line, canyon walls directly below the wastewater discharge point, and the canyon floor exhibited the highest readings up to 20,000 counts per minute of alpha radiation (Tribby, 1947).

Study #8: Radiation Levels in Mortandad Canyon (1952)-- In 1952, LASL scientist conducted a series of radiation surveys throughout Mortandad Canyon and concluded that subsequent rainfalls enhanced the migration of measurable radioactive contamination several miles downstream in the canyon (Aeby, 1952). Results are reported in units of mr/hour. The report provides a concentration and volume of radioactive material released to the canyon. Specific isotopes are not stated in the memo report.

Study #7: Radioactivity in Bayo Canyon (1973-1977)-- Direct radiation measurements throughout Bayo canyon were taken with ion chambers and germanium detectors (LASL, 1978b).

Historical Ambient Air Monitoring Data

Samples of available ambient air monitoring data (including meteorological) collected in areas of concern described in the above section are presented below.

Study #9: LANL Meteorological Data (1956 to 1971)— Measured wind, temperature, pressure, humidity, and precipitation collected at various locations throughout the Los Alamos and surrounding areas are presented (LANL, 1976).

Study #10: Beta/Gamma Concentrations at LANL (1961)-- Airborne radioactive particulate samples collected on filter paper are reported for an air sampler located on the roof of the Administration Building SM-43. Air samples were collected every 24 hours and 72 hours over weekends (LASL, 1961). Report contains sampling results for the first quarter, 1961.

Historical Groundwater/Water Supplies Monitoring Data

Samples of available groundwater monitoring data collected in areas of concern described in the above section are presented below.

Study #4: Radioactivity in Los Alamos, Pueblo, and Guaje Canyons (1957-1958)-- During 1958, groundwater, water supplies, and springs located in the Los Alamos area and in Los Alamos, Pueblo, and Guaje Canyons were sampled by the U.S. Geological Survey. The samples were analyzed for pH, gross alpha, plutonium, uranium, gross beta, total hardness, potassium, sulfur, calcium, magnesium, sodium, chloride, fluoride, total solids, NO_3, and conductivity (Abrahams, 1958a; Abrahams, 1958b).

Study # 11: Radioactivity and Other Constituents in U.S. Geological Water Samples (1960)-- During 1960, groundwater and water supplies were sampled by the U.S. Geological Survey. The samples were analyzed for pH, gross alpha, plutonium, uranium, gross beta, total hardness, calcium, magnesium, sodium, chloride, fluoride, total solids, and conductivity (USGS, 1961).

Study #5: Chromate and Zink in Sandia Canyon (1969-1970)-- During 1969 and 1970, LASL (H-8 Group) reported hexavalent chromium and zinc levels in groundwater samples collected from monitoring wells located in Sandia Canyon (Kennedy, 1971).

References for Environmental Data

Abrahams J.H., 1958a. Quarterly Progress Report on Work at Los Alamos, New Mexico; U.S. Geological Survey, February – December 1957. Repos. No. 768.

Abrahams J.H., 1958b. Quarterly Progress Report on Work at Los Alamos, New Mexico; U.S. Geological Survey, January – March 1958. Repos. No. 768.

Aeby, 1952. Monitoring in Mortandad Canyon. October 28, 1952. Repos. No. 277.

Hanson W.C., 1973. Plutonium-239 Concentrations in Acid-Pueblo Canyons. Memo H8-73-207. Repos. No. 272.

Kennedy 1971. Second quarter Radiochemical and Chemical Analyses for Water Samples Collected During the Period September 1969 through December 1970. Repos. No. 764.

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LASL, 1961. Beta-Gamma Radioactivity in Environmental Air at Los Alamos, 1st quarter, 1961. Repos. No. 614.

LASL, 1971. Los Alamos Scientific Laboratory of the University of California. “Environmental Monitoring Program – July through December 1970.” Report LA-4672-MS.

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Appendix J: Listing of Airborne Release Points

Table J-1: Listing of LANL Stacks

Tech. Area	Stack/Vent Designation	Location	Areas Exhausted	Type of Material	Flow Information	Remarks
	E-4	Original Sigma Building (?)				assumed original Sigma Bldg. based on date (1956)
1	Tuballoy Shop Stack					Assumed TA-1 for now - could be TA-3
2	Omega Stack (Mast)	TA-2-9, on South Mesa, South-Southwest of TA-2	TA-2-1, OWR and Water Boiler (OER)	Ar-41, mixed fission products (radiogases in particular: Xe-133, Xe-135 et al.)	845 cfm in 1969. 880 cfm in 1973. Gross volume for 1977 was 1.300E+07 m3.	
2	Water boiler recombiner blower stack			noble gases, Ar-41, Cs-138	180 cfm in 1970.	stack is 4" in diameter.
2	Water boiler valve-house stack			noble gases, Ar-41, Cs-138	0.4 cfm in 1970.	Flow originates from a 3/8" copper tube.
3		TA-3-16	Van de Graaff (P-9)	tritium	0.25 cfm in 1969.	vertical Van de Graaff
3	FE-H-2, became FE-16 circa. 1983.	TA-3-16	Van de Graaff (P-9)	tritium		it appears this is a new or additional stack added for the Van de Graaff in 1975.
3	FE-H-1, became FE-14 circa. 1983.	TA-3-16	Van de Graaff (P-9)	tritium		added in 1981.
3	FE-9	TA-3-16	Van de Graaff (P-9)	tritium		added in 1985.
3	2 FLMX-1 (FE-15)	TA-3-29 (CMR Building)	south half of Wing 2	Pu-238, Pu-239, U-233, U-235, U-238, Np-237, Th-nat., Am-241 (1967 through 1969)	38,800 cfm in 1970.	

3	2 FLMX-2 (FE-14)	TA-3-29 (CMR Building)	north half of Wing 2	Pu-238, Pu-239, U-233, U-235, U-238, Np-237, Th-nat., Am-241 (1967 through 1969)	50,000 cfm in 1970.	
3	3 FLMX-1 (FE-19)	TA-3-29 (CMR Building)	south half of Wing 3	Pu-238, Pu-239, U-233, U-235, U-238, Am-241 (1967 through 1969); Pu-238 and Pu-239 (1975)	40,000 cfm in 1970.	
3	3 FLMX-2 (FE-20)	TA-3-29 (CMR Building)	north half of Wing 3	Pu-239, U-233, U-235, U-238, Am-241 (1967 through 1969)	34,400 cfm in 1970.	
3	4 FLMX-1 (FE-23)	TA-3-29 (CMR Building)	north half of Wing 4	U-233, U-235, U-238 (1967 through 1969)	49,700 cfm in 1970.	
3	4 FLMX-2 (FE-24)	TA-3-29 (CMR Building)	south half of Wing 4	Pu-238, Pu-239, U-233, U-235, U-238, Np-237, Th-nat., Am-241, tritium (1967 through 1969)	35,150 cfm in 1970.	
3	5 FLMX-1 (FE-29)	TA-3-29 (CMR Building)	north half of Wing 5	Pu-239, U-235, U-238, Np-237, Th-nat., Am-241, tritium (1967 through 1969)	39,430 cfm in 1970.	
3	5 FLMX-2 (FE-28)	TA-3-29 (CMR Building)	south half of Wing 5	Pu-238, Pu-239, U-235, U-238, Th-nat., Am-241 (1967 through 1969)	36,800 cfm in 1970.	
3	7 FLMX-1 (FE-32)	TA-3-29 (CMR Building)	south half of Wing 7	Pu-239, U-235, Pu-241 (1967 through 1969)	33,100 cfm in 1970.	
3	7 FLMX-2 (FE-33)	TA-3-29 (CMR Building)	north half of Wing 7	Pu-238, Pu-239, U-235, Th-nat., Am-241 (1967 through 1969)	31,400 cfm in 1970.	
3	Wing 9 Stack 1	TA-3-29 (CMR Building)	Wing 9 general area		47,420 cfm in 1970.	
3	Wing 9 Stack 2	TA-3-29 (CMR Building)	Wing 9 general area and hot cells		69,020 cfm in 1970.	
3	Wing 9 Stack 3	TA-3-29 (CMR Building)	Wing 9 room 9141 and general area		60,400 cfm in 1970.	
3	Wing 9 exhaust stack 2 charcoal filter	TA-3-29 (CMR Building)				
3	FE-44, FE-45, FE-46	TA-3-29 (CMR Building)	Wing 9	Pu-239, U-235 and fission products (including I-131) (1967 through 1969); Pu-239 (1975)	gross volume for 1975 was 26.26E+08 m3.	Same as Wing 9 Stack 1, Stack 2 and Stack 3; but unknown which is which at this time.

3	Wing 2 roof exhaust	TA-3-29 (CMR Building) Wing 2				Not the same as the "FLMX" exhaust.
3	Wing 3 roof exhaust	TA-3-29 (CMR Building) Wing 3				Not the same as the "FLMX" exhaust.
3	Wing 4 roof exhaust	TA-3-29 (CMR Building) Wing 4				Not the same as the "FLMX" exhaust.
3	Wing 5 roof exhaust	TA-3-29 (CMR Building) Wing 5				Not the same as the "FLMX" exhaust.
3	Wing 7 roof exhaust	TA-3-29 (CMR Building) Wing 7				Not the same as the "FLMX" exhaust.
3	FE-17	TA-3-29 (CMR Building) Wing 2	room air - Wing 2 south offices	Pu-238 and Pu-239 (1975)	gross volume for 1975 was 0.33E+08 m3.	added in 1975.
3	FE-18	TA-3-29 (CMR Building) Wing 2	room air - Wing 2 north offices	Pu-238 and Pu-239 (1975)	gross volume for 1975 was 0.64E+08 m3.	added in 1975.
3	FE-21	TA-3-29 (CMR Building) Wing 3	room air - Wing 3 south offices	Pu-238 and Pu-239 (1975)	gross volume for 1975 was 0.48E+08 m3.	added in 1975.
3	FE-22	TA-3-29 (CMR Building) Wing 3	room air - Wing 3 north offices	U-238 and U-235 (1975)	gross volume for 1975 was 0.39E+08 m3.	added in 1975.
3	FE-26	TA-3-29 (CMR Building) Wing 4	room air - Wing 4 north offices	U-238 and U-235 (1975)	gross volume for 1975 was 0.49E+08 m3.	added in 1975.
3	FE-27	TA-3-29 (CMR Building) Wing 4	room air - Wing 4 south offices	U-238 and U-235 (1975)	gross volume for 1975 was 0.37E+08 m3.	added in 1975.
3	FE-30	TA-3-29 (CMR Building) Wing 5	room air - Wing 5 north offices	Pu-238 and Pu-239 (1975)	gross volume for 1975 was 0.66E+08 m3.	added in 1975.
3	FE-31	TA-3-29 (CMR Building) Wing 5	room air - Wing 5 south offices	Pu-238 and Pu-239 (1975)	gross volume for 1975 was 0.64E+08 m3.	added in 1975.
3	FE-34	TA-3-29 (CMR Building) Wing 7	room air - Wing 7 south offices	Pu-238 and Pu-239 (1975)	gross volume for 1975 was 0.64E+08 m3.	added in 1975.
3	FE-35	TA-3-29 (CMR Building) Wing 7	room air - Wing 7 north offices	Pu-238 and Pu-239 (1975)	gross volume for 1975 was 0.65E+08 m3.	added in 1975.
3	VFE-48	TA-3-29 (CMR Building)				
3	FE-52, became FE-26 in 1984.	TA-3-34 (Cryogenics Building B)		tritium; Pu-238 and Pu-239 (1975)		

3	FE-1 (West, E-2)	west side of SM-35 (Press Building)	1969: TA-3-35, Room 105	U-235 (1967, 1969)	8200 cfm in 1969. 7580 cfm in 1973	1969 memo report makes mention of "recent re-vamp" that apparently affected the area exhausted and the flow rate.
3	FE-2 (West, E-1)	west side of SM-35 (Press Building)	1969: TA-3-35, Room 104	U-235 (1967, 1969)	11,673 in 1969. 9360 cfm in 1973.	1969 memo report makes mention of "recent re-vamp" that apparently affected the area exhausted and the flow rate.
3	FE-3 (Southwest, E-3)	through wall on west side of SM-35 (Press Building)	1969: TA-3-35, Room 101-B	U-235 (1967, 1969)	2800 cfm in 1969. Not in use in 1973.	1969 memo report makes mention of "recent re-vamp" that apparently affected the area exhausted and the flow rate.
3	Stack 1	Shop 13, Beryllium Shop (TA-3-39)		Sc-46, Co-60		1966 only?
3	Stack 2	Shop 13, Beryllium Shop (TA-3-39)		Sc-46, Co-60		1966 only?
3	Stack 3	Shop 13, Beryllium Shop (TA-3-39)		Sc-46, Co-60		1966 only?
3		South Wing, P-12 cyclotron building	Cyclotron (TA-3-40)	tritium		As of 1970, emissions from this stack were monitored, but not recorded. Tritium is released when the He-3 trap is out-gassed.
3	FE-1	TA-3-40	Physics Bldg. Cal. Lab	Po-210 (?)		Same as cyclotron stack?
3		SM-65	SM-65 vault	radon		Presumably just ventilation of air in the vault - not a process area.
3	FE-1 (Southeast, E-6)	East side of SM-66 (Sigma Building)	TA-3-66 fabrication section	U-235 and D.U. (1969)	38,186 cfm (1969). 37,800 cfm in 1973.	

3	FE-7 (Northwest, E-2 and E-3? - not sure about E-3)	West side of SM-66 (Sigma Building)	TA-3-66 ceramics section	D.U. and ThO2 (1969)	not in use in 1967;17,742 cfm (1969); 23,300 cfm in 1973.	
3	FE-8 (Northwest, E-1)	West side of SM-66 (Sigma Building)	TA-3-66 foundry section	D.U. (1967, 1969)	26,461 cfm (1969). 16,800 cfm in 1973.	
3	FE-9 (Northeast, E-7 and E-4? - not sure about E-4)	East side of SM-66 (Sigma Building)	TA-3-66 powder metallurgy section	U-235 and D.U. (1967, 1969)	44,436 cfm (1969). 40,800 cfm in 1973.	
3	FE-10 (Southeast, E-5)	East side of SM-66 (Sigma Building)	TA-3-66 U-235 foundry and Shop 21	U-235 (1967, 1969)	20,189 cfm (1969). 17,500 cfm in 1973.	
3	FE-13 (North, E-3)	North side of SM-66 (Sigma Building)	TA-3-66 foundry and Graphite Shop	D.U. (1967, 1969); Th-234 (1977)	39,513 cfm (1969). 35,200 cfm in 1973.	
3	FE-14 (E-3)	North side of SM-66 (Sigma Building)	TA-3-66 foundry and Graphite Shop	D.U. (1967, 1969)	39,513 cfm (1969)	
3	FE-15 (E-3)	North side of SM-66 (Sigma Building)	TA-3-66 foundry and Graphite Shop	D.U. (1967, 1969)	39,513 cfm (1969)	
3	FE-24	Through roof of SM-66 (Sigma Building) over Room G-105	TA-3-66 Ceramics	D.U. and ThO2 (1969)	not in use in 1967; 2,365 cfm (1969). 2,660 cfm in 1973.	
3	FE-25	Through roof of SM-66 (Sigma Building) over Room B-107	TA-3-66 Foundry	D.U. (1969)	not in use in 1967; 2,549 cfm (1969)	
3	FE-26 (Northwest corner)	Through roof of SM-66 (Sigma Building) over Room B-107	TA-3-66 Foundry	D.U. (1969); Th-234 (1977)	not in use in 1967; 2,549 cfm (1969). 260 cfm in 1973.	
3	FE-27	Through roof of SM-66 (Sigma Building) over Room B-107	TA-3-66 Foundry	D.U. (1969); Th-234 (1977)	not in use in 1967; 2,549 cfm (1969). 800 cfm in 1973.	
3	E-1 (Stack 1)	Shop 15 (TA-3-102)		U-235, U-238		
3	E-2 (Stack 2)	Shop 15 (TA-3-102)		U-235, U-238		
3	E-3 (Stack 3)	Shop 15 (TA-3-102)		U-235, U-238		
3	FE-20	South side of SM-102 (Shop 15)	TA-3-102 (main stack)	U-235, D.U. (1967, 1969, 1975)	16,000 cfm (1969). 16,600 cfm in 1973. Gross volume for 1975 was 1.62E+08 m3.	unknown if same as one or all of Stacks 1, 2, or 3.
3	FE-6 (North, E-1)	North side of SM-141 (Rolling Mill Building)	TA-3-141 Room 148	D. U. (1967, 1969)	14,648 cfm (1969). 13,700 cfm in 1973.	

3	FE-9 (Northwest, E-2)	Through roof of SM-141 (Rolling Mill Building) over Room 136	TA-3-141 Rooms 150, 144 and 142	D. U. (1967, 1969)	18,322 cfm (1969). 18,600 cfm in 1973.	
3	FE-10 (Southwest, E-3)	Through roof of SM-141 (Rolling Mill Building) over Room 144	TA-3-141 Rooms 135, 136, 137 and 141	D. U. (1967, 1969)	25,868 cfm (1969). 30,200 cfm in 1973.	
9	FE-3	TA-9-21	Room 119	tritium	2,704 cfm (1969). 1,900 cfm in 1973.	
9	FE-4	TA-9-21	Room 120	tritium	2,731 cfm (1969). 1,620 cfm in 1973.	
9		TA-9-32				
18	FE-1			U-235, MFP		
20			Cutoff shack	Po-210		1946 only?
21	East Manifold					
21	West Manifold					
21	Exhaust 2 (Building 2 exhaust)		TA-21-2			
21	Bldg. 2 east stack (FE-2, became FE-1 for TA-21-313(2E) in 1984.		TA-21-2 room air, changed to TA-21-313(2E) in 1984.	Pu-239	gross volume for 1975 was 2.78E+08 m3.	
21	Bldg. 2 west stack (FE-1)		TA-21-2 room air	Pu-239	gross volume for 1975 was 3.87E+08 m3.	terminated in 1983.
21	Exhaust 3 (Building 3 exhaust)					
21	Bldg. 3 east stack (FE-2, became FE-1 for TA-21-314(3E) in 1984.)		TA-21-3 room air, changed to TA-21-314(3E) in 1984.	Pu-238, Pu-239	gross volume for 1975 was 1.82E+08 m3.	
21	Bldg. 3 west stack (FE-1, became FE-2 for TA-21-313(3W) in 1984.)		TA-21-3 room air, changed to TA-21-313(3W) in 1984.	Pu-238, Pu-239	gross volume for 1975 was 3.34E+08 m3.	

21	Bldg. 3 main (south) stack (FE-1, Room 313 main process stack?)			U-235 (1977)		
21	Bldg. 3 Incinerator Stack (FE-1, Room 313 incinerator?, became process area stack TA-21-3(P) in 1984 - retained FE-1 designation).			U-235 (1977)		
21	Exhaust 4 (Building 4 exhaust)					
21	Room 401 stack exhaust		Room 401	Pu-239 and fission products (1967)		Does this refer to the drybox, cell and stack collectively; or is this a separate exhaust entirely?
21	Bldg. 4 west stack (FE-2, Room 401 drybox?, became FE-7 for TA-21-314(W) in 1984.)		Bldg. 4 room air, changed to TA-21-314(W) in 1984.	Pu-238 (1973); U-235 (1977)	gross volume for 1975 was 2.66E+08 m3.	
21	Bldg. 4 hot cell stack (FE-1, Room 401 cell exhaust)		TA-21-4 Hot Cell	Pu-239	gross volume for 1975 was 0.48E+08 m3.	
21	Bldg. 4 south stack (FE-1, Room 401 stack?, became main stack (FE-3) circa. 1983.)			U-235 (1978)	Gross volume for 1978 was 3.120E+08 m3.	
21	Room 413 main exhaust (NOT same as Room 413 stack!)		Room 413			
21	Room 408 and Room 413 main process stack (sometimes reported as just Room 413)					
21	Exhaust 5 (Building 5 exhaust)					

21	Bldg. 5 east stack (FE-1)			Pu-239	gross volume for 1975 was 3.74E+08 m3.	
21	Bldg. 5 west stack (FE-2, became FE-1 for TA-21-315(5W) in 1984.)		TA-21-5 room air, changed to TA-21-315(5W) in 1984.	Pu-239	gross volume for 1975 was 3.53E+08 m3.	
21	FE-5/FE-6	TA-21-5 SR		Pu-239	gross volume for 1975 was 0.16E+08 m3.	
21	FE-1		TA-21-5 (Room 530)	Pu-239	gross volume for 1975 was 0.72E+08 m3.	
21			TA-21-5 (Room 530 Hood)	Pu-239	gross volume for 1975 was 0.21E+08 m3.	
21	Bldg. 12 Stack 1	TA-21-12 (#1)		Pu-239		
21	Bldg. 12 Stack 2	TA-21-12 (#2)		Pu-239		
21	Bldg. 12 Stack 3	TA-21-12 (#3)		Pu-239		
21	Bldg. 12 Stack 4	TA-21-12 (#4)		Pu-239		
21			Building 20 (Laundry)	Pu-239, U-235, U-238, Po-210		
21			Building 21 (Vault)	Pu-238, Pu-239, U-233, U-235		
21			Building 33 (waste treatment lab)	Pu-239, Sr-89, Sr-90		
21			Building 35 (waste disposal lab)	Pu-239, U-235, U-238, Cm-244		
21			Building 61	U-235		
21	Building 146	Building 146	Building 2 only? - appears to be upstream of the other buildings.	Pu, U, Am, Cm, Ac, Pa		Appears that 1959 was the first year this facility operated. Not clear if this was a discharge point or just a filtration stage prior to the Building 12 stacks.
21	Building 150 room air exhaust (FE-1)	TA-21-150	Bldg. 150 room air	Pu-238, Pu-239	gross volume for 1975 was 2.83E+08 m3.	
21	FE-4		TA-21-257	Am-241 (1978); Pu-239 (1981)		added in 1978.
21	FE-6		TA-21-257 (Pug Mill)			terminated in 1983.

21	TA-21-324 Process Exhaust (FE-1/FE-2: FE-2 became FE-1 in 1984.)			Pu-238, Pu-239	gross volume for 1975 was 2.02E+08 m3.	
21	DP East Bldg. 152			Po-210, U-235, Ac-227, Th-232		
21	DP East (Bldg. 153) Stack 1					
21	DP East (Bldg. 153) Stack 2					
21	DP East Bldg. 155 NE	TA-21-155 NE		U-235	gross volume for 1975 was 0.57E+08 m3.	this release point was terminated in 1977.
21	DP East Bldg. 155 NW	TA-21-155 NW		U-235	gross volume for 1975 was 0.44E+08 m3.	this release point was terminated in 1977.
21	DP East Bldg. 155 SE	TA-21-155 SE		U-235	gross volume for 1975 was 0.46E+08 m3.	this release point was terminated in 1977.
21	DP East Bldg. 155 SW	TA-21-155 SW		U-235	gross volume for 1975 was 0.59E+08 m3.	this release point was terminated in 1977.
21	FE-5	TA-21-155 North	TSTA			added in 1984.
21	FE-10, became FE-1,-10,-12 in 1984.		TA-21-209 (DP East)			added in 1975.
32			Medical research lab	Pu-239		
33	FE-6/FE-11, became FE-6-11 in 1984.	TA-33-86 (main stack)	Cleaning hood and Room 9	tritium	4,096 cfm (1969). 5,730 cfm in 1973.	
33	FE-8	TA-33-86 (main stack)	Cleaning hood and Room 9	tritium	4,096 cfm (1969)	
35	FE-2 (South, E-10)	South-southwest corner of Building 7	Rooms 127, 129, 131, 133, 135, 137, 139, 141, 143, 145, 155	Pu-239 and U-235 (1967, 1969)	15,600 cfm (1969). 8,080 cfm in 1973. Gross volume for 1975 was 1.67E+08 m3.	

35	FE-3 (Northeast corner, E-11)	East of Building 7	Rooms 164 (Lab C), 165 and 166	Pu-239 (1967, 1969)	8,267 cfm (1969). 9,330 cfm in 1973. Gross volume for 1975 was 1.87E+08 m3.	terminated in 1980.
35	FE-4 (E-13?)				3,030 cfm in 1973.	Assumed same as E-13, but this needs to be confirmed.
35	FE-6 (Northeast, E-14)	East of Building 7	Room 161 (Lab C)	Pu-239 (1967, 1969)	4,050 cfm (1969). 3,530 cfm in 1973. Gross volume for 1975 was 0.48E+08 m3.	terminated in 1980.
35	FE-7 (Southeast, E-15)	East of Building 7	Room 162 (Lab B)	Pu-239 (1967, 1969)	2,308 cfm (1969). 2,990 cfm in 1973. Gross volume for 1975 was 0.43E+08 m3.	
35	Pu labs drybox exhaust (FE-8, Southeast Corner or Southeast Central)	Out of Building 2	Drybox trains and hoods in Rooms 129, 133, 134, 137, 139, 140, 144 and 161	Pu-239 (1967, 1969)	3,142 cfm (1969). 2,170 cfm in 1973. Gross volume for 1975 was 0.40E+08 m3.	
35	Lab A exhaust		Lab A			Definitely co-existed with E-10, E-11, E-13, E-14, E-15, and Pu labs exhaust - not redundant with any of these.
35	FE-11	TA-35-2 South		tritium	9,200 cfm in 1973. Gross volume for 1977 was 1.104E+08 m3.	terminated in 1979.
35	FE H-1	TA-35-2				added in 1980. terminated in 1984.
35	FE-1	TA-35-213	Target Fab. Facility			
35	FE-5	TA-35-213	Target Fab. Facility			
41	FE-2				490 cfm in 1973	emergency use only per 1973 stack air flow measurements memo.
41	tritium gas sample duct feeder	TA-41-4			3,560 cfm in 1973.	this and FE-17 are one stack. Is this FE-4 perhaps? FE-4 became FE-17 circa. 1983.

41	FE-17	West end of Building 4 (TA-41-4)	All of W-7 area	Pu-238, Pu-239, U-235 (1967, 1969); tritium	25,338 cfm (1969). 25,000 cfm in 1973.	
42		TA-42-1	TA-42-1 incinerator	Pu-239, Am-241 (1969)	300 cfm (1969)	
43		Roof of HRL	HRL Room B-128	Pu-238 (1969)		presume this is redundant with one of the FE stacks below, however, it is unknown which one.
43	FS-15	TA-43-1		Pu-239		not known if same as FE-15
43	FE-15	TA-43-1			4,590 cfm in 1973.	FE-15, FE-16, FE-17 and an unknown FE# all feed a common stack per the 1973 stack air flow measurements report. The flow rate for the unknown FE# designation was 4,000 cfm.
43	FE-16	TA-43-1			2,930 cfm in 1973.	FE-15, FE-16, FE-17 and an unknown FE# all feed a common stack per the 1973 stack air flow measurements report. The flow rate for the unknown FE# designation was 4,000 cfm.
43	FE-17	TA-43-1			550 cfm in 1973.	FE-15, FE-16, FE-17 and an unknown FE# all feed a common stack per the 1973 stack air flow measurements report. The flow rate for the unknown FE# designation was 4,000 cfm.
43	FE-24	TA-43-1		Pu-239; P-32 (1977)	230 cfm in 1973. Gross volume for 1975 was 0.05E+08 m3.	
43	FE-9	TA-43-1		Pu-238 and Pu-239 (1975); P-32 (1977)	12,100 cfm in 1973. Gross volume for 1975 was 1.77E+08 m3.	
43	FE-10	TA-43-1		Pu-239 (1975); P-32 (1977)	Gross volume for 1975 was 1.47E+08	

					m3.	
43	FE-11, became FE-12 circa. 1983.	TA-43-1		Pu-239 (1975); P-32 (1977)	Gross volume for 1975 was 2.61E+08 m3.	
43	FE-12, became FE-34 circa. 1983.	TA-43-1		Pu-239 (1975); P-32 (1977)	Gross volume for 1975 was 2.58E+08 m3.	
43	FE-14	TA-43-1		Pu-239 (1975); P-32 (1977)		looks like combined with FE-16 and FE-17 at some point, or may have always been that way.
45			Lab building	Pu-239, Sr-90		
46	FE-11 (Room 8)	TA-46-1	Room 8	U-235	1,130 cfm in 1973.	
46		TA-46-31	Room 170	U-235 (1969)	varies depending on test - prescribed by H-5	
46	FE-36	TA-46-31		U-235	1,300 cfm in 1973.	may be same as for TA-46-31 Room 170 above.
46	FE-37	TA-46-31		U-235	1,750 cfm in 1973.	may be same as for TA-46-31 Room 170 above.
46		TA-46-16	Test Cell 1 and 4 (2 stacks)	U-235 (1969)	varies depending on test - prescribed by H-5. TC-I was asserted at 560 cfm in 1973 and TC-IV was asserted at 750 cfm.	
46	FE-25 (South)	TA-46-31		U-238 (1977)	Gross volume for 1977 was 2.676E+06 m3.	
46	FE-26 (Southwest)	TA-46-31		U-235 (1977)	Gross volume for 1977 was 5.096E+06 m3.	
46	FE-41 (North)	TA-46-31		U-238 (1977)	Gross volume for 1977 was 3.648E+05 m3.	
46	FE-44 (West Stack)	TA-46-31		U-238 (1977)	Gross volume for 1977 was 1.368E+05 m3.	added in 1975.
46	FE-43, became FE-41 circa. 1983.	TA-46-31		U-238 (1978)	Gross volume for 1978 was 1.240E+07	added in 1978.

					m3.	
48	FE-11 (East Fan Feeder - South side of building)	South side of building	Southeast section of building	Uranium and fission products (1969)	21,028 cfm (1969). 22,000 cfm in 1973.	Feeder lines FE-11, FE-12 and FE-13 fed into a common stack located at the south end of the building. In 1984, FE-11, FE-12 and FE-13 became FE-11 (only).
48	FE-12 (West Fan Feeder - South side of building)	South side of building	Southwest section of building	Uranium and fission products (1969)	15,574 cfm (1969). 19,900 cfm in 1973.	Feeder lines FE-11, FE-12 and FE-13 fed into a common stack located at the south end of the building. In 1984, FE-11, FE-12 and FE-13 became FE-11 (only).
48	FE-13 (Center Fan Feeder - South side of building)	South side of building	Old dissolving rooms	Uranium and fission products (1969)	15,699 cfm (1969). 17,900 cfm in 1973.	Feeder lines FE-11, FE-12 and FE-13 fed into a common stack located at the south end of the building. In 1984, FE-11, FE-12 and FE-13 became FE-11 (only).
48	FE-15 (East fan feeder - North side of building)	North side of building	Northeast section of building	Pu-239 and fission products (1969)	24,432 cfm (1969). 27,600 cfm in 1973.	Feeder lines FE-15 and FE-16 fed into a common stack located at the north end of the building. In 1984, FE-15 and FE-16 were designated FE-15 (only).
48	FE-16 (West fan feeder - North side of building)	North side of building	Northwest section of building	Pu-239 and fission products (1969)	21,368 cfm (1969). 20,700 cfm in 1973.	Feeder lines FE-15 and FE-16 fed into a common stack located at the north end of the building. In 1984, FE-15 and FE-16 were designated FE-15 (only).
48	FE-18					added in 1980.
48	FE-37 Feeder Line	North side of building	Hot cells on north side	Uranium and fission products (1969)	2,800 cfm (1969). Not in use in 1973.	Feeder lines FE-37, Fe-38, FE-39 and FE-40 feed into a common stack on the north side of the building.

48	FE-38 Feeder Line	North side of building	Hot cell personnel area	Uranium and fission products (1969)	3,120 cfm (1969). 3,556 cfm in 1973.	Feeder lines FE-37, Fe-38, FE-39 and FE-40 feed into a common stack on the north side of the building. In 1984, FE-38 and FE-40 were designated as FE-40 (only).
48	FE-39 Feeder Line	North side of building	Hot cell on north side of building	Uranium and fission products (1969)	3,120 cfm (1969). Not in use in 1973.	Feeder lines FE-37, Fe-38, FE-39 and FE-40 feed into a common stack on the north side of the building.
48	FE-40 Feeder Line	North side of building	Hot cell personnel area	Uranium and fission products (1969)	2,800 cfm (1969). 1,930 cfm in 1973.	Feeder lines FE-37, Fe-38, FE-39 and FE-40 feed into a common stack on the north side of the building. In 1984, FE-38 and FE-40 were designated as FE-40 (only).
48	FE-45 (Core Wing)	TA-48-1			24,000 cfm in 1973.	FE-45 and FE-46 feed a single stack per the 1973 air flow measurements memo.
48	FE-46 (Core Wing)	TA-48-1			21,500 cfm in 1973.	FE-45 and FE-46 feed a single stack per the 1973 air flow measurements memo.
48	FE-51 (Alpha Wing)	TA-48-1			630 cfm in 1973.	
48	FE-54 (Northeast)	TA-48-1		Pu-239 (1978)		
50	FE-1 (Northeast)	Northeast side of building TA-50-1	Rooms 10 and 11; Size Reduction Facility Room (1982)	mostly Pu-239 (1967, 1969)	20,945 cfm (1969). 26,200 cfm in 1973.	
50	FE-2 (Southeast)	Southwest corner of building TA-50-1	Rooms 24, 34, 35, 36 116, 123, 130 and 131.	mostly Pu-239 (1967, 1969)	44,150 cfm (1969). 35,600 cfm in 1973.	
50	FE-3 (South)	Southeast side of building TA-50-1	Rooms 38 and 38-A; Size Reduction Facility Process (1982)	mostly Pu-239 (1969)	not in use in 1967; 3,712 cfm (1969). 2,800 cfm in 1973.	
50	FE-4, became FE-25 in 1984.	TA-50-1				

50	FE-6	TA-50-1	Retrievable waste pre-treatment Am-241 plant			added in 1983.
50	FE-18, became FE-17 circa. 1983.	TA-50-1				
50	FE-27	TA-50-1	New decon. area			added in 1983.
50	FE-1 (TDF)	TA-50-37			Gross volume in 1980 was 3.300E+07 m3.	
52		TA-52-1, north side	UHTREX reactor	fission products, I-131, trace U-235 (1969)	21,025 cfm (1969)	
53	FE-3 (North Stack)			C-11, N-13, O-15, Ar-41, Be-7 (1977)	Gross volume for 1977 was 2.650E+06 m3. Gross volumes of 1.528E+08 m3 and 1.694E+08 m3 are reported for 1977.	terminated in 1980.
53	FE-4 (South Stack)				Gross volume for 1977 was 1.713E+06 m3.	added in 1977.
53	FE-16	TA-53-1 D-wing		Be-7	Gross volume for 1977 was 1.992E+08 m3.	
53	FE-2	WNR				added in 1981.
54	FE-1	Main Stack, became room exhaust circa. 1983.		Pu-239	Gross volume for 1978 was 2.809E+06 m3.	added in 1977.
54	FE-2	room air exhaust, became process exhaust circa. 1983.			Gross volume for 1978 was 7.950E+06 m3.	added in 1978.
55	FE-15 (North Stack)			Pu-239	Gross volume for 1978 was 2.483E+08 m3.	added in 1978.
55	FE-16 (South Stack)			Pu-239	Gross volume for 1978 was 3.198E+08 m3.	added in 1978.

Appendix K: Summaries of Public Meetings Held by the LAHDRA Project Team

Meeting Summary–
Los Alamos Historical Document Retrieval and Assessment Project

First Public Meeting

Tuesday, February 23, 1999, Los Alamos, NM

Los Alamos Inn, 5:00 p.m. to 7:00 p.m.

Meeting Minutes

First Speaker: Paul Renard, CDC Project Officer

(These statements are NOT direct quotes. All statements are paraphrased.)

Explained that the first meeting is typically held close to the research site. Subsequent meetings are then held at other locations depending on the findings from the research.

The project was initiated in response to a petition, signed by Rep. Richardson inviting the Centers for Disease Control and Prevention (CDC) to study Los Alamos National Laboratory (LANL). Later, an official Memorandum of Understand (MOU) was signed between Watkins and Sullivan.

This study is NOT a full-blown environmental dose reconstruction. It is a records retrieval and assessment that promises a deliverable of a database of relevant records.

This study of LANL records has been on the docket for awhile with six other facilities:

- Savannah River Site (SRS)
- Idaho National Environmental and Engineering Laboratory (INEEL)
- Rocky Flats Environmental Technology Site (RFETS)
- Oak Ridge Reservation (ORR)
- Fernald
- Hanford

The contractor for this study was selected through an open competitive bid won by ChemRisk for this phase of the study. ChemRisk performed similar studies satisfactorily at Rocky Flats and ORR and provided the best proposal. The States of Colorado and Tennessee provided very good letters of recommendation.

Second Speaker: Charles Miller, CDC Technical Lead

(Slide titles presented in bold face, slide contents in italics, and speaker comments in plain text.)

(Speaker comments are NOT direct quotes. All comments are paraphrased.)

Outline of Presentation

- *What?*
- *Why?*
- *Where?*
- *How?*

No commitments have been made to do a full-blown dose reconstruction.

Dose Reconstruction
is a comprehensive analysis of the exposure received by individuals in the vicinity of the facilities that release contaminants to the environment -- real doses to real people

Most of the current research into possible releases are done for regulatory purposes and focus on hypothetical situations. This study is very realistic. It will look at what may have happened, where people have lived, where might have there been some releases. This study is trying to find out what happened.

Why Do Environmental Dose Reconstructions?
- *Integral part of epidemiologic studies; e.g., Hanford Thyroid Disease Study*
- *Provide a comprehensive history of site operations, including releases*
- *Provide an independent, comprehensive evaluation of risk*
- *Provide a baseline for analyzing impacts of future activities; e.g., clean-up*

The information that is being gathered during this study will be necessary for additional studies if they are completed. It is providing a good historic picture.

Dose Reconstruction Activities
Map of the United States noting:
- *CDC Dose Reconstruction*
- *CDC Technical Support*
- *No Current Involvement*

Facilities on Map:
- *Hanford*
- *Lawrence Livermore National Laboratory*
- *Republic of the Marshall Islands*
- *Idaho National Engineering and Environmental Laboratory*
- *Rocky Flats*
- *Nevada Test Site*
- *Los Alamos National Laboratory*
- *Pantex*
- *Sandia National Laboratories*
- *Bendix*
- *Paducah*
- *Fernald*
- *Mound*
- *Ashtabula*
- *Portsmouth*
- *Oak Ridge Rerservation*
- *Savannah River Site*
- *Pinellas*

Basic Assumptions
- *There is not standard methodological guide book*
- *Each site has unique attributes*
- *There are lessons to be learned from each and every study*
- *Common approaches can be developed*

Dose Reconstruction is a Process

- *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*

All available data from the site, state agencies, federal agencies, and other sources will be compiled into one source that will be made available to everyone. The process used at LANL will be different from other studies, as each site has its own unique characteristics. Each also has its own toxicants that were or were not released and different pathways. For example, alligators were identified as a pathway at one site.

Implementing the Dose Reconstruction Process

- *Various stages of the process may overlap in time*
- *Stages may be performed in an iterative manner*
- *All stages may not be necessary at all sites*
- *Will involve CDC staff, contractors, and the public*
- *Total process may require 4-7 years to complete*

Contractors are used because the CDC does not have a large enough staff to perform the necessary studies.

Retrieval and Assessment of Data

- *Both radionuclides and chemicals*
- *Effluent and environmental monitoring*
- *Facility processes*
- *Effluent release points*
- *Use primary data sources, e.g., logbooks*

In addition to standard records, the study is examining facility processes to evaluate data and recreate missing information. Primary sources, such as logbooks, which were hand written by people on a day-to-day basis as they performed their work, are often invaluable sources.

Los Alamos Historical Document Retrieval and Assessment

- *Documents will be retrieved and evaluated for their usefulness for offsite dose assessment*
- *Relevant documents will be declassified (if necessary), copied, and made available to the public*
- *Relevant documents will be entered into an electronic database*
- *A prioritized list of contaminant releases from the LANL site will be developed*

This is not a worker study although it will identify records that may be relevant to worker studies conducted by the National Institute of Occupational Safety and Health (NIOSH).

STRESSED: All necessary documents will be made unclassified.

Document Searches

- *LANL Central Records*
- *LANL Archives*
- *Technical Report Library*
- *Technical Areas*
- *Work for Others*
- *Other sites; e.g., Federal Records Center*
- <u>*Guiding Principle: No Boxes Left Unopened*</u>

Other sites will be included in the search, e.g., Dallas Records Center and records related to early nuclear weapon tests in New Mexico at Farmington, NM and the Trinity Site.

STRESSED: The guiding principal will be adhered to. If a box is labeled "Purchase Orders," it will be opened to make sure it contains purchase orders.

CDC Principles

- *Scientific Integrity*
- *Open and effective communication*
- *Collaboration with partners throughout the nation and the world*

Scientific Integrity

- *CDC staff make site visits*
- *CDC staff review technical reports*
- *Individual outside reviewers; e.g., chemical toxicity*
- *Special review panels; e.g., databases developed*
- *National Research Council/National Academy of Sciences Committee on and Assessment of CDC Radiation Studies*
- *Meeting presentations*
- *Publication in peer-reviewed literature*

Open and Effective Communication

- *All information readily available to all interested parties*
- *Information may be released on a n interim basis*
- *All data used are declassified*
- *Active listening to all parties*

Project contacts promise to give the most correct answers to questions. The contacts are listed on the fact sheet. Please call!

When reports, including drafts, are released, they will be made available to the public.

If relevant information is found in a classified document, that can not be declassified, the public will be informed that this type of problem has been reached.

Collaboration with Partners

- *Other Federal agencies; e.g., DOE, NIOSH, Agency for Toxic Substances and Disease Registry (ATSDR)*
- *State and local officials*
- *Current and former site employees*
- *Members of the general public*
- *Public meetings and workshops, including Federally-chartered Health Effects Subcommittees*
- *Newsletters and fact sheets*
- *Toll-free telephone number*
- *Education activities*
- *Active listening*

Made clear that the Director of CDC and the Administrator for ATSDR is the same person, although these are two separate agencies.

STRESSED: Public is a partner in the process. Please ask questions. Project personnel are accountable to the public.

STRESSED: How much collaboration will occur between project personnel and the public will depend on public direction. However, the budget is not unlimited, but project personnel will do their best to meet public need.

Conclusions

- *Dose reconstructions are an integral part of analytic epidemiology and risk assessment*
- *Dose reconstructions are scientifically challenging*
- *Scientific integrity of these studies must be maintained*
- *Public credibility is an equally important requirement*

STRESSED: The key is public acceptance.

Third Speaker: Thomas Widner, Project Manager

(Slide titles presented in bold face, slide contents in italics, and speaker comments in plain text.)
(Speaker comments are NOT direct quotes. All comments are paraphrased.)

Our assignment

To collect and evaluate information relevant to the assessment of off-site releases or health effects from Los Alamos operations.

The study will focus on records that are likely important. It won't catalog all records, but focus on public health and off-site health effects. Hundreds of thousands of cubic feet of records need to be evaluated. (Showed photograph from Oak Ridge.)

Requirements for credibility

- *an independent project team*
- *qualified and experienced project team members*
- *full access to records*
- *open and effective public involvement*
- *peer review*

ChemRisk is an independent project team that does not have close ties to the Department of Energy (DOE) and other federal agencies.

STRESSED: The team is being granted access to records that are unavailable to the public. Many are classified. It will be granted full access. If the team is told it can not go into a particular place or review particular records, that will raise a red flag. They will find a method, whether by receiving special permission or special clearance for a particular team member, to go examine those records.

The team desires to communicate its findings and discuss the concerns of the public and the information that members of the public might have.

Groups involved in the project

- *CDC's National Center for Environmental Health*
- *ChemRisk, a service of McLaren/Hart, Inc. (prime contractor to CDC)*
    - *Shonka Research Associates, Inc. (document review, database and records management)*
    - *Tech Reps, Inc. (communication)*
    - *Several local consultants to the project team (assistance with public involvement)*

(Displayed photograph of team members)

ChemRisk has worked with Shonka for years on similar studies.
Tech Reps will provide support in preparing and reviewing documents including newsletters and fact sheets.
Consultants Nadine Tafoya and Toby Herzlich will help facilitate public involvement.

In terms of public involvement, the project team is not looking for public relations. It wants to establish two-way communications--share with the public--obtain information that can not be found in written records.

The team is experienced and represents a variety of fields of expertise. It is good at honing in on what is important.

Products of the project include:

- *a database of records related to off-site doses or health effects*
- *a summary of historical operations*
- *a list of materials likely released off site*
- *a prioritization of those releases, and*
- *a set of copies of documents most useful in estimating releases and health effects*

The study will examine the big picture. It will identify materials that were probably released off site and prioritize the releases. The prioritized list and documents will be made available in town. The scope of the project is records focusing on LANL activities in New Mexico, including Trinity Site, Farmington, and Carlsbad. The team will also identify records related to other weapons complex sites.

Information will be gathered from:

- *documents on paper and microfilm*
- *technical reports*
- *technical notebooks*
- *interviews of active and retired workers and members of the public*
- *photographs and motion pictures*

Technical reports will included those released internally and externally.

TERMINOLOGY CLARIFIED: Logbooks and Technical Notebooks are the same thing. Typically they are a very valuable resource.

Interviews are valuable in that they provide additional information and interpretation. During the course of the study, the project team will seek special permission from LANL to talk to former employees (who held security clearances) about laboratory activities that may have classified aspects.
Photographs and motion pictures will be a particular challenge in determining relevancy.

The team expects to find some well-organized records, while others will be just "dumped" materials. A small fraction will probably be relevant. The challenge is to find the significant documents.

Documents will be categorized

1. *Documents that could be used in estimating off-site releases or effects*
2. *Documents that could be useful in <u>confirming</u> off-site releases or effects*
3. *Documents relevant to releases from other weapons complex sites*
4. *Documents that are not relevant*

Category 1 documents will normally be included in the database, copied, and released.
Category 2 documents will normally be included in the database, but not copied.
Category 3 documents will normally be included in the database, but not copied.
Review of boxes of Category 4 documents will be documented (e.g. in “box logs”), but they will not copied or entered into the database.

We seek descriptions of:

- *materials that were used at LANL*
- *facilities they were used in*
- *processes they were subjected to*
- *measures taken to contain materials*
- *monitoring of wastes and effluents*
- *environmental measurements*
- *locations and activities of residents*

Operations, activities, or events of interest include:

- *Routine operations*
  nuclear weapon development production and testing, machining and fabrication, chemical processing, criticality experimentation, nuclear reactor development, accelerator applications fusion research, plasma thermocouple, high explosives development and testing, waste management, biological research, nonproliferation, space programs
- *Accidents or incidents*

Between routine operations and accidents and incidents, it is hard to predict what will dominate off-site exposures. The team is entering the project with no preconceived notions.

Releases will be prioritized based on:

- *The toxicity of each material*
- *Quantities that were present*
- *Potential for (or evidence of) off-site transport and public exposure*

Toxicity: includes carcinogens, developmental or reproductive hazards
Key in evaluation of potential for off-site transfer: measurement in environment or effluents

This project…

- *will study uses and releases of both chemicals and radioactive materials*
- *is focusing on <u>off-site</u> exposures*
- *is mainly concerned with releases in the past*
- *will not likely provide many specific answers in this early stage*

The study will focus on both chemicals and radionuclides. The project team has a lot of experience with both, using methods that allow comparison of risks.

STRESSED: This in not a worker study. It is a study of off-site releases. However, there is not always a clear distinction between the two. For example, a worker may have taken home contaminants on clothing, and workers make up a large fraction of local residents.

Research will look at the past--what has happened. It looks at real not hypothetical or projected releases.

The documents will guide us
While we are familiar with operations at weapons complex sites and the basics of operations at LANL, we have no idea of what we will find.

Documents will serve as a guide for the effort. The team will strive to not be influenced by preconceived notions. It will let the data show what is important.

Fourth Speaker: Paul Renard, CDC Project Officer (Also opened the meeting)

(Slide title presented in bold face, slide contents in italics, and speaker comments in plain text.)
(Speaker comments are NOT direct quotes. All comments are paraphrased.)

Public involvement activities will include:

- periodic public meetings and workshops at varying locations-
- progress updates on records review
- presentations of findings
- newsletters and fact sheets
- toll-free number, e-mail, and mail
- a Web site with project information

Invites the public to not trust the project personnel--ask a lot of questions, watch us, follow along with us in the process.

The team wants to bring stakeholders to the planning tables. It is not here with an agenda.
The team's goal is to do good science and convey the results to public.

CDC is asking what the public desires in the way of a citizens advisory committee. If a committee is formed, there are requirements to strive for balance of representation with regard to geography, ethnicity, gender, etc.
Paul: What do you want in the form of committee representation? Any form of representation can be established, from no committee to a formal FACA Charter. Project personnel will meet with various organizations and Native American governments.

The study is just getting started. It is important that groups contribute information; the public is an integral part of study.

Public: Will we have more opportunities to provide input? Is funding only for three years?
Team: This is the first stage. We may go further. Phase 1 will look at all documents and place result in a database of relevant documents.

Fifth Speaker: Larry Elliot, NIOSH
(Speaker comments are NOT direct quotes. All comments are paraphrased.)

Has been working at Los Alamos in some capacity for 7 years.
Began as a member of the citizen’s advisory board.
NIOSH has completed several occupation studies. Working on two current studies involving records review at LANL.

Public Input
(These statements are NOT direct quotes. All statements are paraphrased.)

Public: Is this study separate from the human radiation studies project?
Team: Yes

Public: Are you going to use the records identified by this group (human radiation studies project team). It seemed like a comprehensive study.

Team: We will hopefully avoid duplication of effort, but will have access to all records, and will probably use some of their work.

Public: Is the size and make up of this audience typical?
Team: Yes and no. Affiliations of most audience members are unknown. Usually a large number of people from the site attend the first meeting. As the study proceeds they expect to attract a wider audience.

Public: Woman is concerned about study. She conducted this kind of work from 1973-80. Based on her experience, she doesn't think the team will be able to come up to speed fast enough to LANL. For example, there are many acronyms and place name changes. It will take 2-3 years to make associations. Her work involved site-specific monitoring. Doesn't know how the team can complete the study in three years and obtain appropriate conclusions.
Team: This is a cost reimbursement type of contract. At Hanford and Fernald, contractors performed directed searches to locate documents related to specific topics. The result was not satisfactory from a public credibility standpoint. To start, the LANL study will be a systematic look at all records. The team doesn't know what they will find or how many records there are. The government and contractors will make adjustments as necessary.

The study will begin with initial prioritization of records. No releases will be discarded– all data will be kept. Then the team, working with public, will make decisions. If the team is going down the wrong road the public, who knows that, needs to point this out. Prioritization is important but not the final answer. It is also important to determine what is "off site." "Off site" is hard to define for Los Alamos, and has changed over the years.

Public: How do you handle data from interviews and personal comments as compared to historical documents?
Team: Anonymity maintained when necessary. Interviews can fill holes in paper trails. For example, when procurement records couldn't be found, and interview explained that a blanket contract was in place. Interviews can tell where to go look for the appropriate written documentation.

Public: How do you evaluate the data? Memory vs. records?
Team: Gaps appear. Won't be able to get all answers. Will characterize findings based on uncertainties.
Team: Interviews may point to a set of records or information that we may not have thought to pursue, such as personal office records.
Public: The way I addressed quality of information from an interview was to keep comments in mind. Didn't report information until I found a paper trail. Another method was to take a bunch of people to the site and let them bounce ideas off each other.

Public: EPA and NRC have addressed prioritization of information, placing on a scale such qualities as trustworthiness and good recollection to poor recollection.
Team: Never used a formal process for evaluating interviews. Will consider your process.
Team: The team as a neutral agenda. It wants to do good science and make the information available.

Public: How far are you going to go in the screening process? Will you identify source terms at this point?
Team: The actual source term will be identified in the second phase, if it is conducted. This first phase is a qualitative at this stage. The second stage (if done) will be more quantitative. It is too big of a job to do at this point. Can't go into great detail at this point. This is a general screen. If nothing else is done, providing the project database itself will have been a good service. Useful documents. Capture relevant documents before they are possibly destroyed. Safeguard information in case of fire or other problem. Even after this information gathering phase, if further work is done we will not stop looking for records. The nature of things is that something will be missed. Always continue to look.

Public: Is there a way you will measure credibility and public acceptance? Do you have experience that you achieved the public acceptance?
Team: The Fernald job is almost completed, and a formal evaluation is now planned. Feels that the community believes we've done the very best job possible. It's not perfect.
Team (Elliot):   Can put you in touch with subcommittee members. This area needs to decide what it wants to do. The Fernald committee had decided it didn't need to spend more money (such as for epidemiologic studies) based on the CDC work.

Public: Can the committee have options between an epidemiologic study and health services, or is it an option to do both?
Team: It wasn't an either/or question. The Fernald committee decided it would be a waste of money to do another study. What they decided made the most sense to them based on what information they were given.
Team: Rosters of public groups are available. Ask people what they thought.

Public: Regarding getting permission for former employees to speak: Los Alamos is a company town, New Mexico a company state. People have economic ties to LANL. Can the team get broad permissions so that individuals don't have to stand up and seek permission?
Team: If this is an issue, we need to work together to find a resolution. During our last visit here, this was discussed as an issue. We will investigate.

Public: Is there a precedent set from other sites for such permissions?
Team: No. Individuals had agreed not to release information. At an annual banquet they were given permission to cooperate during the banquet. At another retiree event, clearance was given for that day to speak to us. For more detailed information, we needed to get individual permission.

Public: Interviews are a valuable historical source. Will they be available?
Team: Information from interviews will be part of database.
Public: Interviews flush out information.
Team: We agree 100%. At the same time, individual rights will be protected.

Public: Have you considered that conflicting interests will pick a portion of your reports to cause public dissention? Have you thought of anything to change that?
Team: We welcome all input on avoiding this sort of problem. We want to get the community to become involved. We want liaisons with various committees. We want everyone to know what everyone is doing. We want to know what their needs and goals are. If the community decides it needs a committee, we hope it can build a diverse committee.

Public: Dose reconstruction: Example tritium: how general do you get or how detailed?
Team: First we look at the total picture, considering amounts released, handling of problem. Then, based on results, may try to compartmentalize and analyze in more detail. If a high potential of risk is involved, a release is studied in the most detail possible. Will identify missing components too, that may keep us from evaluating some releases in more detail.

Public: Know one family that has suffered health consequences thought to be associated with father's work. He probably won't talk to you. However, if blanket permissions are received and there is an appeal to the community to help identify problems, you may get more response.

Public: How far will you go--100-mile radius or specific street in identifying risks?
Team: We will go as far as the data will allow. For example, in Washington, Idaho, and Oregon residents who lived in the domain during a time period can contact the Washington State Department of Health, who will estimate risk encountered on an individual basis. I don't know of any other site doing that. At Fernald, did more of a population-based risk analysis. Depends on the data and the community.

Other Local Public Meetings

CDC and ChemRisk project team members attended two additional public meetings also held that week. The Northern New Mexico Citizens Advisory Board had a public meeting on Wednesday, February 24 and the Rio Arriba Environmental Health Partnership meeting was on Thursday, February 25.

As a result of the three public meetings attended, 37 new names were added to the project contact list. Six people who signed up at the CDC meeting were already on the contact list and one from the RAEHP meeting.

Northern New Mexico Citizens Advisory Board Meeting
(Meeting minutes were obtained via facsimile from Ann DuBois. The excerpt below was taken from the official meeting minutes.)

Northern New Mexico Citizens' Advisory Board
Public Meeting
February 24, 1999, 6:00 P.M.
El Convento, Espanola, NM

I. Opening

The following members were present:

George Chandler (Chair)
Connie Thompson-Ortega (Vice Chair)
Royalynn Allen
Anthony Armijo
Fran Berting
Patrick Feehan
Augustin Garcia
Menice Manzanares
Domingo Martinez
Catherine Rivera-Lyons
Michael Smith
Bill Wyatt

The following members were absent:

John Alejandro
Moises Gonzales
Jim Johnston
Gary Valdo

II. Public Comment

Paul Renard, Centers for Disease Control, Project Officer, NCEH, 4770 Bufo9rd Highway, NE, M/S F-35, Atlanta, GA 30341-3724 770-488-7040

The Centers for Disease Control has funded a new Dose Reconstruction Project at LANL. Forty people attended the first public meeting held on February 23 in Los Alamos. The project is in the document and retrieval stage that will take three years. Public involvement is an important part of the project. ChemRisk has done dose reconstruction projects at other DOE sites. Mr. Renard introduced to the Board Charles Miller and Tom Widner who work with the LANL project.

Michael Smith asked Mr. Renard about what was found at the Savannah River Site. Mr. Renard replied that good agreement existed between the site's and the project's findings. However, he said the project reported twenty times more radiation and four times more plutonium releases than the records showed. These were old releases.

Rio Arriba Environmental Health Partnership Meeting

(Meeting minutes presented below were obtained electronically from RAEHP and were not altered in any way. The attachments cited are not included in this version.)

Rio Arriba Environmental Health Partnership (RAEHP)
Steering Committee Meeting #7
Public Meeting with the Centers for Disease Control and Prevention (CDC)
Northern New Mexico Community College, Española, NM

February 25, 1999

Information included:

1. Minutes from the February 25, 1999 RAEHP Steering Committee Meeting
2. Contact Information from CDC, ChemRisk, and RAEHP
3. Overheads presented at the meeting by CDC and ChemRisk
4. Summary of Notes from Small Groups
5. Agenda for the next RAEHP Steering Committee Meeting, March 24, 1999

Minutes from Meeting
prepared by Joan Doyle

Present: **RAEHP SC Members**: Ana Guitierrez Sisneros (Mora), Daniel Valerio, Louis Lujan, Hilario Romero, Marion Naranjo, Maxine Ewankow, Chris Mechels, Manny Trujillo, Peter Malmgren, Clement Tomas Switlik, Willa Pilar, Vern Westerberg, Johnnye Lewis, Ken Silver, Karen Mulloy, John Ussery, Sarah Atencio, Carmen Rodriguez, and Joan Doyle; **RAEHP Scholars**: Renée Riveras, Jessica Johnson, Velma Dominguez, Maria B. Romero,Peggy Six and Guillermo Vigil; **UNM MPH**: Frances Varela; **NM DOH**: Retta Prophet and James Padilla; **NMED: HRMG**: Barbara Toth; **CDC**: Paul Renard and Charles Miller; **ChemRisk**: Susan Flack, Tom Widner, and Jack Buddenbaum; **ATSDR**: Sandra Lopez; **NIOSH**: Larry Elliot; **DOE**:

Claudia Beach; and approximately 45 members of the public who represented a diversity of concerns including tribes, labor, health concerns, and other interests.

Agenda Item #1 - Welcome – Hilario Romero (NNMCC, RAEHP)

Hilario welcomed the approximately 80 attendees by sharing both his personal and professional connections to LANL. Personally, he has experienced LANL through the eyes of his two padrinos who shared stories of their work at LANL, and from his father's cousin who was shredded through a chain link fence while working at LANL. Also, as a historian, he has studied LANL as part of the modern history of New Mexico.

As a member of the RAEHP Steering Committee, Hilario shared RAEHP's goal of educating people in Northern New Mexico about the effects people have on the environment, and also the effects that the environment has on people.

Agenda Item #2 Johnnye Lewis (RAEHP)

Johnnye welcomed all of the attendees to the RAEHP Steering Committee meeting. She noted that the intent of opening the meeting to the public was to provide access to the community to speak with members of the CDC regarding the document discovery process at LANL. She also mentioned that representatives from ATSDR and NIOSH were in the audience and were willing to answer questions. Johnnye gave an overview of the format of the meeting, stating that first the CDC would present and then there would be opportunity for people to share concerns and ideas in small groups. She emphasized that the focus of the meeting was to generate questions and to address areas that would focus the CDC investigation by incorporating community knowledge and concerns.

Those present consented to having photos taken during the meeting and to allowing groups, in addition to RAEHP, to distribute material to the public on a table outside of the meeting room.

Agenda Item #3 CDC Team: Paul Renard (CDC), Charles Miller (CDC), Tom Widner (ChemRisk), and Larry Elliot (NIOSH)

Paul Renard, Project Officer for the CDC, provided some background on the document discovery process and an overview as to why the CDC was conducting the study at LANL. The Dose Reconstruction process began in 1990 with a Memorandum of Understanding between the Department of Energy (DOE) and Health and Human Services (HHS) (renewed in 1993) that authorized the CDC to conduct health studies on areas around nuclear weapons complexes. These studies have been conducted at Savannah River, GA; Hanford, WA; Fernald, OH; Rocky Flats, CO; and Oak Ridge, TN. The CDC was asked by Bill Richardson, then NM Representative to investigate LANL. LANL was then added to the list. As the resources became available the investigation at LANL was initiated.

Paul gave an overview of the scope of the project. The first phase, which will last about three years, involves record retrieval and assessment. The outcome of this phase will be an electronic database that will be available to the public. For the current project, the contractor is ChemRisk, the same company that conducted similar investigations at Rocky Flats and at Oak Ridge. To complete the record retrieval and assessment, the CDC and ChemRisk are working to achieve the full cooperation of the University of California and the DOE for record access. To complete the first phase, they will look at all documents at LANL. This phase began this week with the first public meeting held February 23, 1999 in Los Alamos. That meeting was not as well attended, as this meeting, which is the second public meeting.

Charles Miller, the Technical Lead for the CDC on this project, then reviewed the many steps involved in a dose reconstruction project. He noted that the current project is not a dose reconstruction project, but a preliminary document discovery process that could potentially lead to a dose reconstruction project. A copy of the overheads that he used to outline the Dose Reconstruction Process is attached. Charles emphasized the participatory nature of the process, stating that it will be the community's decision to determine how far CDC and their contractors will go with the investigation, and that the process will probably last at least 4 to 7 years.

In addition to the information provided on the overheads, the CDC provided a contact information sheet (information included). They encouraged the community to call to provide information to the CDC or to call to obtain information from the CDC. The CDC will send to the public any document that they have, unless it contains personal information. Charles noted that the CDC sends out information as they receive it, which means that the information that they send out is generally in draft form and has not been reviewed.

Tom Widner, Project Manager for ChemRisk, summarized their role as the prime contractor to the CDC on this project (copies of overheads attached). ChemRisk will be collecting and evaluating information for the next three years to assess offsite health effects that impact the public. There are twelve people on their project team, with eight people who have Q level security clearances. Tom said, "We see ourselves as the eyes of the public and feel responsible to collect all relevant information." The products of the investigation will be made available to the public via websites and possibly a reading room. They would like to bring in members of the public to provide the opportunity to show them how they "search a box." Tom used the analogy of panning for gold to describe the process of finding relevant documents.

In response to questions, Tom gave additional information about ChemRisk. ChemRisk is a service of McLaren/Hart, Inc. McLaren/Hart employs about 400 people and focuses on assessing environmental hazards. ChemRisk's specific focus is on human health and ecological risks, and it has been in existence for about 10-11 years.

After showing an overhead of the ChemRisk team, a RAEHP Steering Committee member questioned Tom regarding the number of people of color on the team and the number of local people involved. Tom indicated that there is one person of color on the team. In regards to local hires, Tom noted that they will be hiring local administrative support for the document review process, but the issue of maintaining independence comes into play when hiring locals. The comment was made that there are many well-qualified persons of color in Northern New Mexico who could possibly participate in different roles on the ChemRisk team. Tom stated that Susan Flack, the Public Involvement Coordinator whose home base is Denver would be in the area frequently and would be available to answer questions.

Paul Renard reiterated the CDC's desire for public involvement and mentioned that in other areas Federal Advisory Committees have been established in accordance with the Federal Advisory Committees Act (FACA) to provide a means for public input. Through the FACA local individuals who represent the diversity of stakeholders in the community become part of the planning process and work with the CDC. Recommendations to the CDC on this topic should be sent to Paul.

Larry Elliot of NIOSH remarked positively on the level of cooperation that the CDC is receiving from LANL, which he felt was markedly different than the reception that NIOSH received 7-8 years ago when they began a study on workers at LANL. Larry invited attendees who were interested, to speak with him individually about NIOSH's studies of workers at LANL.

Agenda Item #4 Small Groups – Facilitated by Willa Pilar (RAEHP)

Willa announced the topics for the small groups, along with the facilitator for each group. Attendees were encouraged to go to the group that most interested them, or to attend more than one group, depending on their interest(s). The groups and facilitators were:

Health Effects – Retta Prophet (NMDOH)
Lab Processes – Ken Silver (RAEHP) and Susan Flack (ChemRisk)
Culture/ Traditions/ Lifestyles – Johnnye Lewis (RAEHP)
Exposure Routes – Willa Pilar (RAEHP) and Charles Miller (CDC)
Family and Worker Concerns – Karen Mulloy (RAEHP)
Community Relations – Frances Varela (UNM MPH)

After sharing information in small groups for about forty minutes, the entire group reconvened to hear the reports of the main areas of concern from each group. A summary of the notes from each small group is attached.

Agenda Item #5 Closure – Willa Pilar and Paul Renard

Willa Pilar thanked the many people who participated in the meeting and reiterated that their contributions were very important. She asked the CDC to summarize what they had learned from the meeting and their next steps.

Paul Renard stated that he was impressed with the input and attendance at this meeting. He wanted everyone to know that their comments and suggestions were important and that the CDC would try to address as many of them as possible.

J. Lewis (RAEHP, P. I.) Addendum: The RAEHP and associated community participants should be very proud of their efforts at the meeting. The federal agency representatives repeatedly noted how impressed they were with the meeting, the level of participation, and the focus on identifying and documenting concerns. They heard the concern for local participation and protection of lifestyle and culture loud and clear. It's up to us to make sure they act and follow up on those concerns. Congratulations to all!

Contact Information

Toll-free number for LANL Document Discovery Project inquiries or comments (800) 894-0085
E-mail address for comments or questions **Tom_Widner@mclaren-hart.com**

For the CDC National Center for Environmental Health

Paul G. Renard, Project Officer	(770) 488-7045	**pgrl@cdc.gov**
Charles w. Miller, Technical Lead	(770) 488-7046	**cym3@cdc.gov**

For ChemRisk®, a Service of Mclaren/Hart, Inc. (prime contractor to CDC)
Thomas E. Widner, Project Manager (510) 748-5610 **Tom_Widner@mclaren-hart.com**
Susan M. Flack, Public Involvement Coordinator (303) 449-8471 **Susan_Flack@mclaren-hart.com**

For Rio Arriba Environmental Health Partnership (RAEHP)
Johnnye L. Lewis, Principal Investigator (505) 272-4853 **jlewis@unm.edu**
Project Number, (toll free) (877) 427-7422 **arriba@unm.edu**

Notes from Agency Community Interaction Small Group

Facilitator: Frances Varela (MPH UNM)
RAEHP Scholar: Guillermo Vigil

Summary of Agency - Community Interaction Group

This group was comprised of 5-7 (in and out of group) Rio Arriba County residents, a resident of Santa Fe County, a couple of state environment department staff, a representative from the DOE and CDC. The main themes of this group were how to overcome the community distrust which has been built in the past as a result of mis-communication, mis-information and mis-use of research findings from federal agencies, the Lab to local communities. The group emphasized the need for a credible local Citizen's Advisory Board to be created that would have genuine input into the dose reconstruction project, for vigorous community outreach and for an effective public information and education process, based on a public health model, that would have an on-going evaluation component so that it could be re-adjusted over the life of this project.

I. Strategies for Ensuring Community Input into CDC Dose Reconstruction Project:

- Need for independent Citizens Advisory Board to advise CDC
- Community input into research project
- Need for diverse points of view
- Pay attention to diverse participation
- For community boards, need liaisons to key organizations like NMED
- At beginning of process statement of principles stating values: cooperation, respect and identify the process to be used. Build trust - Do what you say you will do
- Trust will be built only if commitments made are delivered
- Come to the community with findings first before publication
- Create a Health Effects subcommittee as has been done at other sites

A) Federal/CDC Citizen Advisory Board Models:

1) Federal Advisory Committee

- Advisory Committee for Energy Related Epidemiological Research (ACERER)
- Advise on the priorities of research
- Appointed by Secretary of HHS, help set agenda

· CDC group originated as a result of down winders with the understanding the health studies needed to be done by independent agencies

· Created memorandum of understanding

· Should there be a formal committee such as a Federal Advisory Committee?

2) CDC Dose Reconstruction Citizen Advisory Boards (CAB):

· Primarily a CDC committee, DOE just helps
· Up to 30 people
· Appointed by the Secretary for HHS after soliciting nominations from the local community, like to appoint local folks
· Meets four times per year for two days at a time
· CAB creates sub committees. This year all the subcommittee around the country met together
· People get per diem reimbursement and travel expenses covered
· Manner for the government to get advice from the public

II. Communication with the Public in Rio Arriba County:

· Hold meetings in Spanish
· Agencies need to develop a model for communication and public relations
· Need a public health model, both information and education
· Create independent ombudsman position and a process to report information
- Don't use tax paper money for frills and fancy paper

A. Where to distribute information?

· Car Wash
· Wal Mart
· Churches
· Make cassettes and CD's available with information
· Radio and TV - create radio dramas and telenovelas

B. How often should information be released/shared?

· When significant information is discovered? How to determine what is significant?
· Periodically?
· At the monthly CAB?

III. Effective Community Outreach

· Outreach to outlying communities - Hard for folks to come in.
· Hold community meetings in all small communities
· 23 Sovereign Native American Nations, need to go to each tribe
· Need effective ways to interact with tribes
· Need a list of contacts for all tribes

A. Evaluation of Effectiveness

· Need to build in evaluation of model to assess effectiveness
· Who is responsible to determine effectiveness of outreach and communication efforts?

IV. Specific Concerns Voiced About LANL

Concerns re. destruction of wastes at LANL over their lifecycles
More information made public about storing and managing waste at LANL

Notes from Health Effects Small Group

Facilitator: Retta Prophet (NMDOH)
RAEHP Scholars: Jessica Johnson

These Notes are still in Draft Form.

Health Data

- Thyroid disease (thyroiditis) written up two years ago-
- Not in environmental impact statement
- Iodine targets 1985 / Releases / stack emissions
- Liver Damage
- Chronic insomnia
- Blurred Vision
- Respiratory Illness (chronic)
- Misdiagnosis to mask actual condition
- Brain damage
- CNS -solvents damage
- Genetic Defects
- Allergies
- Immune system
- Beryllium Related diseases
- Lung
- EIS - Doc's on ground

LANL

- Work/ cause/ protective equipment/ chemical exposure
- No changing upon exit of work place - Carry home contamination
- Dump solvents in environment
- Western Area Dump Site Solvents, Radioactive material
- DHART facility - implodes plutonium with high explosives/ Current building
- Plutonium stockpile of U.S.
- Nuclear Weapons stockpile
- How is safety maintained?
- Been used to support secretion of hazards, i.e. plutonium

Future Activities

- Constellation of health effects beyond cancer
- What about present activity beyond historical investigations
- Testing of plutonium bits
- Question the levels of Radiation/Chemicals detrimental to health and synergistic effects

Recommendation

- Survey to support dose assessment
- Survey results with dose rate
- Confidential way/vehicle to report health data/ pollution events
- Environmental Health Meetings / Events to help open up opportunities
- Hiring local community person to facilitate
- UNM MPH person could potentially help

Notes from Specific Lab Areas and Processes Small Group

Facilitators: Ken Silver (RAEHP) and Susan Flack (ChemRisk)
RAEHP Scholar: Daniel Valerio

Summary Specific Lab Areas and Processes

The first two technical areas we discussed raised broader issues that may be applicable throughout the Laboratory. TA-1 (Old Townsite), which has been the focus of several clean-up efforts in years past, raises the issue of "How clean is it by today's standards?" An underground electrical lines project in the mid-1980's, running from TA-3 to TA-55, raises the issue of whether subcontractors receive information about hazardous areas before commencing work, and whether they leave behind information on contaminated areas once their work is done. Other technical areas of concern from the standpoint of historical exposures were: Acid Canyon (TA-45), Bayo Canyon (TA-10), Omega West Reactor (TA-2), CMR (TA-3), DP West (TA-21), LAMPF/LANSCE (TA-53) and Area G (TA-54). Tritium and depleted uranium were discussed as site-wide concerns. A lively discussion took place on using source term data together with environmental measurements to look for temporal correlations between releases and contamination. Among the environmental media proposed as time-integrated measures of contamination were: trees and tree rings; volcanic ash; sediment cores; and ground water.

Old Townsite (TA-1)

- How clean is it by today's standards?
- How complete are the RCRA clean-up work plans?
- old rad laundry

Underground Electrical Lines (Between TA-55 and TA-3 [CMR])

- mid-1980's a subcontractor from Texas, project for the "hardening" of electrical lines against neutrons
- leaking acid waste lines and an old dumpsite, possibly containing PCBs
- do subcontractors?:
    - receive information about hazardous areas before commencing work?
    - share and leave behind information about hazardous areas once their work is done?

Acid Canyon (TA-45)

- old liquid waste treatment facility today in close proximity to a skate boarding park. Are the kids at risk?

Bayo Canyon (TA-10)

- radiolanthanum (RaLa) experiments c. 1948-1962.
- NMED may be a good source of information on RaLa
- Dynamic and ordnance experiments in Bayo Canyon
- contaminants of historical concern: lanthanum, high explosives, cesium and strontium
- strontium may be accumulating in chamisa (sage) plants.

Omega West Reactor (TA-2)

- mid-1950's until 1992
- shut down due to a tritium leak
- releases from the stack would have occurred at ground level, resulting in greater bystander doses than releases from elevated stacks
- "radioiodines" -- not just I-131, but I-125 as well

CMR (TA-3)

- mid-1950's until the present
- plutonium, americium, and highly enriched uranium.
- PCBs and mercury

DP West (TA-21)

- 1940's until the 1970's
- plutonium and highly enriched uranium

LAMPF/LANSCE (TA-53)

- Neutrons and activation products
- EMF, due to the great quantities of electrical energy used

Tritium as a Site-Wide Concern

- old LANL publication on tritium in honeybees
- Area G
- Hillside 138, south of the Los Alamos Inn's parking lot, fruit tree elevated levels of tritium (and maybe also plutonium and mercury)
- NMED DOE Oversight Bureau and the Lab's Environmental Restoration Program

Depleted Uranium as a Site-Wide Concern

- 100,000 kg was cited as the amount of uranium that has been "blown up" at LANL, and potentially released into the environment, in dynamic experiments over the years

Potential Environmental Indicators of Past Releases

- environmental measurements that might provide a time-integrated picture of past releases from LANL
- Trees and tree rings to measure tritium
- local species of piñon and juniper
- Volcanic ash
- Sediment cores in the Rio Grande before and after construction of Cochiti Dam for patterns of plutonium deposition (Recall: public health advisories regarding consumption of fish caught in Cochiti Lake)
- Abiquiu Dam sediment cores

- local rumors of dumping of LANL wastes in the lake
- dam's hydroelectric power for LANL's energy-intensive processes and its impact on downstream communities who depend upon the river
- "Background" ground water studies, possibly conducted by the USGS and others in the 1930's and 1940's

A Bit of Worker Folklore

- Workers at the linear accelerator (LAMPF/LANSCE, TA-53) talk about the "Meson Ghost," the image of a 12 foot tall woman which appears during certain experiments.
- How would we have to correct our dose calculations to take account of her height and body weight?

Notes from Cultural / Traditional / Lifestyle Impacts Small Group

Facilitator: Johnnye Lewis (RAEHP)
RAEHP Scholars- Peggy Six, Maria Romero, and Louis Lujan

Summary of Small Group: Cultural / Traditions / Lifestyles

This group identified the need for Hispanic and Tribal communities to work together to ensure that traditional and cultural values are incorporated as valued end-points for decision-making when evaluating LANL impacts. In spite of the recognized uniqueness of the individual communities with respect to sovereignty issues, values, traditions, religion, and lifestyles, common-overriding concerns were identified. The communities can speak as one with respect to the importance of maintaining their unique cultures and the need for preservation of privacy to ensure that cultures are maintained. Within these themes, the need for assessment to be tailored within each community can be supported. The communities can also unite on the need for local participation in the process, if it is perceived as valid. This does not mean only shadowing or observing, but by paid positions as technical staff, training of students to develop community expertise, and incorporation of community knowledge in the process.

UNDERSTANDING OF DIVERSITY

- What values are important to tribes and other local communities? (e.g. acequias, sacred sites)
- What are the expectations of this assessment?
- Disruption of cultural/traditional/ceremonial practices is an impact on health
- Uncertainty about safety of environment leads to a loss of traditional use patterns
- Lack of independent verification creates lack of confidence in assurances of safety
- Lack of appropriate non-governmental assessment

CDC Control/ Interaction

- Are contractors independent?
- How can that be demonstrated?
- Walk through to see process only a first step
- "Shadowing" by community
- Sharing declassified documents
- Community not technical
- "Best Science" not necessarily clear or comprehensible
- participation in process is essential
- want local participation – work as a team
- Hire local support on each team – provides community capacity building and increases trust in the process

Cultural Loss

- Locally trying to develop a model to evaluate loss of way of life
- Accept as basis for decision
- Support local ongoing efforts to answer and develop models – don't reinvent the wheel

Lack of Trust in Valley

- Workers know information is classified
- How to build trust with that knowledge in community?
- To be credible must have local involvement and LANL (two-way learning and trust)
- Developing trust is the only way to achieve long term change and respect

Tribal Issues

- Sensitive tribal information must be respected
- Avenues for inclusion
- Protect Resources and culture by maintaining privacy and ownership of information
- Train enough to trust tribal results
- Lack of understanding prohibits participation, especially in tribes
- Gather and interpret information in partnership as means of training and building skill

Hispanic Issues

- Trust essential
- Complete involvement
- Recognition of Uniqueness of culture and history as well
- Same issues of privacy protecting culture

Notes from Exposure Routes Small Group

Facilitators: Charles Miller (CDC) and Willa Pilar (RAEHP)
RAEHP Scholar: Velma Dominguez

Computer Modeling

- Need to account for NM terrain and weather
- Impact of Arroyos and Air pockets

- Currently the EPA model for flat land - does not represent NM
- Need computer modeling unique to New Mexico
- Computer modeling is inadequate - need other methods to account for exposures

Unique Food Chains and Lifestyles

- Food, Game, Plants, all used for both food and ceremonial usage
- Curanderas - collection of food, health care implications, etc.
- Native Beliefs about food sources, animals, etc.
- Healing properties of different foods
- Relationship to spirituality
- Plants and animals create Ambiente

LANL Test Wells

- Location of test wells poorly communicated to public
- Nature of contaminants poorly communicated to public
- Relationship of well location to water sources uncertain

LANL CAB

- Present CAB should not participate in CDC Dose Reconstruction
- History of mistrust - lawsuit
- Present CAB is not neutral

CDC

- Need to communicate to community that CDC are not DOE employees
- CDC need to express openly any conflicts of interest
- Need to include local participation to create a reliable and trustable way to interpret information
- Need reliable (Trustable) way to interpret declassified data from LANL
- Trustable interpretation of LANL Data requires local participation in format and distribution of data

Methods of Advertising and Announcing Findings

- Local Radio: Las Vegas – KNMX, Española and Taos – KDCE, KSWV, KUNM (89.9) and KANW (89.1)
- Local newspapers
- Use many different methods

Past Exposure Routes

- Use Hospital Discharge Data as a reference to identify possible sources and location of contaminants
- Use Tumor Registry as a reference to identify possible sources and location of contaminants

Notes from Worker Family Concerns Small Group

Facilitator: Dr. Karen Mulloy (RAEHP)
RAEHP Scholar: Renee Rivera

Summary of Worker Family Concerns Small Group:

The Worker / Family Concerns small group centered discussion on the experiences of workers and families, their knowledge of environmental releases by LANL, as well as the relationships between workers' and families' and LANL. This collective experience gave the discussion a basis in reality. The discussion was lively among the participants, with many people moving in and out to take advantage of discussion in other groups.

There were many ideas on how the CDC should proceed with its investigation. A list of agencies and people that the CDC should contact was compiled. There were several themes that kept coming up in the discussion. The lack of communication on what is known or not known about toxic releases and health effects was a thread that ran through all topics. The lack of trust was also a major theme. The participants felt that communication was key to building trust between the CDC, LANL, and the community and workers.

Risks /Concerns of Families

Cancer, especially thyroid, hasn't been explained why it's so high

- Cancer rates done, but haven't shared with people in community or haven't explained studies so that they are understandable
- Leiomyosarcoma – 4 deaths in two years
- Previous explanations inadequate to explain cancer rate, (example – in Los Alamos they screen for cancer more frequently than most places)
- Need to get the community involved.
- Concern over materials that are brought down the hill.

Communication

- Families feel as though they have never gotten the truth so they don't know what to do
- CDC trying to say that now it is totally open- How to develop trust to improve communication?
- CDC Meetings regarding LANL on access to records going much different than in the past
- Seems as though obstacles have been cleared for the CDC.
- Tonight is the first time heard from any agency that LANL had resisted cooperating with investigations (referring to NIOSH study)
- NIOSH- 8 years ago not given access to records by LANL despite Q clearances
- CDC should ask for declassified documents early on to get them in time to study.
- Communication of health problems helps CDC focus on specific types of radiation.
- LANL not open to peaceful overtures.
- LANL do not want people to speak up.
- Underrating of exposures by LANL

Agencies/Groups to Involve:

- NIOSH
- CCNS
- Pueblos
- Environmental Restoration Project (background information)
- Ask students who have been employed by labs
- Talk to widows and children of workers
- Will LANL provide a database of retirees?
- LRG (LANL Retirees), but most of participants are Anglo,
- University of California retirees
- previous subcontractors, perhaps can contact trade unions to reach workers
- Try to get politicians involved - state, federal (Bill Richardson)
- retirees not current workers might feel freer to talk about issues
- Carlos Vasquez at UNM has done a study on the impact of LANL on the Hispanic community- has hours of interviews
- Newnet monitors atmospheric and noise interference, explains what could have happened

Worker Concerns

- In order to get accurate historical data need to protect rights of current workers
- Address the issue of employees being able to speak up. Who can they speak to without repercussions?
- Make workers aware of whistle blower program
- Make workers aware of their rights
- Previous attitude was to just get the job done therefore little information about where toxins were dumped
- Another problem is that places where things have been dumped have been built over
- Use oral history to obtain first hand data from workers
- Workers not allowed to raise health concerns
- Need to make people in work places responsible for safety management

Bigger Picture

- Need to focus on the bigger picture.
- Why is the Lab growing? Who made/ makes the decision?
- How will information that is learned in the CDC investigation going to be applied? How will it help public health?
- How will information be reported to the community?
- Talk about the atmosphere of the Lab.
- Questions about wind patterns and exposure
- Known hot spots and other hot spots: Sandia Canyon – Kids used to play there now it's closed; DP Road

Meeting Summary–
Los Alamos Historical Document Retrieval and Assessment Project

Second Public Meeting

Tuesday, July 27, 1999, Santa Fe, NM

Santa Fe Community College, 5:30 p.m. to 7:30 p.m.

Introduction: Paul Renard, CDC Project Officer

(These statements are NOT direct quotes. All statements are paraphrased.)

Paul Renard introduced the topic as an update of the progress made during the last six months of the Los Alamos Historical Document Retrieval and Assessment Project led by the Centers for Disease Control (CDC) at Los Alamos National Laboratory (LANL). During the meeting discussion topics would include the numbers of documents that need to be processed and the number of documents that have been reviewed. Sample documents would also be provided as representatives of the types of documents that are being declassified and made available to the public.

First Speaker: Thomas Widner, Project Manager

(Slide titles presented in bold face, slide contents in italics, and speaker comments in plain text.)
(Speaker comments are NOT direct quotes. All comments are paraphrased.)

Thomas Widner opened his presentation by reviewing basic terminology and the process being used for the study.

Dose Reconstruction
is a comprehensive analysis of the exposure received by individuals in the vicinity of the facilities that release contaminants to the environment -- real doses to real people

This study is a realistic look at what may have happened, where people have lived, where might have there been some releases. This study is trying to find out what happened.

Why Do Dose Reconstructions?
- *Integral part of epidemiologic studies; e.g., Hanford Thyroid Disease Study*
- *Provide a comprehensive history of site operations, including releases*
- *Provide an independent, comprehensive evaluation of risk*
- *Provide a baseline for analyzing impacts of future activities; e.g., clean-up*

The information that is being gathered during this study will be necessary for additional studies, if they are completed.

Dose Reconstruction Activities
Map of the United States noting:
- *CDC Dose Reconstruction*
- *CDC Technical Support*
- *No Current Involvement*

Facilities on Map:
- *Hanford*
- *Lawrence Livermore National Laboratory*
- *Republic of the Marshall Islands*
- *Idaho National Engineering and Environmental Laboratory*
- *Rocky Flats*
- *Nevada Test Site*
- *Los Alamos National Laboratory*
- *Pantex*
- *Sandia National Laboratories*
- *Bendix*
- *Paducah*
- *Fernald*
- *Mound*
- *Ashtabula*
- *Portsmouth*
- *Oak Ridge National Laboratory*
- *Savannah River Site*
- *Pinellas*
- *Republic of the Marshall Islands*

Either the CDC or other departments led the studies of these sites. The studies reviewed past operations and releases.

The Dose Reconstruction Process
- *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*

The current study is the first step of the dose reconstruction process. The information-gathering step will last three years. During the study, the project team will look at all records at LANL to identify what may have been released offsite. Determination of what, when, and how much may have been released offsite may be conducted in the future.

STRESSED: This is an important first step. All the steps may not be completed

Implementing the Dose Reconstruction Process
- *Stages of the process may overlap in time*
- *Stages may be performed iteratively*
- *All stages may not be necessary at all sites*
- *Will involve CDC staff, contractors, the public*
- *Total process may require 4-7+ years to complete at each site*

Iterative stages may occur based on findings that may affect phases the study and the order in which they are conducted.

Retrieval and Assessment of Data

- *Both radionuclides and chemicals*
- *Effluent and environmental monitoring*
- *Facility processes*
- *Release points*
- *Use primary data sources, e.g., notebooks*

The study has a high interest in the most basic records, such as logbooks. About 4000 logbooks have been reviewed already.

Los Alamos Historical Documents Retrieval and Assessment

- *Documents will be retrieved and evaluated for their usefulness for offsite dose assessment*
- *Relevant documents will be declassified (if necessary), copied, made available to the public*
- *Relevant documents will be entered into an electronic database*
- *A prioritized list of contaminant releases from the LANL site will be developed*

The project team is currently establishing a list of notable documents and evaluating those, which contain relevant information regarding releases.

Document Searches

- *LANL Central Records Center*
- *LANL Archives*
- *Technical Report Library*
- *Technical Areas*
- *Work for Others*
- *Other sites; e.g., Federal Records Center*
- <u>*Guiding Principle: No Boxes Left Unopened*</u>

These represent the areas identified to search. Part of the process includes identifying the proper channels to access documentation.

STRESSED: No boxes will be left unopened. In the past they have learned that directed sampling does not reveal all the information, so the LANL study is a more comprehensive look at the records.

CDC Principles

- *Scientific integrity*
- *Open and effective communication*
- *Collaboration with partners throughout the nation and the world*

The information and the process will be available to the public. Part of the process will include workshops that will be conducted during the next two years. Project personnel will work with the public and site contractors. Relevant reports will be released to the public.

“This is a very open process.” The project team knows it can learn from the public, which has information that will enable completion of the work. The team will work with partners including the National Institute of Occupational Safety and Health (NIOSH), the Agency for Toxic Substances and Disease Registry (ATSDR), and other studies related to worker health. The team will share methods and results.

Groups involved in the project

- *CDC's National Center for Environmental Health*
- *ChemRisk, a service of McLaren/Hart, Inc. (prime contractor to CDC)*
    - *Shonka Research Associates, Inc. (document review, database and records management)*
    - *Tech Reps, Inc. (communication)*
    - *Several local consultants to the project team (assistance with public involvement)*

Information will be gathered from:

- *documents on paper and microfilm*
- *technical reports*
- *technical notebooks*
- *interviews of active and retired workers and members of the public*
- *photographs and motion pictures*

The project team has conducted some interviews already, and more are scheduled. However, the team is building a knowledge level before doing much more interviews to make future interviews more productive.

Document Searches

❖ *LANL Central Records Center*
- *LANL Archives*
- *The Report Collection*
- *Technical Areas' Records*
- *"Work for Others" Records*
- *Other sites; e.g., Federal Records Centers*

The LANL Central Records Center is the division where all documents are stored long term.

The study began with the plan to search records in the order noted on the slide. For several reasons, the project team is now spreading out to more locations. The team is trying to improve their efficiency. One problem encountered was regarding the number of people that can work in one location at one time.

The LANL Central Records Center

- *The first focus of our records review*
- *Contains about 18,900 cubic feet of historical records by our count (not including microfilm and fiche)*
- *Most records are in paper form in boxes and drawers or are images on microfiche or microfilm*

Searching the Records Center is a daunting task that was started about five months ago.

(Slide Depicting Photograph of Boxes Stored at Oak Ridge National Laboratory)

The drawers are like file cabinets, but 10 drawers high. Bringing pictures of the center is not allowed, but the Records Center is impressive. It has rows on rows of boxes and drawers and there are also boxes stacked on top of the drawers.

Records in Drawers

- *10 drawers high, with boxes often on top*
  - *Row B-1 190 drawers*
  - *Row B-2 240 drawers*
  - *Row B-3 240 drawers*
  - *Row B-4 190 drawers*
  - *Row B-5 190 drawers*
  - *Row B-6 190 drawers*
  - *Row B-7 190 drawers*
  - *Row B-8 210 drawers*
  - *Row B-9 210 drawers*
  - *Row B-10 190 drawers*
  - *Row B-11 210 drawers PLUS…*
  - *Hundreds of motion pictures, 20 shelves of medical X-rays, 7 shelves of data tapes, 307 boxes on top of the drawers, and 36 boxes in Row B-12.*

One-third of a Typical Row of Drawers

(Illustration depicting row of drawers)

The records in the drawers are organized into bays. To visualize how the bays look, recall the last scene in the movie *Raiders of the Lost Arc* as an example. It is warehouse like. The project team even had to complete ladder training to access documents.

Records in Boxes

- *8 boxes high on metal shelves*
- *Example: F Bay*
  - *16 rows*
  - *3,820 "locations"*

The rows at LANL consist of seven shelves with eight boxes high. Some of the boxes are organized, and others are just a "desk dump." As an example of how many boxes the team will review, F Bay includes 16 rows of boxes with 3,800 locations where boxes can be stored. Some locations are empty because those boxes were retrieved.

Stamps for Marking Boxes

CDC/NCEH✓
REVIEWED

★ CDC/NCEH ★
DO NOT DESTROY

When a project researcher reviews a box, he or she highlights relevant information and marks the box with a stamp. Boxes with relevant information are stamped "DO NOT DESTROY" to protect useful information. In some rows, stamps are on essentially every box in a row.

The Process at the Records Center

- *Documents are reviewed by our project team;*
- *Relevant records are identified, summarized, and flagged in their boxes or drawers;*
- *Boxes are stamped and review logs are updated;*
- *For Category 1 documents and summaries, review for public release is requested;*
- *Classification and Privacy Act reviews occur; and*
- *After clearance, possibly with redactions, the documents are copied for release.*

In some cases, information has to be cut from documents before release. Once released, copies of the documents are provided to ChemRisk and then to the CDC. Another copy will be provided to a local reading room.

Sample Documents (two slides)

- *Stack monitoring data (handwritten data sheets and various levels of summaries)*
- *Documentation of release, usage, or disposal rates for materials not routinely monitored*
- *Accident reports (e.g., fires, criticality excursions, dispersals of radioactive material)*
- *Documentation of releases perceived to be unusually high (for example, from DP West and Omega stacks)*
- *Reports of early radiological and chemical monitoring in streams and canyon soils and sediments*
- *Progress reports of groups involved with health physics, industrial hygiene, and safety programs*

Most documents marked for review have not made it thought the classification and review process. However, documents from some categories were brought as examples of the types of information being recovered.

Note: Copies of the sample documents were made available for the public to take. A slide of each document was also shown.

Sample documents (w/Thomas Widner's comments) included:

- Stack monitoring data

  These are examples of basic monitoring records. Included were log sheets with hand-written stack-monitoring data from the late 40s and 1995. One Office Memorandum was a summary form from 1955. It gives the estimated releases from DP West Building for stack monitoring.

  STRESSED: Again, these are samples. They do not represent highest numbers. Susan Flack is cataloging what has been found so far.

- Documentation of release, usage, or disposal rates for materials not routinely monitored

  These types of records are helpful when monitoring records are unavailable or lacking complete information. One example, an Office Memorandum, discusses materials used during a particular process. Another example, a short report entitled "Disposal of Hazardous Chemicals," lists disposable explosives and estimated quantities.

- Accident reports:

  These reports are often very interesting. The examples discuss fires in radioactive waste burial grounds, a fire in a plutonium-use area, criticality accidents, some resulting in deaths.

- Documentation of releases perceived to be unusually high

  Examples included documentation on the Omega site stacks and memos discussing the DP West Stacks. Concerns stated were regarding significant increases of materials going up stacks, including a suggestion for setting up a test farm down wind. Documentation also discussed the Omega reactor stacks, which were flexible tubing that went up the mesa and were attached to tree near a trailer park.

- Reports of early radiological and chemical monitoring in streams and canyon soils and sediments

  In the early years, this type of information is not as abundant.

- Progress reports of groups involved with health physics, industrial hygiene, and safety programs

  These reports are in the form of annual, monthly, and weekly reports. Many have been flagged, but they have not gone through the declassification review process. These particular examples may not be particularly important to they study, but serve well as the types of documentation being examined.

Records Center Review Statistics (as of July 16th)

Approximate number of "boxes" reviewed:	*3,700*
No. of these flagged for classification review:	*188*
Boxes added to the list for review each week:	*~10 to 15*
Boxes that have been reviewed by S7:	*~40*
No. of these that required Privacy Act review:	*19*
Boxes reviewed and publicly releasable:	*21*
Number of Document Summaries prepared:	*879*
Notebooks reviewed to date:	*over 3,500*
Notebooks flagged for review:	*14*

The number of boxes flagged for review means that in 188 boxes the project team found one or more records that needed public release. It may be one page or the entire box.

The team is currently adding 10-15 boxes each week. The backlog is one issue Paul Renard will discuss. In general, the rate of review is not keeping up with the search.

The Document Summaries will be input into a Microsoft Access database. It will be searchable by such items as time, area, and release.

The team is getting more people cleared for access and is expanding the search to include other facilities.

Progress in Records Center

Storage Area	Number of Locations	Locations Reviewed	*Percent* Reviewed
B I	2,453	611	25%
C Bay	3,870	232	6%
E Bay	2,384	950	40%
F Bay	3, 084	1,407	46%
G Bay	4,184	134	3%

G Bay is in a separate building that requires more support from the Records Center staff.
F Bay may be closer to 50% as of today. The team is picking up speed. It is also moving into Report Library and Archives next. The Archives are in the same building as the Records Center, so the problem with limited number of people with access will be a factor there too.

Second Speaker: Paul Renard, CDC Project Officer

(Slide titles presented in bold face, slide contents in italics, and speaker comments in plain text.)
(Speaker comments are NOT direct quotes. All comments are paraphrased.)

Paul Renard introduced Travis Kubale and Mary Schubauer-Berigan from NIOSH and Joe Maloney from ATSDR, a parallel agency to the CDC.

Current Obstacles (4 Slides)

- Clearances
  – 7 Q's in place – 3 more Q's pending
  - 7 partial Sigmas 10 adequate Sigmas
  – Number of people in vaults – 7 (only 4 in Archives at one time)

- Declassification
  – Now 2 people – ½ days/week
  – Letter designating declassification for this project to be a higher priority
  – University of California plan enumerating amount of resources required to adequately support this effort
  – Tom Widner will present numbers of these boxes.

- Space
  – Only 4 people allowed to work in Archives at one time
  – When and/or if we get more declassifiers, then space issues will again arise in Archives
  – CDC has modified the contract to allow different venues
  - LANL Records Center
  - LANL Archives
  - Technical Report Library

- Problem of Sigmas

– 1-12 are need. Verification and Communication from DOE Headquarters→LANL has occurred.

The document retrieval process is not an easy task. The problem is related to size. At LANL there are more boxes in one building than at the entire Hanford site.

Recent progress is the result of significant collaboration between the Department of Energy (DOE) Headquarters, the DOE offices at Albuquerque and LANL, the University of California, and LANL. Some snags were simple to solve. One problem was that a social security number was transposed. The problems are not caused by stonewalling but by explainable hurdles.

The space issue is a real problem. Because of the limited space in the Records Center, the number of people must be limited as well. There is only room for four people in one area at a time. The contract planned for the whole team to be in one area at a time. Space was not perceived as an issue when the contract was written. To solve the space problem, CDC modified the existing contract to allow searches of more than one building at once.

As of Monday, July 26, the security problems were solved. The required Q clearances and Sigmas were received. This was a monumental task, but it has been solved.

Declassification is a much bigger problem, but all the problems are problems encountered at other facilities as well. The length to solve the problem varies at each site, however.

The declassification problem has occurred because there are not enough declassifiers available. At the Savannah River Site, people were brought out of retirement to get enough declassifiers on board. That is being look at LANL. Currently there are two people available for a half day each week. In addition, a letter was written and received that raises the priority level of the document retrieval and assessment project.

A lot has happened during this last day and one half. The message now is that there is a path forward.

Another issue recently surfaced. DOE-Albuquerque is the official reading room for the area, and it has been determined that the records released by this project will be sent there for now. The project team is trying to get something more locally.

Another concern was whether Richardson’s security proclamation would slow down the study. The project team received a letter stating that the study will be exempt.

Public Commentary and Questions

(These statements are NOT direct quotes. All statements are paraphrased.)

Public: How will the documents be organized
Paul Renard: We have recommend that all the records be kept in one place. Along with the records, we will provide some background--maybe a copy of the proposal and the contract. We want people to be able to find and look at the information from the study.

Public: Can I make a recommendation that a site such as the University’s Government Documents Center be considered as a possible location? They are prepared for organizing and preserving the documents. On the other hand, the DOE reading room is open from 9-5, which proves a burden to get access. Will there be a duplicate source--maybe via the Internet or other source?
Paul Renard: The deliverable for this project is a database, which may be provided on a CD-ROM. We will consider your recommendations.

Public: What years are included in the study?

Paul Renard: The CDC study will look at the time from when LANL opened to the present. NIOSH looks at workers stuff. ATSDR considers future events. All these groups are working on the same topic in different areas.
Tom Widner: The project team will also collect information from other related areas. The Trinity Site is an example.

Public: If you do a full-blown dose reconstruction, what is the process? Will information be generic, or will it describe specific releases at specific times?
Paul Renard: A dose reconstruction will look at scenarios of different types of people at different times.

Public: How specific will a dose reconstruction be?
Paul Renard: The person that can answer that question is not here. I can say we may certainly do a dose reconstruction. If we do, it will not be completed in a vacuum. The process will be discussed, and we will work with the public. Right now we are in the first phase, which is huge in itself.

Public: Is there specific criteria to determine if a dose reconstruction is necessary?
Paul Renard: No. At Fernald, a complete dose reconstruction will be completed based on the fact that some silos were never capped allowing radon to escape. It would be very premature to say that in New Mexico we are going all the way to a dose reconstruction. The decision will be made with the public.

Public: Why didn't you get a letter regarding the level of commitment from day one?
Paul Renard: We did get some. We had five to six declassifiers. We met them, and their manager said there would not be a problem. I do not think he knew the magnitude of the study. We still face some problems, but we have cleared major hurdles. It took seven months to get over them, but we are making progress.

Public: Are there people at other sites that are already qualified?
Paul Renard: The ChemRisk team all had Q clearances, but there were problems transferring the clearances to LANL.

Public: Why aren't more declassifiers working on the CDC study?
Paul Renard: All the declassifiers were not available for our project. They have been on other projects. Now the letter should increase priority for this project.

Public: Regarding declassification, what is it?
Paul Renard: Some of the documents are classified and must be declassified. Others are not classified but must be reviewed. I don't know if there are different declassifiers for different types of documents? All the information has to be reviewed.

Public: There is a real public trust issue regarding the DOE-Albuquerque reading room. It has a reputation for having the biggest and "baddest" lawyers. It's the hens and foxes analogy.
Paul Renard: The DOE reading rooms are a vehicle to make information available to the public. There is a huge expense in running them. We are concerned about the public perception. I don't have something worked out. May be we can do something at other locations. The database is a potential for checks and balances. CDC has worked with reading rooms before.

Meeting Summary–
Los Alamos Historical Document Retrieval and Assessment Project

Third Public Meeting

Tuesday, October 5, 1999, Los Alamos, NM

Fuller Lodge, 4:00 p.m. to 6:00 p.m.

Introduction: Paul Renard, CDC Project Officer

(These statements are NOT direct quotes. All statements are paraphrased.)

Paul Renard introduced the topic stressing the importance of conducting interviews with active and retired workers as part of the Los Alamos Historical Document Retrieval and Assessment Project led by the Centers for Disease Control (CDC) at Los Alamos National Laboratory (LANL). Renard explained how retirees were an essential part of other projects including at the Savannah River Site (SRS). Their interviews provided information that helped researchers find valuable documents. Renard also explained that interviewees may remain anonymous, that security concerns will be dealt with, and all material will be reviewed for classified information before being released.

Renard also invited the public to contact retiree groups at Fernald and SRS to discuss the interviewing process and find out about their experiences when they participated in similar studies.

Renard also reviewed some of the obstacles the LAHDRA team is facing at LANL including obtaining the required clearance levels and access, space limitations, and hold ups with the classification review.

Renard introduced:

- Charles Miller, the project's technical lead and the Chief of the Dosimetry Section at CDC.
- Mary Schubauer-Berigan, NIOSH representative

Primary Speaker: Thomas Widner, Project Manager

(Slide titles presented in bold face, slide contents in italics, and speaker comments in plain text.)
(Speaker comments are NOT direct quotes. All comments are paraphrased.)

Thomas Widner began his presentation by reviewing basic terminology and the process being used for the study.

Dose Reconstruction
is a comprehensive analysis of the exposure received by individuals in the vicinity of the facilities that release contaminants to the environment -- real doses to real people

The general process is called dose reconstruction; it is different from cleanup risk assessment, which looks at hypotheticals. The LAHDRA study is a realistic look at what may have happened, where people have lived, where might have there been some releases.

Dose Reconstruction Activities
Map of the United States noting:
- *CDC Dose Reconstruction*
- *CDC Technical Support*
- *No Current Involvement*

Facilities on Map:
- *Hanford*
- *Lawrence Livermore National Laboratory*
- *Republic of the Marshall Islands*
- *Idaho National Engineering and Environmental Laboratory*
- *Rocky Flats*
- *Nevada Test Site*
- *Los Alamos National Laboratory*
- *Pantex*
- *Sandia National Laboratories*
- *Bendix*
- *Paducah*
- *Fernald*
- *Mound*
- *Ashtabula*
- *Portsmouth*
- *Oak Ridge National Laboratory*
- *Savannah River Site*
- *Pinellas*
- *Republic of the Marshall Islands*

The map indicates where similar studies were completed or ongoing studies. The studies leaders are either the CDC or state health departments.

Public: People at other locations other than LANL were also exposed. Will you examine those too?
Response (Charles Miller): CDC has two other projects going on: Marshal Islands and Christmas Islands

Why Do Dose Reconstructions?
- *Integral part of epidemiological studies; e.g., Hanford Thyroid Disease Study*
- *Provide a comprehensive history of site operations, including releases*
- *Provide an independent, comprehensive evaluation of risk*
- *Provide a baseline for analyzing impacts of future activities; e.g., clean-up*

The information we gather can be useful wherever a good historic background is helpful.

The Dose Reconstruction Process
- *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*

We are in the retrieval and assessment stage. As the process advances, it becomes more detailed and rigorous.

Retrieval and Assessment of Data
- *Both radionuclides and chemicals*
- *Effluent and environmental monitoring*
- *Facility processes*
- *Release points*
- *Use primary data sources, e.g., notebooks*

The study is concerned with both radionuclides and chemicals. Effluent monitoring is one of the main areas being examined. We are interested in release points and our focus is on raw data rather than annual summary reports.

Los Alamos Historical Documents Retrieval and Assessment
- *Documents will be retrieved and evaluated for their usefulness for offsite dose assessment*
- *Relevant documents will be declassified (if necessary), copied, made available to the public*
- *Relevant documents will be entered into an electronic database*
- *A prioritized list of contaminant releases from the LANL site will be developed*

These are the tasks being conducted during the first stage. It is a process of gathering data and assembling the information in a database. One of main products of this stage will be a list of materials released offsite.

Document Searches
- *LANL Central Records Center*
- *LANL Archives*
- *Technical Report Library*
- *Technical Areas*
- *Work for Others*
- *Other sites; e.g., Federal Records Center*
- *<u>Guiding Principle: No Boxes Left Unopened</u>*

The groups involved in the project are ChemRisk, the prime contractor to CDC; Shonka Research, which is providing a lot of engineers and scientist; Tech Reps, communications support, and other local contacts.

The document search started at the Central Records Center. The Technical Report Library is another important source. Tech Areas will be a challenge. The process identifies where materials are and evaluates the types of information they contain. Other sites will be included to locate and evaluate those records that were shipped off site. The research team is following the guiding principle of “No Boxes Left Unopened to ensure that the search is thorough and comprehensive.

We Seek Descriptions of:
- *Materials that were used at LANL,*
- *Facilities they were used in,*
- *Processes they were subjected to,*
- *Measures taken to contain materials,*
- *Monitoring of wastes and effluents,*
- *Environmental measurements, and*
- *Locations and activities of residents.*

This is where we really need the help of retirees and workers. In addition to information about LANL activities, information about residents such as where they lived, where they got their water, milk, and food, is also very important.

The LANL Central Records Center

- *The first focus of our records review*
- *Contains about 18,900 cubic feet of historical records by our count (not including microfilm and fiche)*
- *Most records are in paper form in boxes and drawers or are images on microfiche or microfilm*

The initial focus of the study was the Central Records Center, which contains Row after row of these drawers of records **(Slide of graphic depicting row of file cabinets with drawers stacked 10 high)**. Records include many varieties from computer punch cards to typical paper records. **(Slide Depicting Photograph of Boxes Stored at Oak Ridge National Laboratory)** Other records are stored in boxes, as shown in this picture of another site. This gives you a general understanding of what we are dealing with.

Stamps for Marking Boxes

CDC/NCEH✓
REVIEWED

* CDC/NCEH *
DO NOT DESTROY

As part of the process, materials reviewed are stamped indicting that they have been reviewed. Materials found as essential to the study are also stamped. Researchers also keep logs of the materials in the boxes.

Records Center Review Statistics (as of August 31)

Approximate number of "boxes" reviewed:	*5,650*
No. of these flagged for classification review:	*298*
Boxes added to the list for review each week:	*~10 to 15*
Boxes that have been reviewed by S7:	*~55*
No. of these that required Privacy Act review:	*26*
Boxes reviewed and publicly releasable:	*41*
Number of Document Summaries prepared:	*1,043*
Notebooks reviewed to date:	*over 3,500*
Notebooks flagged for review:	*15*

This slide summarizes what we have been able to complete so far in the records center. The classification reviewers are limited to about 8 hours per week, which is limiting the amount of material that has been released. Documents are being prepared and made available in a database. These numbers exclude the microfilm and microfiche.

Progress in Records Center

Storage Area	Number of Locations	Locations Reviewed	*Percent* Reviewed
B Bay	2,453	1,107	45%
C Bay	3,870	917	24%
E Bay	2,385	1,759	74%
F Bay	3,084	1,406	46%
G Bay	4,184	461	11%

The Records center is broken up into bays. G Bay is lagging behind because it is in a separate building making it harder to get to. It also requires more logistical support. We are seeing possible some duplication of paper records in microfiche.

Interviews with Current and Retired Workers Help Us:

- *Identify and describe operations possibly associated with off-site releases*
- *Identify relevant collections of records*
- *Develop our understanding of historical operations*

We find, more and more, that records are stored all over the place, and workers are helping us identify these places. They help us assemble the big picture.

Interviews with Current and Retired Workers Help Us:

- *Identify interview candidates with knowledge about specific subject areas*
- *Interpret information from documents or other interviews, or fill in gaps*
- *Understand record-keeping practices of years gone by*

Workers can help identify those people who contain a wealth of information. They can also help us interpret the records we are finding. They identify jargon, meanings, and fill in gaps of what we see. They can tell us what might be out there, what to look for, and where to look for it.

Who Do We Interview?

- *Candidates are often identified from author or distribution lists from key documents, from division rosters or progress reports, or from other interviews*
- *Interviews can be conducted with individuals or with groups*

Interviews can be conducted in a variety of places to help maintain privacy or secrecy, as needed. In another study, a retiree was interviewed by request in a McDonalds 20 miles away. Interviewee may also remain anonymous.
The interviews are flexible. Generally, at least two project members participate so that one can talk and the other can take notes. This method allows the team to capture the information while keeping an interview going.

Public: Will you send letters stating your wish to interview someone?
Response (Tom Widner): We use a number of methods including going through our LANL contact Joe Graph. Everything is done individually depending on circumstances. The process is informal. We are trying to put together an accurate record. We are not trying to amplify or hide information.

Important Facts about Interviews:

- *All interviews are voluntary*
- *Interviews can remain anonymous; names can be excluded from our records*
- *Those who held security clearances in the past can receive authorization to speak freely during the interviews*

As we go through the process we hope to build your confidence. The interviews are voluntary and can be anonymous. We will maintain confidentiality. For people with security clearances, we can get approval to talk about possibly classified information for a specified time for a specified purpose. We will protect information and people.

Important Facts about Interviews:

- *We prepare a summary of each interview*
- *Summaries are reviewed for classified information*
- *Interviewees are given the opportunity to review the summaries for factual accuracy*
- *Summaries enter our project database*

Summaries may be excluded from database.

Conclusion: Paul Renard, CDC Project Officer

Paul Renard invited those attending to participate in interviews or by identifying others who may be information resources. He provided the 800 number. In addition, the project is developing a web site for the World Wide Web. It will contain project information and meeting summaries.

Public Commentary and Questions

(These statements are NOT direct quotes. All statements are paraphrased.)

Public: What are you focusing on regarding materials?
Response: Use, containment, toxicity, quantities, evidence of off-site release or release into the environment. On many materials, we are seeing that a lot of the original toxicity research was conducted at LANL.

Public: Were you involved in the Hanford search?
Response (Tom Widner): No, Charles Miller and Paul Renard were.
(Charles Miller): Two or so years ago the CDC released a draft form of the toxicity study of Hanford. Some people were not happy with the way the report was released. The biggest problem with a study of that type is that an epidemiology study will never establish whether or not a personal illness was directly caused by a release. Hanford is one of the reasons we are conducting the study in the manner we are at LANL. Hanford was a directed study. There never was a search of ALL records. That's why we are looking at EVERYTHING carefully. We are committed to completing Phase 1 right now. We are establishing a very good historical record of LANL.

Public: If the study showed thyroid cancer four times higher than elsewhere, would a full-scale study be conducted?
Response (Charles Miller): Cancer rates are a piece of information that would factor in.

Public: Have you published a list of criteria to cause you to flag a document?
Response (Tom Widner): We put together a search plan that contains some criteria. We also rely on the knowledge and experience of the researchers. We can share search plans that describe the type of information we are looking for.
(Paul Renard): CDC does not want ChemRisk to do a lot of analysis in this phase. The second phase is reserved for the analysis of records.

Public: What happens if you can not declassify records?
Response (Paul Renard): We have always been able to release all relevant records, although they do come out sanitized.
(Charles Miller): We have never found dose information that has been nationally sensitive. All could be sanitized and released showing the pertinent information. I'm aware this site is different. We will tell the public if a document can't be released.

Public: Does the focus include things that came here and then went off site. I mentioned earlier Utah and the NTS as concerns of exposure to people working there. Workers here had the potential of a lot more exposure.
Response (Mary Schubauer-Berigan): NIOSH has a study going on regarding luekemia. The agency is interested in information from this study. They are providing NIOSH with a log of information that NIOSH may find useful.
(Tom Widner): The focus is on off-site exposure, but we are also cataloging worker exposure.

Public: Can you elaborate on where the documents will be held for public review?
Response (Tom Widner): The official DOE public reading room is at the Zimmerman library in Albuquerque. We are looking for a location for a more local reading room. Currently we are making previously scanned records available and will start sending documents there in a couple of weeks.
(Paul Renard): This is one of the hurdles we face. Once we were told the reading room was on Kirtland Air Force Base. The UNM library is more accessible, but we still want to get something more local. We will announce when the reading room is set up and the documents are available.

Public: I know LANL information was found at Oak Ridge National Laboratory (ORNL). How much has already been shipped out?
Response (Tom Widner): There is a lot of ORNL stuff here--a lot of sharing.

Public: Off-site test documentation is available in Nevada at reading room there.
Response (Ken): The steering committee of Rio Arriba sent a letter to Bill Richardson to get a local library in Espanola. The letter was sent about five weeks ago. No response yet.

Public: We also sent him a letter to get more declassifiers made available.
Response (Paul Renard): We are wrestling with the declassification system. The University of California has a contract announcement out to get some more people available in the short term and get classification review officers on line on a permanent basis for the project.
(Tom Widner): What Paul just said is an important step. We can't do much with the documents in the boxes until they are released. We want to make them available to the public as soon as possible. Sample documents released earlier were found useful by some members of the public.

Public: Where are you at with the FACA?
Response (Paul Renard): A FACA is the only way the federal government listens to consensus advice. The Rio Arriba people and others around Espanola are not interested in a FACA. CDC is very interested in looking at alternative ways to enhance public involvement. FACAs are expensive, and we are unable to conduct them properly in all 17 locations. We pledge to have regular public meetings at various locations to give updates on findings and hurdles. If you are not on the mailing list please sign up, and please spread the word.

Meeting Summary–
Los Alamos Historical Document Retrieval and Assessment Project

Fourth Public Meeting

Wednesday, March 8, 2000, Taos, NM
Taos Convention Center, 5:00 to 7:00 p.m.

Introduction: Paul Renard, CDC Project Officer

(These statements are NOT direct quotes. All statements are paraphrased.)

Renard introduced:

- Charles Miller, the project's technical lead and the Chief of the Dosimetry Section at CDC;
- Tom Widner, Program Manager.

Renard explained that this is the fourth meeting. Other meeting meetings will be held at different locations in New Mexico to give everyone a chance to attend a LAHDRA meeting.

This meeting will highlight progress, summarize existing obstacles, and provide examples of results.

The project is the result of a Memorandum of Understanding (MOU) that carved out positions and dollars to examine Los Alamos National Laboratory (LANL) records. Other sites that were investigated include Savannah River, Fernald, and Hanford. These studies are examples of environmental dose reconstruction studies. The LANL study is a first step that may or may not lead to a dose reconstruction.

During the LANL study, which has been on-going for about a year, the LAHDRA team will examine all records and determine which are pertinent to a dose reconstruction. The deliverable will be a database of releases and supporting documentation.

We are asking the public NOT to trust us. Get involved; push us; ask us about things that do not seem right.

Some of the hurdles we have faced have become success stories in some cases. We have obtained all necessary badges and access privileges. We are getting sufficient number of reviewers. The successes are a result of collaboration between Department of Energy (DOE) headquarters, DOE-LANL Operations, DOE-Albuquerque, and the University of California. The collaboration was made possible through conference calls held about every two weeks.

Primary Speaker: Thomas Widner, Project Manager

(Slide titles presented in bold face, slide contents in italics, and speaker comments in plain text.)
(Speaker comments are NOT direct quotes. All comments are paraphrased.)

Widner gave a brief overview the project process, project goals, and progress to date. He also presented samples of relevant LANL documents to members of the audience for review.

Dose Reconstruction
is a comprehensive analysis of the exposure received by individuals in the vicinity of the facilities that release contaminants to the environment -- real doses to real people

The emphasis of the LAHDRA project is an examination of real doses to real people. It does not consider hypothetical doses or events. The project is looking at both chemicals and radionuclide releases.

Why Do Dose Reconstruction?

- *Integral part of epidemiological studies; e.g., Hanford Thyroid Disease Study*
- *Provide a comprehensive history of site operations, including releases*
- *Provide an independent, comprehensive evaluation of risk*
- *Provide a baseline for analyzing impacts of future activities; e.g., clean-up*

The primary reason for a dose reconstruction is to support epidemiology studies. For example, the Hanford study provided a comprehensive history of what has occurred at the site. Studies like this often are the first comprehensive study of a site. The site history is one of the most worthwhile products of the project. Other agencies use the information we gather for their studies.

Dose Reconstruction Activities

Map of the United States noting:

- *CDC Dose Reconstruction*
- *CDC Technical Support*
- *No Current Involvement*

Facilities on Map:

- *Hanford*
- *Lawrence Livermore National Laboratory*
- *Republic of the Marshall Islands*
- *Idaho National Engineering and Environmental Laboratory*
- *Rocky Flats*
- *Nevada Test Site*
- *Los Alamos National Laboratory*
- *Pantex*
- *Sandia National Laboratories*
- *Bendix*
- *Paducah*
- *Fernald*
- *Mound*
- *Ashtabula*
- *Portsmouth*
- *Oak Ridge National Laboratory*
- *Savannah River Site*
- *Pinellas*

At some of these sites CDC has served as the technical advisor. The project team was involved in quite a few of the sites. It is amazing of how inter-related the sites are. This is the first phase of the dose reconstruction process.

Retrieval and Assessment of Data

- *Both radionuclides and chemicals*
- *Effluent and environmental monitoring*
- *Facility processes*
- *Release points*
- *Use primary data sources, e.g., notebooks*

We are looking for data on off-site releases. We use the basics: interviews, handwritten log books. We find these the most reliable and most useful.

Los Alamos Historical Documents Retrieval and Assessment
- *Documents will be retrieved and evaluated for their usefulness for offsite dose assessment*
- *Relevant documents will be declassified (if necessary), copied, made available to the public*
- *Relevant documents will be entered into an electronic database*
- *A prioritized list of contaminant releases from the LANL site will be developed*

These are the tasks being conducted during the first stage. It is a process of gathering data and assembling the information in a database. One of main products of this stage will be a list of materials released offsite.

Sample Document: Document Summary Form Report

The Document Summary Reports will be placed in a database. Most relevant copies of the actual documents will be made available in a public meeting room. During the process, the reviewer uses the form to prioritize the document's importance, identify types of releases, and to describe the amount of a release and the importance of the release.

Document Searches
- *LANL Central Records Center*
- *LANL Archives*
- *Technical Report Library*
- *Technical Areas*
- *Work for Others*
- *Other sites; e.g., Federal Records Center*
- *Guiding Principle: No Boxes Left Unopened*

Other sites could include such locations as the Federal Records Centers or National Archives.

No stone will be left unturned. The entire team has received security clearances, and they have been given unprecedented access to LANL records.

Groups involved in the project:
- *CDC's National Center for Environmental Health*
- *ChemRisk, a service of McLaren/Hart, Inc. (prime contractor to CDC)*
    - *Shonka Research Associates, Inc. (document review, database and records management)*
    - *Tech Reps, Inc. (communications)*
    - *Several local consultants to the project team (assistance with public involvement)*

Introduced: Paul Renard and Charles Miller, of CDC; Joe Shonka, of Shonka Research; and Cheryl Allen, of Tech Reps. Tech Reps is building a web site, which will be another avenue for sharing our progress.

Our Assignment

To collect and evaluate information relevant to the assessment of off-site releases or health effects from Los Alamos operations.

We are searching boxes, microfilm, microfiche, notebooks, motion pictures, and more.

Document Searches

- ★ *LANL Central Records Center*
- *LANL Archives*
- ★ *The Report Collection*
- ★ *Technical Areas' Records*
- *"Work for Others" Records*
- *Other sites; e.g., Federal Records Center*

So far the project team has been hitting the Central Records Center hard. However, they have changed their approach to spread out to the Report Collection and Tech Areas. Ten people on team hold security clearances. They trade off visits to LANL to search for records.

Records in Boxes

- *8 boxes high on metal shelves*
- *Example: F Bay*
  - *16 rows*
  - *3,820 "locations"*

The Records Center resembles the last scene in the movie, Raiders of the Lost Arc. This photo is not from LANL, as they will not permit photos to be taken, but LANL's records storage looks very similar. Each box is looked through. Relevant items are flagged to copy, then reviewed for classified and privacy act content.

Stamps for Marking Boxes

CDC/NCEH✓
REVIEWED

★ CDC/NCEH ★
DO NOT DESTROY

As part of the process, materials reviewed are stamped indicting that they have been reviewed. Materials found as essential to the study are also stamped. Row after row of boxes now have these stamps.

Records Review Statistics (as of mid-January)

Approximate number of "boxes" reviewed:	*8,045*
No. of these flagged for classification review:	*345*
Boxes added to the list for review each week:	*~10 to 15*
Boxes that have been reviewed by S7:	*~300*
Number of Document Summaries prepared:	*~1,400*
Drawers of Notebooks reviewed:	**1,200**
Number of LA reports reviewed:	*~1,500*
Drawers of microfilm/fiche reviewed:	*~20*

We add about 10 boxes or so each week. Contract classification reviewers were brought in, and the backlog has been greatly reduced. Review of the microfilm and fiche is labor intensive. The number of LA reports reviewed now is closer to 2,000.

Progress in the Records Center

Storage Area	Number of Locations	Locations Reviewed	*Percent* Reviewed
B Bay	2,453	1,966	80%
C Bay	3,870	2,729	71%
E Bay	2,385	2,214	93%
F Bay	3,084	2,687	87%
G Bay	4,184	894	21%

These numbers are current as of the middle of January. It is now probably a couple percentage points higher for each. G Bay is more difficult, but the level of effort was increased and is now 80% complete.

Interviews with Current and Retired Workers Help Us To:

- *Identify and describe operations possibly associated with off-site releases*
- *Identify relevant collections of records*
- *Develop our understanding of historical operations*

Another initiative that will be important is interviews with active and retired workers. Some have been conducted, and the team will be doing more. Interviews are relevant sources of information, and they help identify records that were previously unknown to the team. Special arrangements can be made to allow retires to speak freely about past operations and potential releases.

Interviews with Current and Retired Workers Help Us To:

- *Identify interview candidates with knowledge about specific subject areas*
- *Interpret information from documents or other interviews, or fill in gaps*
- *Understand record-keeping practices of years gone by*

Assistance provided through interviews is very helpful to bring an understanding to some records. For example, the terminology has changed and not all aspects of an operation are always documented.

Sample Documents: Air Samples from 10/8/45 to 4/19/46

One of our firsts goals is to locate stack monitoring data. This document, from a technical area facility, gives air tolerance levels. We look at how results compare to tolerance levels.

Renard: As a non-scientist, why is this chart significant?

Public: Who is going to do the analysis to determine if it was significant?

Widner: We will prioritize as we collect information. When we look at records, we also must identify other information that will substantiate or complement the information already found. In this example, such information includes filters, how sampled, how often sampled, where sampled. This is just one piece of the puzzle. We must collect all the information to determine significance.

Renard: CDC or its contractors will analyze the information in another phase.

Miller: To determine what is significant we must first determine what are they filtering. We have the counts per minute; we know the facility; we must find out what they are sampling.

Widner: Here they are just doing particle sampling. The records do not indicate what they are sampling. That was assumed based of the radioactive materials used in the building.

Public: How complete are the records?

Widner: That is hard to determine at this time.

Public: How organized is the data?

Shonka: I happen to know this was a plutonium facility. They were looking at radon and trying to account for long-lived particles. While each individual box is well organized, the boxes themselves are not organized. The technicians were very meticulous in record keeping.

Sample Document: Group GMX – 3 Effluents

Older records are difficult to find. For information about chemicals we often have to rely on anecdotal records from across the site. Chemicals were not well documented. This document lists solvents and buildings where high quantities of explosives were stored or set off. Many clues are obtained here about what chemicals were released. We also have some modern day chemical inventories, and from there we are working backward.

Renard: What Tom just said is true at most sites. The chemical paper trail is not complete in the early years.

Widner: Documents that show the amount of chemicals used and disposed of are used to piece together the whole picture. Quite a variety of toxic chemicals were used at LANL.

Document Sample: Air Monitoring Results; DP West

This is another example of stack monitoring showing day and night counts. It shows different counts at the DP West facility. We need to find out how they came up with that number to determine if it is significant or not.
Document Samples: Information on Plutonium Emissions, Ambient Concentrations, and Resulting Doses.

This set of four documents is a compilation from microfilm about stack releases from Tech Area 3. A large number of releases came from this facility. The types of filters used are important to know because older filters are not as efficient. This packet talks about adding better filters and justification for adding new filters. The documents talk about efficiency of the filters. Some bag filters were found to be between 0 and 80% efficient. HEPA filters were added that drastically reduced emissions.

Miller: We are trying to collect actual handwritten records to make sure original records match handwritten datasheets.

Widner: Original datasheets are preferred. This report concludes new filters were not justified at that time.

Regarding incidents, we have found documents that include meteorology data such wind speed. Such information helps determine off-site consequences. Again, we prefer raw meteorological information.

This last example gives an indication of high releases. We are seeing where an operation contributed to high-releases. Such records point us in other directions to look for additional information. This identifies specific monitoring. We are also mindful of other operations that were not monitored -- enriched uranium was closely monitored; unenriched uranium was not monitored as closely because it was not as expensive.

Public Commentary and Questions

(These statements are NOT direct quotes. All statements are paraphrased.)

Ken Groves: Where will future searches focus?

Renard: The contract was originally set up with funding increments, based on finish a venue (one area would be searched, when finished the team would move to the next, etc). In practice this did not work because of space problems. The revised contract allows ChemRisk staff to work in more than one location. Some bays have been focused on. Now the team will be moving into other places that we consider important. We will be moving to the tech areas soon and will be finding more of these "nuggets."

Widner: More information is being made available off site.

Public: We have heard of records that have been moved or destroyed. Stories that are not supposed to be repeated—like dumping in canyons

Widner: Interviews are helping. However, we will never be able to gather all the information to complete the whole picture. We start with documents and use interviews to fill gaps.

Public: We are concerned because this is the most secret lab in the United States.

Widner: We are not being excluded from any records.

Renard: Some of these stories probably are true. But this is one of the reasons we like to go back to original logs. These are good people. They were conscientious when filling out the records. We will fit together the pieces, but when we are finished, there will be some gaps. So far it is too early to determine if the puzzle will be fairly complete or more like Swiss cheese. We are confident that we will get enough to get a good picture.

Public. Have you seen numbers indicating that boxes were destroyed?

Miller: At Idaho it was discovered that some boxes had been destroyed. Now, DOE has a moratorium on destruction of boxes that are important for epidemiology studies.

Widner: At LANL, three copies are being made of relevant documents.

Miller: At Idaho, CDC did not ask for the most relevant documents to be copied. Here ChemRisk is making copies of all relevant documents.

Public: We are making the records available at the public library in Los Alamos. However there is interest in establishing a reading room at Northern New Mexico Community College in Espanola, NM. The logistical problems must be resolved. Right now the only thing we can do is get the documents out of LANL. It was also suggested that Santa Fe would be a good place.

Renard: The MOU agreed to provide one set of documents for a public reading room. Dollars are in question. CDC has stepped back. With the reading room there is a huge financial obligation because the records must be followed for a long time. The documents going to the Los Alamos Public Library reading room are copies with no alterations. The library has a copy machine. We have to remember that Zimmerman Library in Albuquerque is the official DOE reading room, but we are trying to keep the records available in the Los Alamos area. The funds are not available to have multiple reading rooms. This is a big effort to get the records out of LANL. We need a place with good public access and good hours.

Public: It seems there is nothing written in stone. Yet, there is a very interested group in Espanola. It would benefit lab scientists if the records were off the hill. There exists an animosity between the public and LANL.

Public: Is LANL more interesting than other sites?

Widner: Each site is different and has different hurdles. LANL is interesting regarding the variety of operations and materials used over the years.

Public: What are your reactions to DOE's comments about releases and cancer for workers? What is the relationship to off site residents?

Renard: I cannot comment on that DOE headline. It is news to everyone. You need someone from DOE to comment. CDC is looking at off-site releases. Our focus is the public. NIOSH is worker focused. They will benefit from this study, as well. ASTDR is looking at current and future risks rather than historical risk.

Public: DOE admits radiation caused cancer in its workers. What will DOE admit to regarding public contamination?

Widner: We do not accept things at face value. We use these items as clues to find corroborating evidence. We don’t believe everything we read in every document. We play one against the other to formulate conclusions.

Miller: We are establishing a database as a record. It is establishing a baseline. We do not have all the answers today, but the database will preserve the information. We are at the first stage of the first real history of LANL. It will grow. Sometime, probably before the end of the summer, Tom Widner will produce a report summarizing what the team has found up to this point. It will be a work in progress. The public will need to read the report and contribute.

We will make the report available on the web site. We will announce it via a mailing. When you receive notice, tell your neighbors and former LANL workers. This will be a draft for which we will need feedback. Give us guidance.

Public: What do you mean by the national security question?

Miller: The team does not have access to two types of documents. One type contains information on how to steal a nuclear weapon. The other covers how to diffuse a nuclear weapon. This information is strictly technical data. We are confident it would not be relevant to any type of dose reconstruction.

Renard: So far we have not been denied access to anything we have requested. We fully anticipate being able to look at all records. If we cannot, we will tell you.

Public: Is there a nuclear exemption for a nuclear research reactor around 1969, 1970? Is this part of the study?

Widner: I have looked through a document regarding that particular issue, and it is not marked with such an exemption.

Shonka: We are looking at real weapons information.

Public: Which part of your organization is conducting the interviews?

Widner: The same people that are reviewing documents.

Public: How have you identified people to interview?

Widner: We held a previous meeting regarding interviewing. Plus the University of California has a list of retirees to contact. Some retirees do not want to be bothered. Others are a gold mine of information. We can conduct interviews in remote locations and the interviewees can remain anonymous. Please recommend people.

Public: Is there another part of CDC that is collecting data now?

Widner: We do not do any monitoring. We are interested in the data other organizations collect, but we do not do any sampling. We have contacted sister agencies to see what they are doing and are collecting data from them.

Public: Do not use the CAP 88 Model at LANL. It does not work.

Miller: This study is gathering and prioritizing information. After this is study is completed, we will need to evaluate on where to go from here. We may have to use some modified models or develop new models. We have no preconceived notions of what models we will use.

Attachment: Results of Public Meeting

Attendance

Twenty-four (24) people attended the March 8, 2000 public meeting held at the Taos Convention Center, El Taoseno Room, 120 Civic Plaza Drive, in Taos, New Mexico from 5:00-7:00 pm. Thirteen (13) people signed the sign-in sheet at the meeting. seven (7) people in attendance were representatives of CDC, NIOSH, or CDC contractors (i.e., ChemRisk, Shonka Research Associates, and TechReps). Three (3) people in attendance were from the University of California.

Contact List

Four (4) new names were added to the project contact list as a result of the public meeting. Five (5) people who signed up at the meeting were already on the contact list.

Public Feedback

No (0) anonymous comment forms were turned in at the end of the public meeting.

Media Coverage

An announcement appeared in the Federal Register on February 24, 2000 (Volume 65, Number 37, Pages 9272-9273) [attachment = mtg4_fedreg.doc]. An announcement also appeared in the Thursday, March 2, 2000 edition of the LANL Daily NEWSBulletin's Bulletin Board, Los Alamos National Laboratory's on-line newsletter. A public service announcement was provided to twenty-four (24) radio and television stations [attachment = mtg4_psa.doc]. A press release was provided to eleven (11) newspapers in the form of a press release [attachment = mtg4_pr.doc].

Meeting Summary–
Los Alamos Historical Document Retrieval and Assessment Project

Fifth Public Meeting

Wednesday, September 13, 2000, Los Alamos, NM

Holiday Inn Express, 5:00 p.m. to 7:00 p.m.

Introduction: Paul Renard, CDC Project Officer

(These statements are NOT direct quotes. All statements are paraphrased.)

The meeting provided an update of status of the project. Renard introduced speakers and topics, including discussion of the access issue. He announced that a draft of the project's first report would be made available.

Regarding access to laboratory records, Renard emphasized that the CDC is committed to excellent science and putting facts on the table. CDC does not have an agenda. Its approach is neutral. "This evening I want to let you know about access problems."

Renard said: With the fire in May, access was withdrawn during evacuation of the Los Alamos and the laboratory. In early June, access to classified records and vaults was withdrawn because of national security issues as reported in the news media. We continue to work in unclassified records. We have not come to a standstill. CDC and its contractor is committed to following all national security rules. We have requested new access to the Department of Energy (DOE) Headquarters. As of today, the request has not been signed. It is going through the channels to Sec. Richardson's office. We don't know when it will be signed. If we do not gain access back into the classified records, I will make the recommendation to terminate the project. As the project officer it is not fair to ask the contractors to work in the periphery. I am confident that terminating the project won't be necessary. We proceed with that spirit.

Introduction to the Draft Report: Charles Miller, CDC Technical Lead

(These statements are NOT direct quotes. All statements are paraphrased.)

We recently modified the contract and requested a status report about every six months. It is not the final report. It is not a CDC report. It is a ChemRisk report. The report will let you know what we are finding during our search. It is a representative picture of where we are at this time, where we are going, and where we are now. It includes information and a critique. If you don't like where the project is heading, let Tom Widner know. If you know of something that should be in here, let us know. We want complete documentation of the site. This is a living document, and is not final. It will be updated on a regular basis. It clearly is a draft. But it is important, because we want to know what your comments are.

Primary Speaker: Thomas Widner, Project Manager

(Slide titles presented in bold face, slide contents in italics, and speaker comments in plain text.)
(Speaker comments are NOT direct quotes. All comments are paraphrased.)

What we are doing at Los Alamos

- *Reviewing historical records*
- *Selecting those relevant to off-site releases or health effects*
- *Describing those relevant documents in a project information database*
- *Making copies of relevant documents available to the public*
- *Summarizing historical operations and what was released, prioritize releases*

The database and documents will be made available to the public at the official DOE library and a reading room in Los Alamos at the library.

Where we are in the process

- *Document review is at most one-third complete.*
- *We have reviewed over 95% of the paper documents at the Central Records Center, but much microfilm and microfiche remains to be reviewed.*
- *We have received most of the records at the ES&H collection at TA-35.*
- *We have reviewed less that 5% of the reports at the Report Collection.*

The document is about one-third complete, but maybe less. We don't have a real good handle on what is out there. We find more all the time.

The review of unclassified ES&H documents is essentially done. We are now looking at the Technical Report Collection, which has some records that are not classified.

Please keep in mind that…

- *Many more documents remain to be reviewed, and there are many more interviews to be conducted.*
- *Many of the relevant documents we have identified are not yet available for our use or for public release.*
- *Anything we say about prioritization of releases at this point is based on LANL summary reports, not on independently estimated releases.*

We intend to do many more interviews. It took us a little more than a year to figure out the release process. Then the heightened security issue came into play. Once access is regained, the process should be speedy.

So far, the sample we have supplied to the public were well received Susan Flack, will go over some samples. They are an indication of they type of documents we are finding.

Review of Sample Documents: Susan Flack

(Speaker comments are NOT direct quotes. All comments are paraphrased.)

Samples: sets of nine sample documents were made available.

Document Number 455:
One of the oldest (from 1945). For each area it identifies materials used and hazards to employees. HF, depleted uranium. explosives used by X Division. Started as a list of chemicals. Did not state specific quantities. It is a good example of documents from the period—brief.

Document Number 494:
1983. A legally privileged record.

Question: What do you mean by legally privileged?
Answer: Designed to protect personal information about living people. Also looking for opinions of counsel. A few documents have been redacted. It's a privacy issue. Remove name, not health effect.

Question: How do we know its numerous or multiple records of one person?
Answer: The document analysts see the full information. Names may be removed prior to public release.

Question: Is NIOSH alert to tracking individuals that show up in this document.
Answer: NIOSH does get part of this information. We have a NIOSH log that indicates records that they might like to review.

Document Number 615:
1980. A complete copy is in the sample set. Two page environmental summary about a release or contamination and what is being done about it. It provides a perspective of how the lab is communicating with the public.

Document Number 1127:
Stack release document. Monthly reports. These are about the most original reports that we have seen; although, we have sometimes seen documents written in pencil. Reports like this are the source of information for typed reports. The document records the highest average, comparison to the previous month, identifies id trends, and accidents if there were any. With such reports, we can go back to the original data to see how they came up with the averages.

Explosive test shots, DU, mercury. This memo talks about what toxic materials were in these test shots. They were trying to come up with a monthly report about shots.

Document Number 7335:
Describes circumstance surrounding the monitoring. This says GMX division was required to report to H division the contents of the shots.

Public: Starting in 1947, the H Division was always at the shots and made a report of what happened.

Susan: We've been interested in the amount of DU at the start in case the monitoring was faulty.

Public: The reports are explicit.

Susan: We like to go back to the original. We don't rely on the monitoring reports.

Public: I just want you to be aware of this type of report.

Document Number 1403:
With chemical release information, we are having a harder time. We often find things like these. They call it a release, but when we dig into it, more often it is inventory. We go to this level to start with, then we put in the pieces. Earliest found is from 1971. These records are not retained very long because of the type of information it was.

Stack effluents from DP West. 20 percent efficient. Like better system. Stated to be below public and occupational limits. Gives history of emissions.

The last couple of documents are related. The show potential sources and releases. The four-page list goes through time periods, building numbers about nuclides released. Goes by TA. They are kind of a first draft. Final version, cumulative totals released: tritium and decay factor. A lot of footnotes.

Susan Flack returned the floor to Thomas Widner.

Primary Speaker Continued: Thomas Widner, Project Manager

(Slide titles presented in bold face, slide contents in italics, and speaker comments in plain text.)
(Speaker comments are NOT direct quotes. All comments are paraphrased.)

Seventeen boxes of documents have been released. The database includes about 3000 entries.

This report, our first deliverable, summarizes what we have found so far. It will change quite a bit. We will improve the picture as we go along.

Contents of the draft history/prioritization document
- *Introduction to the project*
- *History of Los Alamos operations*
- *Overview of information gathering to date*
- *Effluent data availability*
- *Environmental data availability*
- *Radionuclide releases and their prioritization*
- *Chemicals used and their prioritization*

Map of LANL. One of first tasks was to catalog the technical areas (TA): changed, disbanded, combined. The TA furthest from TA-34 is located in Los Angles CA. It is a machine shop. Except for one TA, we have been able to reconstruct what all the TAs were used for.

History of Operations
- *Processing of plutonium*
- *Processing of uranium*
- *Processing of other metals*
- *Tritium operations*
- *Polonium operations*
- *Operations with radioactive lanthanum*
- *Processing of high explosives*
- *Testing of high explosives*
- *Nuclear weapon component design & testing*

We have started to put together a timeline. The timeline includes fires, significant events, reactors, and it shows overlaps.

If you have suggestions of what to include, let us know. Another part looks at effluents. Another, nuclear device testing.

History of Operations

- *Nuclear device testing (weapons, Plowshare)*
- *Nuclear reactor development*
- *Accelerators*
- *Criticality testing*
- *Fusion research*
- *Plasma thermocouple*
- *Biological research*
- *Waste treatment and disposal*
- *Special studies*

Effluent Data Availability

- *We are identifying and characterizing the release points at LANL.*
- *We are trying to find the "raw data" for effluent measurements, or as close to it as possible.*
- *We are cataloging the periods of time for which we have located various forms of effluent data.*

Table 4 is quite an effort in starting this process. This is an important step for learning where the airborne releases took place. We are trying to get raw data. Tables 6, 7, and 8, identify types of data that we have found. Table 8 is effluent data. As we find more data, we will continue to build on our report.

The data is starts in 1948, before that is an unknown.

We look at releases and what volume was present. We present the dilution volume over time. Starting in 1948, plutonium is more important. After 1972, tritium is a more important issue because plutonium releases became more controlled.

Public: You will need to establish what types of instruments were used throughout LANL's history. Variation exists in quality of different instrumentation.

Widner: I agree, that's going to be important.

Question: Will you do a quality assessment?

Widner: We haven't done a quality assessment yet. The information presented at this point is based on data found. Currently, we are not conducting interpretations of the data. If this study goes on, the quality assessment would go much further. We are gathering information at this stage.

Environmental Data Availability

- *We are searching the documents for historical environmental measurements.*
- *We are familiarizing ourselves with routine monitoring programs and special studies that have been conducted by LANL and others.*
- *We are summarizing the environmental surveillance data that are available.*

Prioritization of Radionuclide Releases

- *We have summary documents that describe past radionuclide releases, and we are assembling the effluent measurements.*
- *We have made some preliminary comparisons between radionuclides, sources, and plutonium facilities.*

The pie chart on page 87 shows airborne releases from DP West. TA-21 is dominated by plutonium releases.

A cumulative of dilution is required where comparisons are made between routine releases form different sites as based on reported releases. This approach does not take in dilution from site and site boundary. It also hasn't taken in to consideration decay of releases.

Chemicals Used and their Prioritization

- *We are assembling data from-*
  - *The current chemical inventory system*
  - *Historical chemical inventories*
  - *Site documents*
- *We have identified 38 high-quantity chemicals from the current inventory and ranked those with US EPA toxicity values.*
- *We are maintaining a list of toxic materials that are documented as having been used.*
- *We have prepared a table of reported quantities historically used or released.*

The modern-day system is a starting point. We will fill in with information from interviews and other sources. At this point in time, we can see what is in use and what are more toxic. It is a big challenge to go back in time.

Table 20 lists the types of chemicals and materials used. It records quantities used or releases. It is assembled from different documents. The further back we look, the harder it is to find information. We will have to rely on interviews and other tidbits we might find.

The document set will be available in the Los Alamos public library for a period of time. Then it may go to Espanola at the college. Another set will be maintained in the Zimmerman Library at the University of New Mexico. They have a government reading room in the basement. We are trying to make a good index available to find records easily.

To give feedback, one fact sheet includes the names of project team members. Tom Widner will meet with interested people to review suggestions and concerns.

Public Commentary and Questions

(These statements are NOT direct quotes. All statements are paraphrased.)

Question: Will the documents be scanned and made available on the Internet?

Widner: We have discussed this, and will need to work with CDC regarding this proposal.

Question: Will a public announcement be made when the records are made available?

Widner: Yes. If the Web site is published the announcement will be made there. We will also announce it by e-mails.

Question: In the 1990s there were many reported cases of thyroid cancer with a suspected cause being the source term from the Omega West reactor. Has anyone seen which specific isotopes were released?

Answer: We have not seen good data on that matter, but we will keep that concern in mind.

Widner: When you talk about a release, correction factors often have to be applied. One of these is determining the significance of releases in D Building in earlier periods. Large unknowns exist that we are focusing on now. D Building is the first plutonium processing building.

Margaret Anne Rogers: I am concerned about reconstructing history. I don't see reference to my work. It would have been a short cut.

Widner: We have not seen your files.

Margaret Anne Rogers: In those files are interview tapes of old-timers that have died. My emphasis was different because I was trying to figure out what was contaminated.

Widner: We would like to look at people like yourself and would like to sit down and talk to you. We want to gear up interviews again, because we gain a lot of useful information and learn more about where to look and for what.

Renard: CDC asked the contractor to go back to original documents.

Margaret Anne Rogers: I kept original documents.

Renard: We would love to talk to you.

Question: Useful information would include when stacks operated, what equipment was used, what were the specified emissions, and what tests were conducted.

Widner: We have found quiet a bit of information on these subjects. I agree, it's important.

Question: In order to identify holes, you need to know what to look for. There has never been a study to confirm official releases.

Widner: I think we can modify some of our summary methods to document that better.

Meeting Summary–
Los Alamos Historical Document Retrieval and Assessment Project

Sixth Public Meeting

Tuesday, April 24, 2001, Los Alamos, NM

Los Alamos Inn, 5:00 p.m. to 7:00 p.m.

Introduction: Paul Renard, CDC Project Officer

(These statements are NOT direct quotes. All statements are paraphrased.)

I will summarize the subjects that will be covered in more detail by other speakers. These topics included access at Los Alamos National Laboratory (LANL), which was achieved through discussions held Thanksgiving and Valentine's Day weeks. Access was regained in February and is bound by Special Security Plans. A plan will be developed for each location the research team will need access to. CDC has had input in preparing the plans; the team has tested a plan, and it is working. Other topics include the project newsletter, reading rooms, and change of ownership for ChemRisk.

Problems we have encountered include:

- CDC has requested security clearances for different venues, which has not happened yet.
- Space limitations still hamper the effort. In addition to the researchers, now the team members' escorts must be accommodated. Obtaining additional security plans for more venues should solve this problem.
- Prescreening of records an issue, but should be worked out.

CDC is planning another meeting with LANL in June, tentatively set for the third week. The meeting is with higher-division-level management at LANL to improve their comfort level with the project and its team of researchers.

First Speaker: Robert Whitcomb, of CDC

(Slide titles presented in bold face, slide contents in italics, and speaker comments in plain text.)
(Speaker comments are NOT direct quotes. All comments are paraphrased.)

Background

- *Project begins December 1998 with* ***unescorted access*** *to record repositories*
- *Access to LANL record repositories were suspended on May 2000 due to safety and security issues surrounding the:*
  - *Wen Ho Lee,*
  - *Cerro Grande Fire (lab closed, May 2000), and*
  - *Missing hard drive incidents*

Project work is patterned after lessons learned during similar studies at other sites. One of the first studies was conducted at Hanford. It was a directed search that lead the team to miss some relevant information. At LANL, the team is using a systematic approach where all records are searched.

Result of Heightened Security

- *Centers for Disease Control and Prevention (CDC) and it's contractor no longer had access to all record repositories at the Los Alamos National Laboratory (LANL)*

Corrective Measures

- *February 2001 – A Special Security Plan was approved for two venues:*
    - *Records Center*
    - *Reports Library*
- CDC provided comment and input

The largest collections of documents are contained in the Records Center and Reports Library.

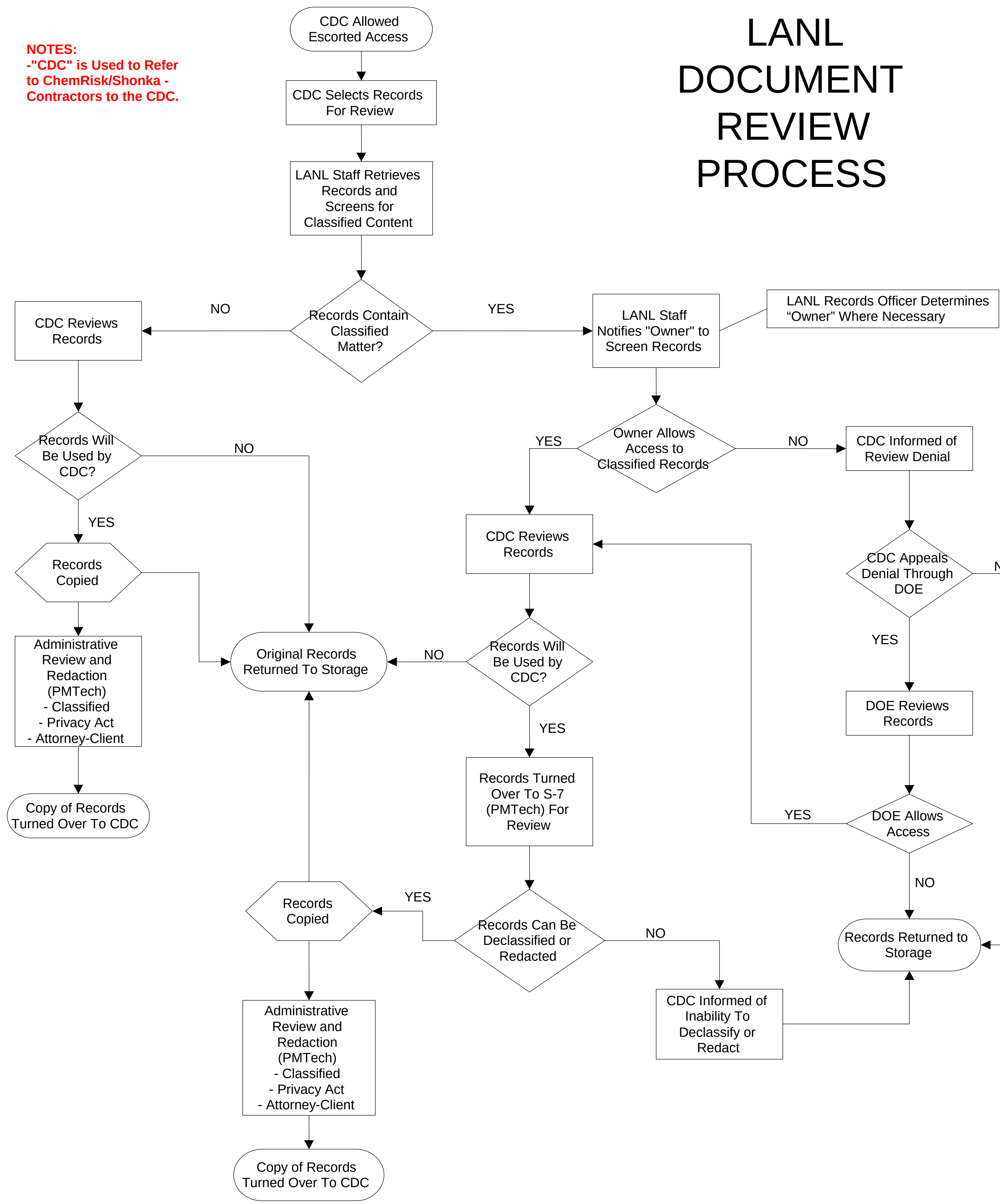
What does the plan do?

- *CDC and it's contractor now have* ***escorted access*** *to the two venues*
- *Access to certain categories of classified information will be limited*
- *CDC staff will have verification responsibility to ensure documents don't contain project related information*

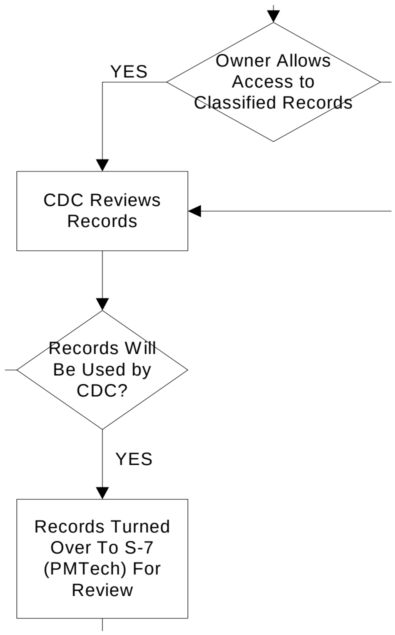
The plan is a reaction caused by a heightened awareness of national security issues. The plan allows government workers to review records prior to the research team's access to determine if there is a good reason to protect the records.

How does this work?

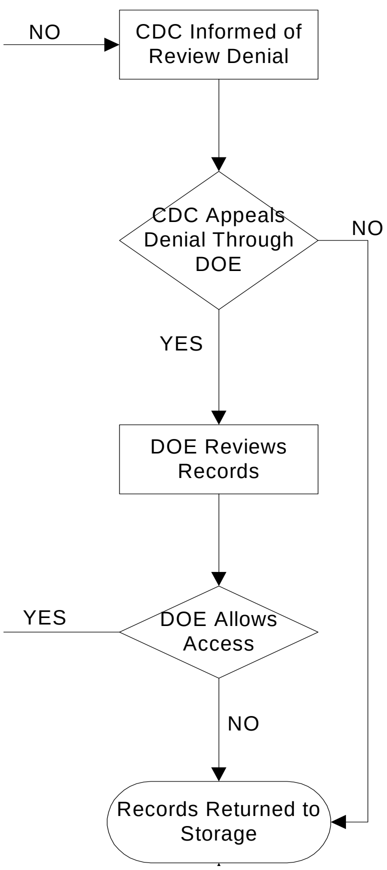
This flow chart illustrates the screening process. If a record is not classified, the team reviews the document. If a document is classified, the owner of the document must first be notified and will review the document.


NOTES:
-"CDC" is Used to Refer to ChemRisk/Shonka - Contractors to the CDC.
LANL DOCUMENT REVIEW PROCESS
CDC Allowed Escorted Access
CDC Selects Records For Review
LANL Staff Retrieves Records and Screens for Classified Content
Records Contain Classified Matter?
NO
YES
CDC Reviews Records
LANL Staff Notifies "Owner" to Screen Records
LANL Records Officer Determines "Owner" Where Necessary
Records Will Be Used by CDC?
NO
YES
Owner Allows Access to Classified Records
YES
NO
CDC Informed of Review Denial
Records Copied
CDC Reviews Records
CDC Appeals Denial Through DOE
NO
YES
Administrative Review and Redaction (PMTech)
- Classified
- Privacy Act
- Attorney-Client
Original Records Returned To Storage
NO
Records Will Be Used by CDC?
YES
DOE Reviews Records
Copy of Records Turned Over To CDC
Records Turned Over To S-7 (PMTech) For Review
YES
DOE Allows Access
NO
Records Copied
YES
Records Can Be Declassified or Redacted
NO
Records Returned to Storage
Administrative Review and Redaction (PMTech)
- Classified
- Privacy Act
- Attorney-Client
CDC Informed of Inability To Declassify or Redact
Copy of Records Turned Over To CDC

Owner Allows Access



If the owner releases the document, the team reviews the document and determines if it is relevant to the study or not. If the record is considered necessary to the study, the document is turned over for classification review.



Appealing a Document Denial

If the document owner refuses to release a document, then the team can appeal. The team will be allowed to review the document and see if it contains information relevant to the study. If it does, DOE will review the document and allow access to relevant information.

What are the Special Categories?
- *Nuclear Weapons Design Information*
- *Sigma 14 and 15 Information (may be expanded at a future date to include the emerging Sigma 16 category)*
- *Sensitive Compartmented Information (SCI)*
- *Special Access Program Information*
- *Foreign Government Information (FGI)*

Restrictions are applied according to special categories of records.

Nuclear Weapons Design Information
- *Documents relating solely to nuclear weapons design, such as weapons components blue prints, drawings, or other schematic or graphical design information*

Sigma 14 and 15 Information
- *Sigma 14 - The category of sensitive information concerning the vulnerability of nuclear weapons to deliberate unauthorized nuclear detonation.*
- *Sigma 15 - The category of sensitive information concerning the design and function of nuclear weapons use control systems, features, and their components. This includes use control information for passive and active systems.*

Sensitive Compartmented Information (SCI)
- *Information that has been determined pursuant to Executive Order 12958 or any predecessor order to require protection against unauthorized disclosure and that is so designated*
    - *Includes conventional weapons, security systems, foreign relations, and intelligence information*

Special Access Program Information
- *"Not later than February 1 of each year, the Secretary of Energy shall submit to the congressional defense committees a report on special access programs of the Department of Energy carried out under the atomic energy defense activities of the Department"*

(42CFR23 Subchapter VIII - Military Application of Atomic Energy Section 2122a)

Foreign Government Information (FGI)
- *Information provided to the U. S. Government by a foreign government or governments, an international organization of government, or any element thereof, with the expectation that the information, the source of the information, or both, are to be held in confidence.*
- *Information produced by the United States pursuant to or as a result of a joint arrangement with a foreign government or governments, or an international organization of governments, or any element thereof, requiring that the information, the arrangement, or both, be held in confidence*

Additional Access Granted

- *March 2001 - authorization was granted to release without review classified information dated on or before 31 December 1962*

Additional information has been opened up since the original plan was developed. This information included old weapons design, such as information about Fat Man and Little Boy. So much of this information is already available to the public, that nothing is gained by keeping it under lock and key.

Summary

- *CDC and it's contractor have regained access to two classified records repositories*
- *Security Plans for additional venues have been requested*
- *Future Security Plans for additional venues will be drafted with CDC input*
- *CDC believes that this project can continue successfully, but will take longer to complete*
- *We will continue to keep the public informed of our progress*

It is good news that the team has regained access. Security plans for additional venues have been requested. CDC believes this project can be completed successfully, but it will take longer than anticipated.

Public: How long is the appeal process when an owner denies the team access to a document?
Response (Whitcomb): That's the verification process that will happen if access truly is denied. The team will appeal, and at that time the verification process will mean only a team member will be allowed to review the document. Refusal by the owner limits the number of people who actually review that information. I think some documents are in process now. I don't know if any of the owners have rejected access yet.
Response (Renard): Lessons learned from past studies have taught us to search for and identify work for others early in the process as these reviews often take a very long time. We don't know how long the process will take here.

Public: Is your program going to cover the time before the Trinity drops?
Response: The team will look at all records for this area where weapons were developed and tested. Records concerning radiation fallout are relevant to the study.

Public: Will fallout records for the two Japanese sites be part of the study or is it just limited to Los Alamos? The other sites will be a whole different approach because it is detonation not production.
Response (Renard): We are collecting information regarding Trinity. We already have reviewed information about other sites, and quite a bit about Trinity. That information is not falling through the cracks. We are pulling in logging information.

Public: I am a down-winder. I need to know that information.
Response (Widner): We are definitely finding relevant information.

Primary Speaker: Thomas Widner, Project Manager

(Slide titles presented in bold face, slide contents in italics, and speaker comments in plain text.)
(Speaker comments are NOT direct quotes. All comments are paraphrased.)

Documents Available for Review

- *Documents that we have selected as relevant are becoming available for public review.*
- *14 boxes of documents have been placed in the Government Information collection at UNM in Albuquerque.*
- *Arrangements are being made by DOE for the documents to also be available in Los Alamos and Española.*

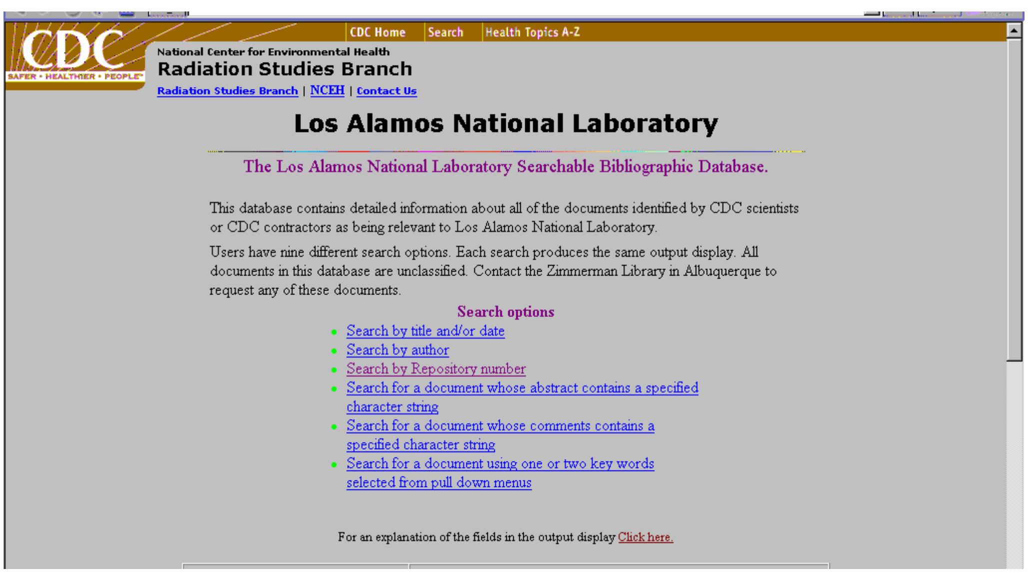
I will cover a few other areas we are working on.

Fourteen boxes of records released from LANL for this study were delivered to the Government Collections at the University of New Mexico in Albuquerque. We are trying to make arrangements to have records made available closer to Los Alamos. The public library in Los Alamos and the Northern New Mexico Community College are both under consideration.

UNM Library in Albuquerque

- *A searchable database of the available documents is on CDC's Web site… http://www2.cdc.gov/nceh/radiation/LANL/default.htm*
- *Interested parties should visit the Government Information desk in the basement of the library building.*
- *Documents can be requested by Repository Number, and can be copied at some cost.*

A searchable database is available on the Internet. It is primarily a finding aid for documents available in the reading room. The newsletter includes a map to the reading room. Documents can be requested by repository number which is available through the Internet searches. You can request up to three at a time and copy them at a small cost to yourself.



The document database is accessible anywhere the Internet is accessible. You don't have to go to the library to use it.

Other *(closer)* Reading Rooms

- *Mesa Public Library in Los Alamos*
  (2400 Central Avenue)

- *At or near Northern New Mexico Community College in Española*
- *The plan is for newly released documents to be available in Los Alamos for a certain period, then be transferred to Española.*
- *Details will be made available as soon as they are finalized.*

We are working with other folks to establish closer reading rooms. Another set of documents is ready for delivery, and we will share details as soon as they are finalized. The plan is to send documents to Mesa library for a set time, then transfer them to Española for longer storage.

Same People, Different Name

- *McLaren/Hart was acquired by J. A. Jones Environmental Services in October 2000.*
- *The composition of the project team will not change.*
- *We will work under the name of J. A. Jones Environmental Consulting.*

Our name has changed to JA Jones but we still have the same group of people working on the project. JA Jones has been around for a long time, and the company is not interfering with the team's work.

Project Web Site – Coming Soon

- The purposes of the Web site are to:
  - Keep interested parties informed
  - Present information about the project and the project team
  - Present summaries of our meetings
  - Make our work products available, including draft reports and newsletters
  - Provide an avenue for acquiring public comments and additions to our contact list
  - Provide links to related information

CDC is completing the final review. The site includes copies of slides and see summaries from the meetings, including public commentary. It is a useful tool to summarize what subjects are covered and issues that come up. It also includes the draft report, newsletter, and other working products. It is an avenue to ask questions or submit comments. We will get the word out when it is available.

Guest Speaker: Peter Malmgren

(Speaker comments are NOT direct quotes. All comments are paraphrased.)

Peter Malmgren is conducting the study: Los Alamos Revisited, an Oral History Project. CDC is supporting his study. The interviews are yielding oral histories of Los Alamos workers and area residents. The information gathered during the study will be publicly available, and is being shared with the project team.

Peter Malmgren described the study:

I have been at this for 16 months, spending time at 21 locations including villages, hamlets, towns, and cities. Initially I concentrated on interviewing workers from the valley. There are many blue-collar people living in the valley that have not been heard before. Now I am also talking to people in Los Alamos. Paul Renard opened the door.

I appreciate the people who have invited me into their homes. I am a big advocate of oral history, but I am not a technical wizard. Working together, I like to think we could bring these two disciplines together and add a personalized touch to the document search. I hope to be able to give CDC leads to make the search fruitful.

The study's goals are to (1) honor men and women, and (2) examine health and safety issues. As I entered in the process I used a carefully screened set of questions, which I have since trashed. I have learned that I need to go with what the people want to tell me. I am coming from a preservationist attitude: honor individuals; build an archive.

I am planning on holding a photographic exhibit. Photos have a lot of power, but I will use excerpts form interviews to give zip. The exhibit will be held in the Onate Center, north of Española. I hope this will turn into a reunion of sorts. Images often trigger more memories and more stories. I could get more information at the time of exhibit.

Meeting Summary–
Los Alamos Historical Document Retrieval and Assessment Project

Seventh Public Meeting

Thursday, April 26, 2001, Española, NM

Northern New Mexico Community College, 5:00 p.m. to 7:00 p.m.

NOTE: The same slides were used for this meeting as for the April 24, 2001 meeting. While the slides will not be repeated here, the public comment and discussion period is summarized.

Introduction: Paul Renard, CDC Project Officer

(These statements are NOT direct quotes. All statements are paraphrased.)

I will give you a thumbnail of what you will hear tonight. A lot has happened since we met last. Charles Miller and I meet with Los Alamos National Laboratory (LANL). A path forward was agreed to. During Valentine's Day week, CDC and LANL worked out a security plan that restored are team's access to LANL. Each venue will need a separate security plan. Tom Widner will go into detail about our regained access. He will also talk about the Web site, Reading Rooms, and the change of ownership for ChemRisk. CDC now has a Web site with Los Alamos project information.

Peter Malmgren will talk about his study, Los Alamos Revisited. It's been our experience with other dose reconstructions that retirees are extremely important. Peter's study will be an invaluable resource.

We have encountered some snags with the new process. Currently, we are only allowed into two places. We have requested additional venues. The space problem continues and now escorts are required for our team members. We want to be able to access additional venues so that we can spread people out. The process of prescreening of records by owners is a bit of a bottleneck, but we are working through the problem. We also asked for a list of venues. We want to find out where all the records are located. Our next meeting with LANL management will be in June.

Public: Is there any other information about Los Alamos at other locations, such as at Oak Ridge?
Response (Renard): Yes, Bob will address that.

Public: Will this study use contractor records, ex. medical records?
Response (Renard): Medical records will not be part of the study to protect people's privacy.
Response (Widner): If we know about contractor records, we are going to look at them.

Public: Do you look at logs?
Response (Renard): We look at summary reports, but we try to go back tot the original documents. Hand-written, original log books, provide the most reliable information.
Response (Widner): We've looked through 1000s of log books already.

First Speaker: Robert Whitcomb

Public: Is this a new process? Are you looking at classified records first?
Response (Whitcomb): Yes.

Public: Do you feel restricted?
Response (Whitcomb): We are restricted because we have to have and escort.

Public: Does the owner review apply to a single document, a box of records, or a particular person's documents?
Response (Whitcomb): It could apply to both. The process is cumbersome because classified and non-classified records are housed in a classified area. In the reports area there are places where just non-classified records are housed.

Public: Have you done anything about documents held by others?
Response (Whitcomb): We will talk about more, trying to track down other records held in other facilities.

Public: Once they say yes, what do they screen for?
Response (Whitcomb): The owner determines is someone else can look at the document.

Public: What if they change their mind during the screening process?
Response (Whitcomb): The owner determines is someone else can look at the document.
Response (Renard): This process takes much longer. At Hanford, we started looking at records that we thought were pertinent. Then found additional records were needed. Here, we are looking at all records. I have asked Tom and company to start the process now to determine owners, and get the process started now, because it will take along time. That's why we are starting this process early.

Public: Originally the study was making documents available to the public. Can the public still see them? Originally, I thought yes, now I think this is narrowing the process.
Response (Renard): CDC will still get to see all records. Declassified records will be redacted so that all information will not publicly available.
Response (Whitcomb): Like the Savannah River Site, all relevant information will be preserved. The plan is just adding more steps. The process will work, just at a slower pace.

Public: Are you going after classified records first because the process will take longer?
Response (Whitcomb): Yes, but also classified records contain the bulk of the relevant information. Also, while we have access, we want to look at as many classified records as possible before something else happens to stop access.

Public: Is DOE the steward of the documents? Do they decide what is not seen? Does CDC get to look at these to decide if they are relevant?
Response (Whitcomb): There are many avenues we can take during an appeal. This plan has been in place for just two months, and we are just now starting to follow the process. We have a foreign nation document which will be a good test for the process.

Public: Will the process be tested by June?
Response (Whitcomb): We almost completed a cycle for this meeting, but have been unable to reach the documents owner.

Public: Will you make a guess on the length of the delay, and how will it impact the cost of the project?
Response (Renard): Until we know how much is there and where it is, it will be difficult to determine the length or cost of the project. The original project was for planned to last three years. It may take us seven

years to look at all the records. We are going to extended the project, but I can't give specify it's duration now.

Public: How many venues exist?
Response (Renard): We don't know where they are. We have been told that we will get a list. That list is most likely classified. I don't have a clearance. When I see something, you'll get to see it. Our cleared personnel, will get to see the list and the information. We're committed to the project. The lab is behaving like they are going to work with us.

Public: Do you see the change of administration in Washington as making an affect?
Response (Renard): We still don't know. We are watching.

Public: A lot of people here used to work at the lab, and they have shared with us a lot of the problems when people try to assert there are health problems. Is there a possibility that the classified process is going to reduce access to declassified records?
Response (Whitcomb): The team will get to look at that documents that an owner denies access to determine if it is useful to the study.
Response (Renard): We are pushing for good science. In our agreement with LANL, the research team gets to determine if a document is relevant. We will tell you if we are denied access.
Response (Whitcomb): The newsletter design features a puzzle. Each document is a piece of the puzzle. We are have access, and we are in the identification phase, which is most important.

Public: You said there were 5-6 million records?
Response (Renard): Just classified records.

Public: When talking about records, is the lab the owner, or the person named on that document?
Response (Whitcomb): It could be a person, a location on site, or an offsite person.

Public: What happens if the owner is no longer available?
Response (Whitcomb): There will be a chain of custody.

Primary Speaker: Thomas Widner, Project Manager

Guest Speaker: Peter Malmgren

Tom Widner:
Another project we would like to introduce you to is Los Alamos Revisited; An Oral History Project. For this study, Peter Malmgren is conducting interviews that are yielding valuable information relevant to the LAHDRA project. CDC is supporting Peter's project through our contract.

Peter Malmren:
This project has been going on for 1.5 years. It is about friends and neighbors offering their knowledge.

Prior to starting the study I went to read about LANL's history. There are hundreds of books on the subject, but there is not a single book written from the perspective of the working man. Something is missing in the historic records. And that became the focal point of the study.

I am interviewing Los Alamos and White Rock folks, but mostly I am concentrating on the people from the valley. They paid the price for 35-40 years. They have a lot to tell us, and they have a lot to share with the research team. The study will pull people together to share information.

At first it was slow going, then after a successful March meeting here, where about 500 people showed up, things just took off. I have found many gracious people, also some who are suspicious. I had to put my opinions aside and go in objectively. The last eight months, I have been faced with the challenge of getting into an Indian pueblo. I tried to cut corners but was immediately stonewalled. Since then, I have gone through official channels and now have permission to interview pueblo residents.

I have conducted 70 interviews in about 1.5 years. I thank Ken Silver. He came up with this idea. I also thank Johnnye Lewis who believes in and sustains the project. I also thank Paul Renard for giving real hope about the future of this project.

I am preparing a photographic exhibit and I could use your help identifying some of these. Part of the process is taking photos to people who have knowledge about them. I am planning an exhibit in June, to coincide with Paul Renard's next visit. I hope it will be a reunion that triggers more memories.

Public: Do you have access to the labs photo library?
Response (Widner): We are trying to help Peter gain access to more photos.
Response (Malmgren): Mead let me look through some and the majority of photos are from there.

The exhibit will be in the Onate Center and will be prepared for travel. The main things is to share the information.

I would like to close with some quotes from the interviews. (Shared three quotes.)

Announcement from Hilario Romero:

(Speaker comments are NOT direct quotes. All comments are paraphrased.)

What I want to see in future are safety standards. A new cold war is starting with China. We can become a casualty of cold war. In terms of the history project, I know a lot of sources and have collected a lot of history.

We want to have a reading room here. It is long process and I am hoping that we will be able to obtain money to fund a reading room. I am waiting for DOE.

Public: What can people in the audience do to help with that effort?
Response (Romero): I am waiting for a call from DOE in Albuquerque.
Response (Renard): A second set is available for use in Española. To support local access.

Announcement from Yesca Sullivan:

Yesca Sullivan from the El Rio Arriba Environmental Health Association announced a the award of a Technical Assistance Grant awarded by the Environmental Protection Agency to hire technical advisors to interpret and comment on technical documents related to the North Railroad Avenue Superfund Site in Española, NM.

Public Commentary and Questions

(These statements are NOT direct quotes. All statements are paraphrased.)

Public: Let's talk about how the project can be helpful to us. During the March meeting, a person who worked on a mercury still was later diagnosed with mercury poisoning. All these years, the lab and bureaucracy are saying this didn't' happen. More than 50 years later I have read documentation that says this did happen. At least they can't tell him that he is crazy. We really want to assist people with those kind of things.

Response (Renard): We are continuing to let NIOSH know about anything we find.

Public: Most of us look at LANL as being a big fat dragon with a of tails and no head. We have resentment against them. We were booted off of the land, and now have a class action lawsuit. A lot of land is going to be returned because it was declared surplus. But now it is contaminated and burned. Now we are suing for money, not land. Most of us, have worked at LANL. Our purpose in coming to the meeting is because we are interested in getting compensated. DOE is fighting us. They say we must be almost dying or in the grave to get money from them.
Response (Renard): I think we will succeed. We are getting in. We are not here as a compensation piece, nor a lab advocate. We want to do good science. What we find, the good, the bad, and the ugly, will be made available to you. You can use it how you want.

Public: What it is going to take is money. We are petitioning Congress to introduce a bill to pay us for 3500 acres that the lab says is not valuable.

Public: I was a 30-year LANL employee. What always bothered me was our dosimeters. The readings were always 0. However, each room had a dosimeter and those records showed readings. I would like you to take a close look at that.
Response (Renard): And we will. For the first round we are looking at everything. Then we will take a closer look. We will compare records from wall-mounted dosimeters to personal dosimeter readings. This will all be combined for the dose reconstruction.

Public: Come see me. I have binders showing true readings.
Response (Renard): We will talk to you and the others.

Meeting Summary
Los Alamos Historical Document Retrieval and Assessment Project

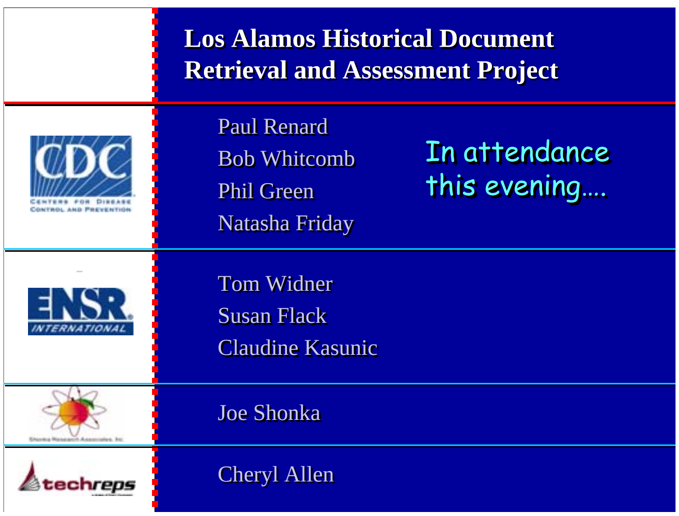
Eighth Public Meeting

Tuesday, November 27, 2001, Santa Fe, NM

Radisson Santa Fe, 5:00 p.m. to 7:00 p.m.

Introduction: Paul Renard, CDC Project Officer

(Slides are reproduced from presentation; speaker comments follow.)
(Statements are NOT direct quotes. All statements are paraphrased.)



Paul Renard: Introduced staff from the Centers for Disease Control and Prevention (CDC):

- Phil Green
- Bob Whitcomb
- Natasha Friday
- Marie Spano

Many months ago, during one of the first meetings, which was held in Española, I made a statement that if we get to the point where access is denied, I would let you know. That is now happening. There are a number of records we were denied access to. For some of these records, it has already been determined that CDC will be allowed to view the records and determine if they are relevant or not. In all cases, CDC needs to be part of verification process.

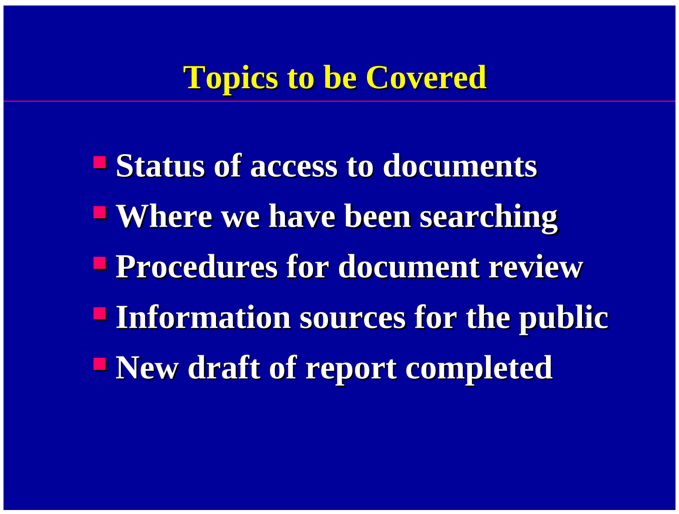
We will learn more from Tom Widner about records that fall within six categories, which have been determined are not relevant to our study. Basically, CDC will not see all documents. However, the CDC is still optimistic that the team will see all documents relevant to chemical and radionuclide releases.
An appeal process is in place for when the CDC is denied access. During the appeal, the Department of Energy (DOE) in Albuquerque will review the documents and make a

determination if they do indeed contain information that must be withheld. The process is being tested. The CDC has been denied access to several boxes. We don't know how the process will go.

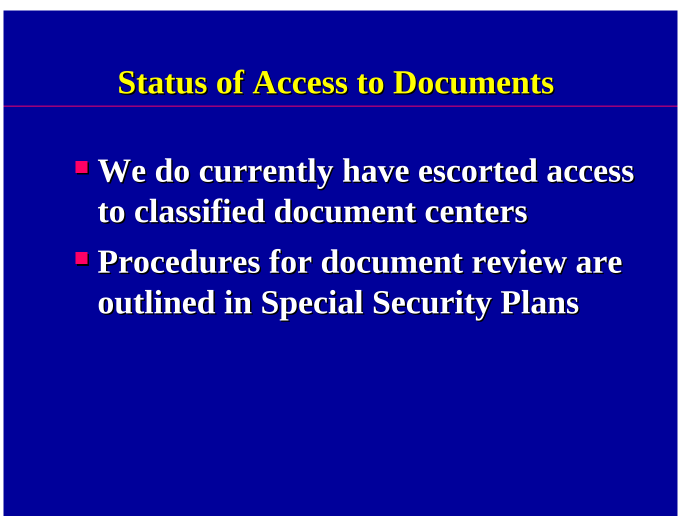
As of October 1, 2001, Paul Renard has been selected for a new position at CDC. This was his last public meeting concerning radiation studies, but he will continue to participate. Phil Green will likely be named the next Project Officer. Currently Bob Whitcomb is the Acting Project Officer. Renard has been working to combat the anthrax threats.

Primary Speaker: Tom Widner, Project Director

(Slides are reproduced from presentation; speaker comments follow.)
(Statements are NOT direct quotes. All statements are paraphrased.)



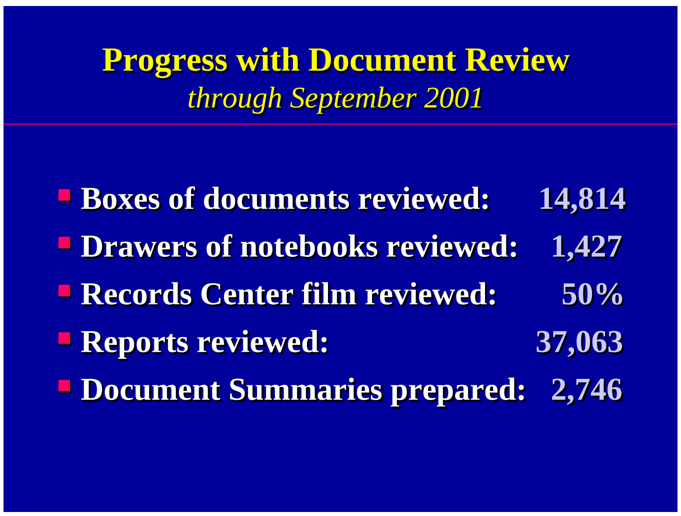
Tom Widner: No additional comments.



Tom Widner: Los Alamos National Laboratory (LANL) has put together Special Security Plans that prescribe how access to documents is obtained and the process for clearing documents to make them publicly accessible. Plans are in place for the Central Records Center under Roger Meade, the Technical Report Collection under Jack Carter, and the Associate Laboratory Directorate for Nuclear Weapons, whose holdings contain a particularly high concentration of nuclear weapons design information.

Tom Widner: We have gone through tens of thousands of records including microfiche and technical reports. We prefer to locate and make use of basic data sources (such as notebooks), where we can get as close as possible to the original information.

We are in a new repository, the ALDNW, within the Nuclear Weapons Division. It includes a main vault plus hundreds of individual safes.



Tom Widner: This slide summarizes the extent of our search. Each roll of microfilm is equivalent to a box of records. So far, we have gone through about one half of the microfilm at the Records Center. We were able to document that about 3000 rolls of microfilm duplicate paper records that were are reviewing, so we do not have to review those rolls. But thousands of rolls remain to be reviewed.

We are completing Document Summary Forms that contain information for inclusion in the project information database. The summaries contain information relevant to chemical and radionuclide releases. Each summary is entered into an Access database, a version of which is available on the Internet.

Procedures for Document Review

- Classified documents are to be pre-screened by “owners” to judge our need-to-know.
- Six categories of information are to be withheld from us.
- We can appeal to DOE when documents are withheld.

Tom Widner: LANL has established procedures that outline the process for our document review. Document owners review documents to determine if information falls within six categories for which access will be denied. Decisions to deny access can be appealed to the DOE in Albuquerque.

Categories of Information for which Access is to be Denied

- Nuclear Weapons Design Information
- Sigma 14 and 15 Information
- Sensitive Compartmented Information
- Special Access Program Information
- Foreign Government Information
- Unclassified Sensitive Vendor Proprietary Information

Tom Widner: We agree that Nuclear Weapons Design Information does not contain information needed for a dose reconstruction. However, these types of records are sometimes mixed in with other information that is necessary and relevant. This is where the difficulty lies.

Sigma 14 and 15– are categories of classified information that touch on areas such as vulnerabilities of nuclear weapons and systems used to prevent their unauthorized use.

Sensitive Compartmented Information – is a category that includes information regarding some specific programs that require special access control.

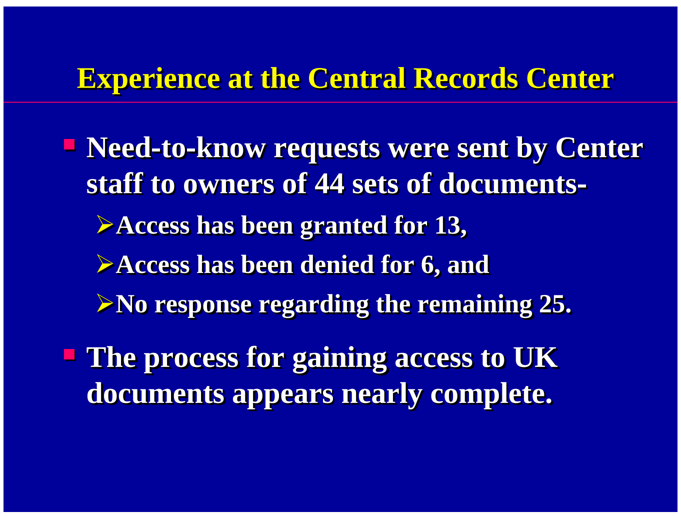
Special Access information is highly secretive. The “Star Wars” program is an example. Only a very small fraction of records at LANL are Special Access.

We need special permission to review information from Foreign Governments. We will soon have access to some United Kingdom records.

Proprietary information includes trademarks, copyrights, trade secrets, and proposals with salary information.

If we feel that a record was inappropriately assigned to one of these categories, we will appeal.

Tom Widner: After the missing hard drive incident and the Wen Ho Lee case, prescreening of records was initiated. Problems we have encountered include difficulty in finding document owners and getting them to respond to our requests for "need-to-know" reviews. These problems are detailed in the next few slides.



Tom Widner: The system needs to be improved. We have discovered that the document owners need to be educated so that they know what they are supposed to do. The also need to understand what the criteria are for determining if a document should be withheld. We will fine-tune the system, seeking more accountability and providing clear instructions.

We found 12 drawers of information from the United Kingdom that we were initially denied access to. However, we have sought special permission, and we will soon be given access.

Experience at the Report Collection

- Access has been granted for classified reports issued before 1963.
- Review "by title only" was required for a small fraction of those pre-1963 reports.
- Prescreening by "owners" for reports from 1963 or later has been problematic-
  - LANL requested we review by titles alone.
  - From about 1,200 reports reviewed, review of titles alone is not conclusive for at least 200.
  - Prescreening by a contractor is being proposed.

Tom Widner: The Report Collection contains a wide variety of technical reports, including some that document the histories of weapons systems--when they were designed, when they were retired, and more. We have access to virtually all the records produced before 1963. After 1963, we were initially denied access to all LA reports because they might contain information that falls within the six secure categories. Then LANL asked us to review only the titles of documents to determine their relevance for a dose reconstruction. We are trying to improve the system so that we can look beyond the titles to determine relevancy.

Experience with ALDNW Documents

- Contents of the main ALDNW vault were prescreened by a retiree (~12,500 documents).
- Over 99% of documents were restricted to review by title only due to stated presence of deniable category material.
- We completed review of the vault, requesting review of some documents beyond their titles.
- Hundreds of safes are being prescreened by owners, and review has begun.

Tom Widner: Contents of the ALDNW vault were first prescreened by a retired LANL worker. He noted which documents had restricted access. Later, we reviewed these restricted documents by title only. We found that the material has very little information about releases. However, we may appeal a few of the restricted documents that we think may be relevant to our study.

Some Sample Document Titles

- "Theory of Radio Flash- Part III"
- "Leotard"
- "Lowcard Program"
- "Pajara Pinex"
- "Input and Output for Clyde"
- "Bowie"
- "Quarterly Status Report on Weapons R&D"
- "Mix- Past and Future"
- "Nuclear Materials"

Tom Widner: Assessing a document to determine if it is relevant to our study by using the title alone is often very difficult. As you can see by the titles on this slide, titles are often cryptic and determining the type of information a document contains by reviewing the title alone is in many cases impossible. If we are only allowed to determine relevancy on the basis of title alone, we want to err on the side of safety. If there is any possibility that a document could be relevant, we will appeal any restrictions.

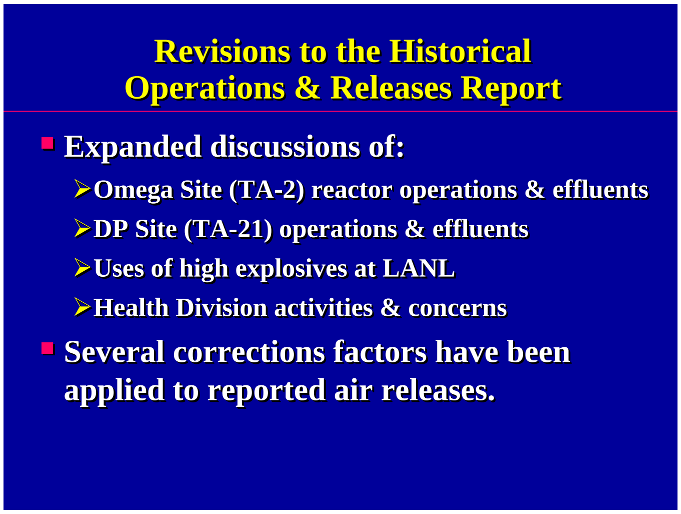
Information Sources for the Public

- The project Web site is available at www.shonka.com/ReConstructionZone
- Copies of relevant documents are available at the reading room in Albuquerque.
- A database describing publicly available documents is available at http://www2.cdc.gov/nceh/radiation/LANL/default.htm

Tom Widner: The Project Web site is available to the public. Cheryl Allen designed the site, and Shonka Research Associates is hosting it. The site contains information about the project, team, meetings (including copies of slides and meeting summaries), and reports. Our last report is available on the Web site, and our newest version will be made available their when the reviews are completed.

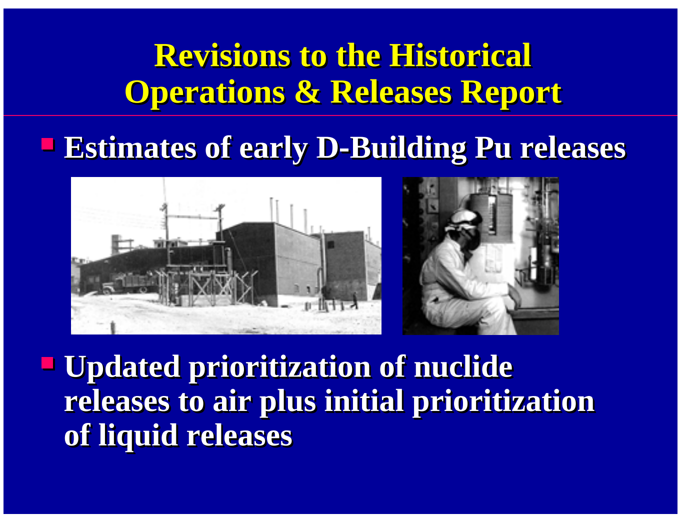
The reading room in Albuquerque has already been supplied with about 20 boxes of records released from LANL, and we have an additional five boxes ready to go. In addition, there still exists the opportunity for additional reading rooms. The DOE is working with some organizations to work out the logistics.

A database of the document summaries is available on the CDC Web site. It lists all the documents available at the reading room.



Tom Widner: The second draft of the Historical Operations and Releases Report has been completed. The CDC and LANL classification officers are now reviewing the report. When the reviews are complete, copies will be made available. Highlights of the report include expanded data on the Omega and DP sites, information about the quantities of high explosives used at LANL and how they were used, and concerns the Health Division identified while monitoring potential effects.

We have also applied correction factors to some of the reported plutonium air releases from the early years. Early monitoring systems did not quantify releases as well as they can today, so we applied correction factors to data obtained before 1975.



Tom Widner: Another addition to the report includes estimates of early D-Building plutonium releases. We have collected information on the design of the building and its ventilation systems. These will help us estimate releases. We must make estimates because there are no data regarding airborne effluents from D-Building.

To Get a Copy of the Revised Report

- Sign up at the table at this meeting,
- Contact us at (800) 894-0085 or send an e-mail to twidner@ensr.com , or
- Download a copy from our Web site: www.shonka.com/ReConstructionZone

Tom Widner: To get a copy of the revised report when it is released, either sign up at the table in the back of the room, send me an e-mail, or you will be able to download a PDF version from the Web site. My business card is also on the table and includes the toll-free number and Web site address.

Other Project Activities

- We are continuing to support the "Los Alamos Revisited" oral history project.
- We will be expanding our interviewing of current and former workers.
- We are continuing to share information with NIOSH regarding documents that are relevant to worker exposures.

Tom Widner: Peter Malmgren's oral history project is still in progress. So far, Peter has interviewed 95 people including former LANL workers and area residents. We are also expanding our own interviews. At first we hesitated in conducting interviews because our knowledge about LANL was limited. Now that our knowledge about the site has increased, we will be conducting more interviews. The documents we review provide some of the information we need for our study, but interviews help us interpret these documents and fill in gaps in the recorded information. We also continue to provide NIOSH with information we discover that is relevant to worker exposures.

Public Commentary and Questions

(These statements are NOT direct quotes. All statements are paraphrased.)

Public: In order to safeguard the Manhattan Project, the president issued a security classification preventing information about radiation effects on humans from being released. Do you see any remnants of this very old security classification?

Tom Widner: No. We have seen hundreds of records dealing with litigation of various types. None that we have seen fall within the six protected categories. Some information is protected by the privacy act.

Public: Have you obtained access for other owners, such as the Air Force, other than the United Kingdom?
Tom Widner: Work for others (WFO) is part of our study. When we find relevant documents from other owners we will obtain special permission to review them.
Paul Renard: Our experience has shed some light in regards to WFO documents. In past studies, we learned late in the process that WFO information can be very important and very difficult to get access to. With the United Kingdom documents, we made an early request to push these documents through the system. So far, we have not looked at a lot of WFO, but we will. We also have not seen the United Kingdom documents yet, but access has been granted.
Tom Widner: In regards to Air Force records, we have looked at reports in the Reports Collection on different phenomena related to weapons and releases. We have not been denied access.
Susan Flack: In the early years there were two to three times as many military people as civilians that were part of LANL, and many of the documents we are reviewing are military records.
Peter Malmgren: I have talked to two people who participated in Air Force cloud monitoring activities, mainly at the Pacific islands. I have also talked to people who were charged with cleaning the planes used to collect samples from the mushroom clouds.
Tom Widner: We have seen reports regarding this monitoring.
Peter Malmgren: This monitoring and clean-up of planes was completed by volunteers because the Air Force knew it was dangerous.

Public: Cloud monitoring supposedly ended by 1962. Have you found any evidence regarding later cloud testing around LANL?
Yes, we have seen records of cloud monitoring of non-nuclear explosives drops around Sandia Base and other military bases.

Public: You said the new draft will address the high explosives issue. LANL has long history of hydro testing, using high explosives. What are the potential impacts of hydro testing?
Tom Widner: The report includes updated analysis with estimates of uranium released in hydro tests. Hydro testing causes uranium to be a priority, but what we must address is how much settled locally or traveled off site.

Public: Don’t be obsessed with uranium.
Tom Widner: We are not putting blinders on. We are looking at all materials used at LANL.
Joe Shonka: LANL made their own estimates regarding radioactive lanthanum releases, and we have placed it in our prioritization scheme.
Public: One of the reports available in the reading room addresses natural uranium.

Public: Where else have similar studies been conducted?
Tom Widner: Rocky Flats, the Oak Ridge Reservation, the Savannah River Site , Fernald, and Hanford. Some are finished; others are about half way completed. Savannah River is in a full-blown dose reconstruction.

Public: During the last meeting you said more sample documents would be available at this meeting. Did you bring any samples?
Paul Renard: So you like sample documents. We have a better crowd at this meeting despite the weather; now I know why.

Tom Widner: We can get you more samples.
Susan Flack: At first it was fairly easy to get documents released; now it is harder.
Tom Widner: We will send you six or seven more samples. In addition, CDC is considering scanning select documents and making them available.

Public: Because of the September 11 attacks, are you seeing increased problems gaining access to documents on the Web?
Tom Widner: No. It may be harder to park at LANL, but the procedures have not changed.
Paul Renard: In fact, our access has improved.
Tom Widner: The security level is heightened and the workload of personnel who must escort us has increased. As a result, getting to some venues may take longer, but access has not changed.

Public: Are you behind the firewall [referring to our access to LANL computer networks]?
Tom Widner: Yes.

Public: Will you be issuing a description of the documents you are denied access to?
Tom Widner: Yes. The descriptions will be terse but we will be glad to share them.
Paul Renard: Today, we have spent much of our time hashing out the details of the appeal process. The procedures will be discussed at LANL during the next management meeting. Results are promised to us by next week.

Public: Based on worker experiences, you may ultimately be denied access to the chain of information. You will still need to reveal to the public the kind of information not being released.
Paul Renard: CDC is concerned with the credibility of the study. We want to keep the nation secure, but at the same time the increasing restrictions on access to information brings up the issue of credibility and integrity of the study. As promised, if we can't go over a hurdle, we will let you know. This has never happened at this site. I really think people are looking at our efforts in a good spirit.

Peter Malmgren: Can you be challenged to produce reports and summaries making them more comprehensible to the general public?
Paul Renard: First we are extracting scientific data. Then we are preparing citizen summaries that report our findings in language that is as nonscientific as possible.
Tom Widner: We strive to write our reports at the appropriate level.

Public: How long will the study take?
Paul Renard: We will soon pass our original deadline, and have extended the study 3-4 years.
I really don't know when the study will be complete. It depends on the cooperation we receive to view records. Plus, there are many more records than we originally anticipated.

Public: Do you encounter the same problems at each site?
Bob Whitcomb: We break new ground at each site. For example, access here is compounded by the fact that everything is compartmentalized, and there are many facets of record repositories, each having a different methodology to access records.
Paul Renard: At Hanford and Fernald, the studies were directed searches. We did not look at all the records. Instead we followed leads to particular records. This caused problems and we had to readjust source terms as an example. Through those studies, we learned we must go through all of the records.

Public: It's good that you are examining reports of the LANL Health Division. Their public monthly reports ended in 1963. Have you found any monthly reports after 1963?
Susan Flack: We have reviewed a 20-page memo that claims monthly reports were issued more sporadically but go through 1967. Jack Carter does not have copies of these because they don't have LA numbers. We will make a request to Roger Meade to get these reports.
Public: The ones I found useful don't have numbers.
Susan Flack: We have reviewed binders in the Oppenheimer Study Center that contain unclassified versions of many of the H Division reports. The collection doesn't have all of the months and some pages are missing.
Tom Widner: We will keep an eye out for health reports issued after 1963.

Peter Malmgren: I brought a taste of the photo exhibit, which has been extended to the public at an exhibition held at the Santa Fe Community College. The photos are archival photos provided by Roger Meade. The text comments are those of people interviewed. The exhibit will be displayed in January at Los Alamos in the main library.

Public: In regards to applying correcting factors to air effluent data, I have a comment: the factors can't corrected for deficiencies in the equipment.
Paul Renard: We are not saying that the data are perfect.
Bob Whitcomb: Another way to look at calculating source terms is data verification, for example using environmental data.
Public: Do they tend to jive?
Bob Whitcomb: Yes.
Paul Renard: Some exceptions exist and we find that releases were higher than reported.
Joe Shonka: Reports from all the divisions are very enlightening, and we continue to look for others.
Susan Flack: The X-Division Progress Reports from the 40s and 50s are also very useful. They contain quantities of explosive materials cast and disposed of as waste.
Claudine Kasunic: I have found while looking through different documents from the early years that they tend to be very factual and straightforward. The people that wrote those seem very honest.
Paul Renard: That statement is true at other sites too. This is another reason why we try to go back to the original documents. Monthly summaries are important, but we have found that the original reports are most reliable.
Claudine Kasunic: I find that notations in the margins are also very open. They note disagreements on draft reports. We are seeing initial drafts with actual revision notations.

Meeting Summary–
Los Alamos Historical Document Retrieval and Assessment Project

Ninth Public Meeting

Tuesday, July 10, 2002, Española, NM

Northern New Mexico Community College, 5:00 p.m. to 7:00 p.m.

Introduction: Bob Whitcomb, CDC

(Slides are reproduced from presentation; speaker comments follow.)
(Statements are NOT direct quotes. All statements are paraphrased.)

Bob Whitcomb thanked everyone for coming to the meeting and taking the time to find the room. He apologized for the inconvenience of not having the meeting in the usual room.

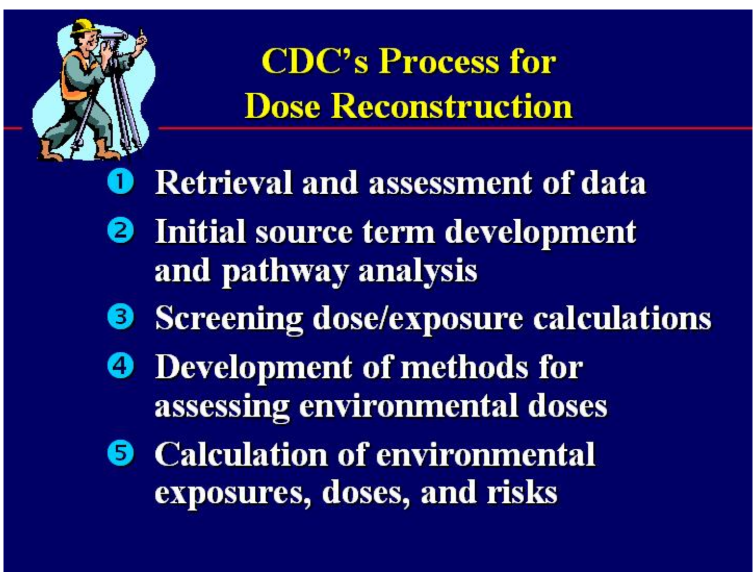
He introduced Phil Green, the new Project Officer for the Centers for Disease Control and Prevention (CDC), and C.M. Wood, the new Technical Lead on the project for CDC. Wood's expertise is health physics. In addition to the document review project, he has been involved with Cerro Grande Fire response.

Other team members in attendance were:

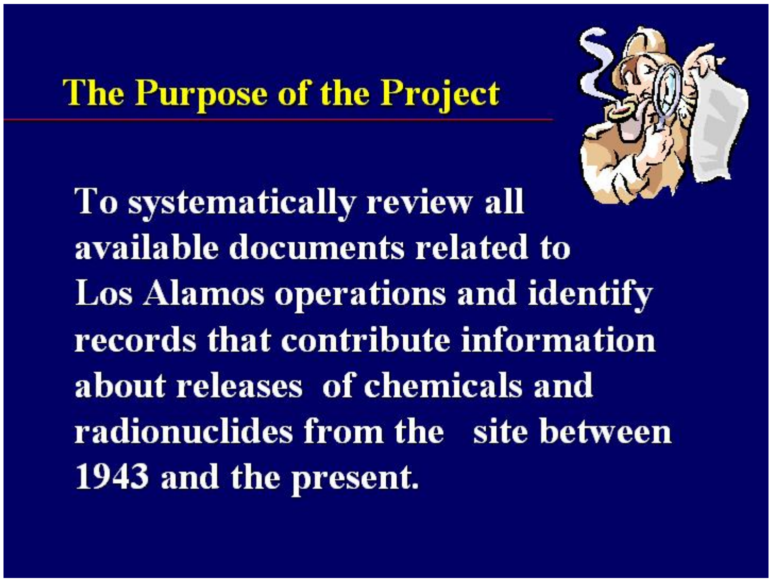
CDC	Phil Green, new CDC Project Officer
	Bob Whitcomb
	C.M. Wood, CDC Technical Lead
ENSR	Tom Widner
	Jack Buddenbaum
	Susan Flack
	Claudine Kasunic
	Peter Rasco
Shonka Research Associates	
	Regan Burmeister
TechReps	Cheryl Allen

Primary Speaker: Tom Widner, Project Director
(Slides are reproduced from presentation; speaker comments follow.)
(Statements are NOT direct quotes. All statements are paraphrased.)

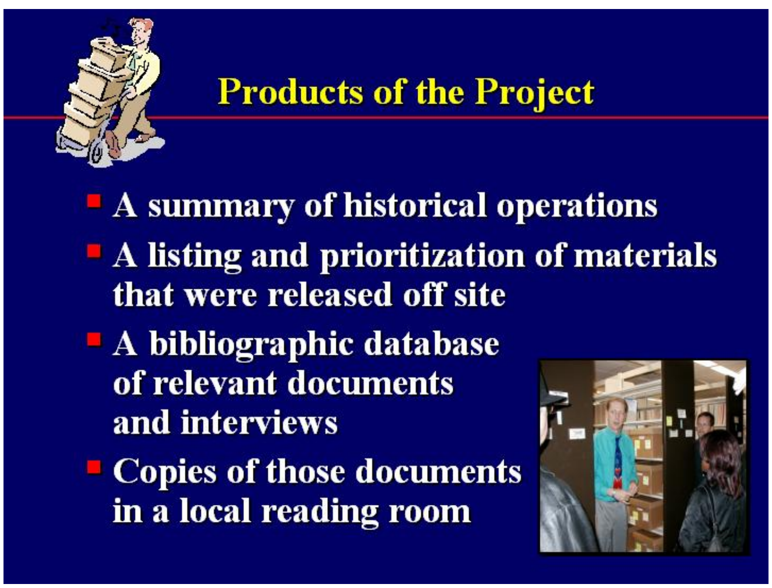
The organizations involved in the project include those listed on the slide. Researchers who are reviewing the documents hold DOE Q-level security clearances.



For several years, the team has been on the first stage of the process, which is collecting all the information available, making an inventory of the information, and evaluating the information. Based on the team's findings, CDC will work with you and other stakeholders to determine if we should go to any of the subsequent steps.



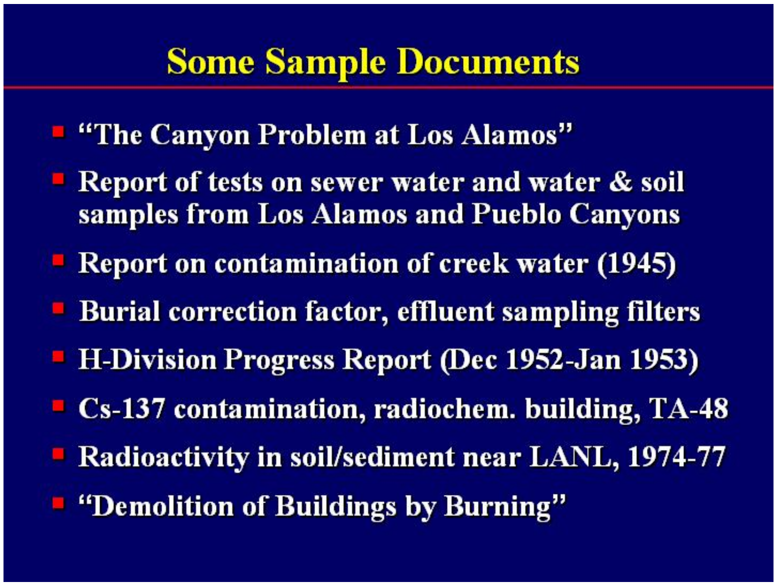
To clarify the purpose of our work: our team's focus is on off-site releases. We will not predict future releases or doses, nor will we focus on worker exposures. While our focus is on off-site releases and health effects, some of the information we are finding is also relevant to workplace exposures. We do notify NIOSH of documents that we find that appear to be relevant to worker exposures.



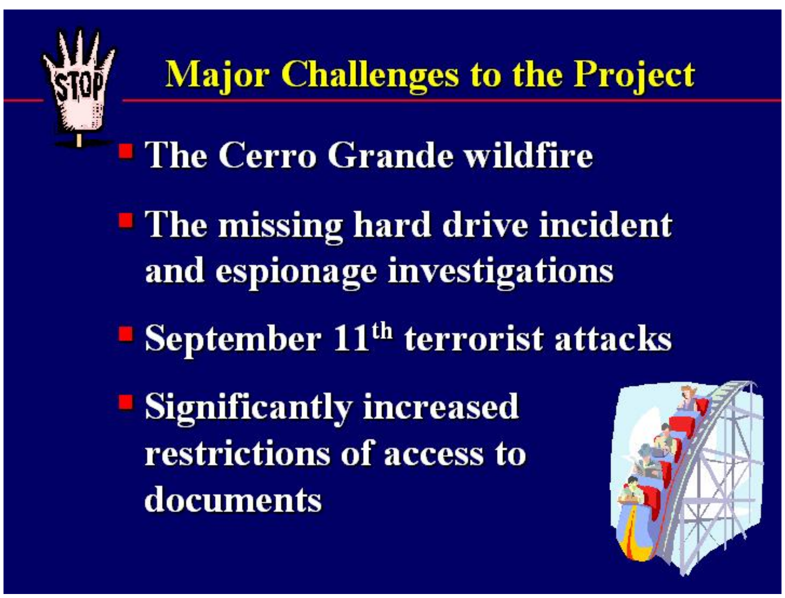
These are the products the team is working on. The summary of historical operations and releases is a work in progress. Copies of it are available upon request and on the Web. It is an early draft, and we want your feedback on it.

Relevant documents are summarized and added to the project information database. A form of that database that is accessible on the CDC Web site includes all of the documents that are available at the public reading room at the Zimmerman Library at the University of New Mexico. We continue to encourage DOE to establish a reading room closer than Albuquerque. The Department of Energy (DOE) is investigating possible hosting by the Mesa Public Library in Los

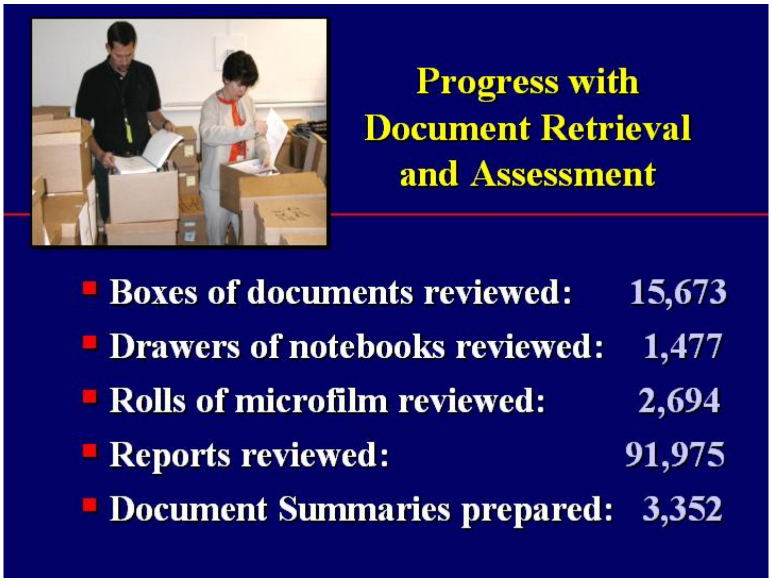
Alamos and/or by El RAEHA. We have received a strong message that a closer reading room is necessary. Another 14-15 boxes of records will be added to the current reading room soon.



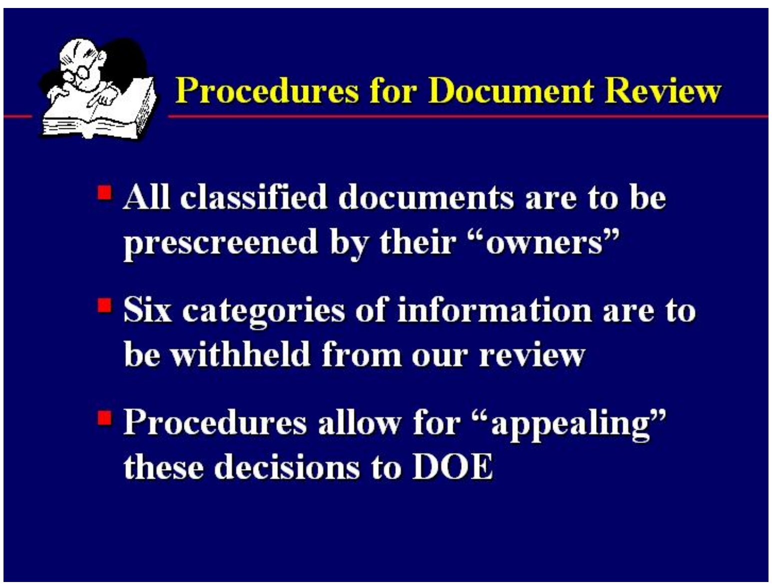
Sample documents are available at the welcome desk. The slide summarizes the documents included in the sample set which were selected as typical of several types of documents that are relevant. For example, H-Division progress reports document how materials were used and what problems the health division folks were concerned about at the time.



The process has been challenging during these last three years. We went through the fire, operational reviews, the missing hard drive incident, and espionage investigations. Together with the September 11th terrorist actions, these events led to heightened security conditions and increased restriction of our access to classified records at Los Alamos National Laboratory (LANL). The course of this project has been described as a roller-coaster ride.



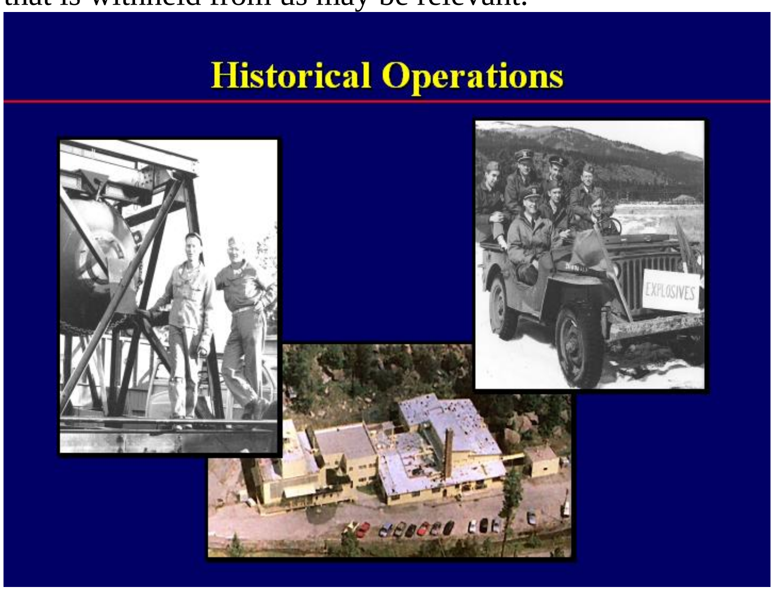
We have now reviewed more than 100,000 technical reports, and created about 3,500 document summaries that are available in the project database.



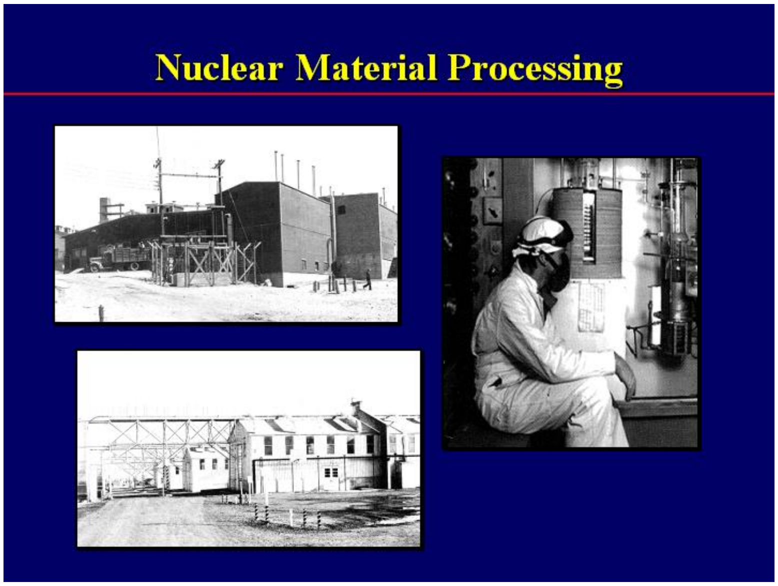
We must now be escorted at all times when we are in a document repository. With the heightened security, more limits have been placed on the number of people allowed in a facility at any one time. We can continue to work, but the increased security has made it more difficult and time consuming. Now, all documents must be prescreened by their “owners.” We are able to appeal if we are denied access to a document that we think is important for our study. During the last couple of weeks, we successfully worked through some problems. We have a better plan in place. We will be denied access to some documents that fall into five categories. The appeal process will be important, because a second set of eyes will review documents we were not able to review, to determine if that denial was appropriate. A couple levels of appeal will be in place. Very few of the documents at LANL fall into the categories of deniable material, and we are confident that we will have access to the documents that are likely to contain information relevant to off-site releases.

The types of documents that we will not have access to include these listed on the slide. They include nuclear weapons design information, including drawings and photos; Sigma 14 and 15 information, which touches on nuclear weapon vulnerabilities and similar issues; and vendor proprietary information which can include patentable information and trade secrets.

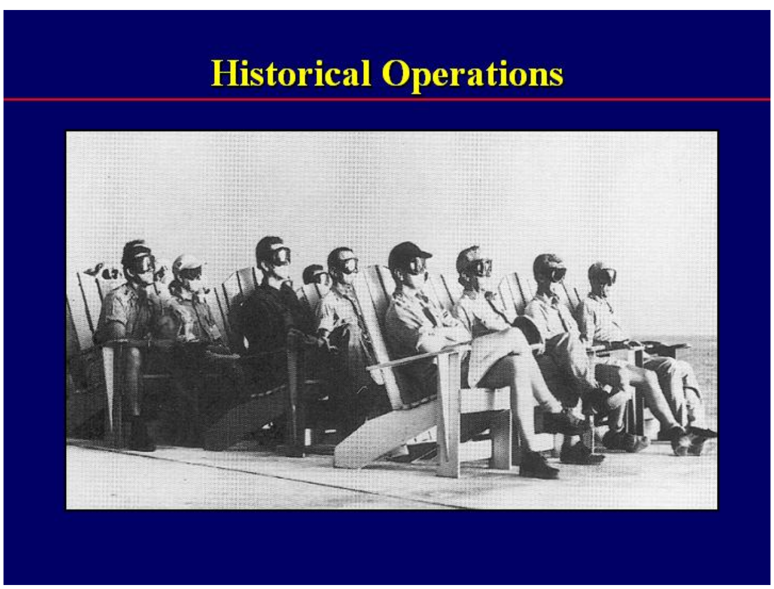
Today showed that the appeals process can work. We reviewed some United Kingdom documents to which we were initially denied access. We will push when there is any chance that a document that is withheld from us may be relevant.



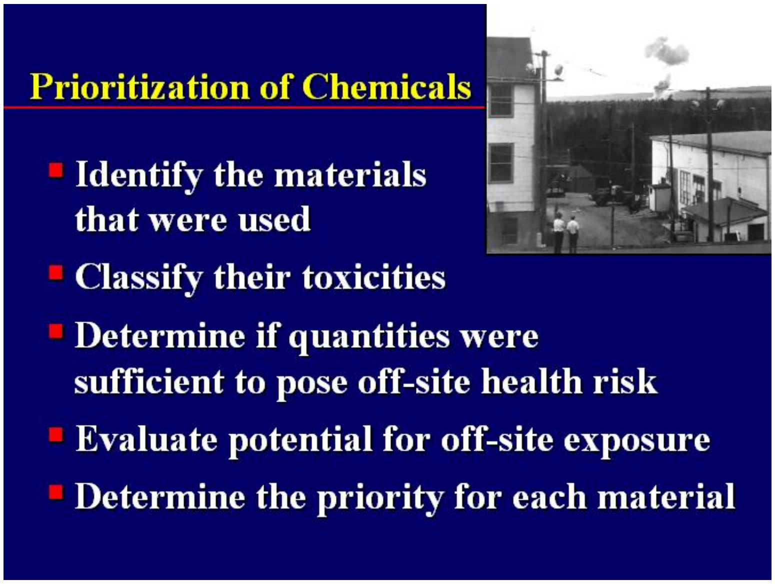
Historical operations at Los Alamos have been very diverse. These photos show some examples, namely atomic and thermonuclear weapon production and a wide variety of support functions. Unlike typical applications of high explosives (to blow things up), LANL used them to assemble precision-machined parts in precise fashions. We are looking closely at support functions such as production and testing of high explosives and nuclear reactor operations.



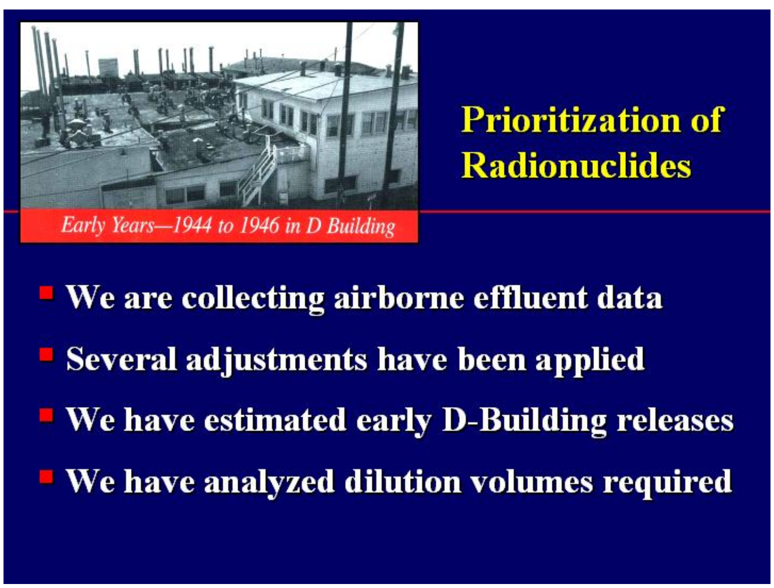
These photos are related to nuclear material processing. Early plutonium processing in D Building (upper left) was done in open hoods with ventilation that led to releases thru rooftop stacks with no filtration or effluent monitoring. Later, LANL transitioned to DP West site (lower left). During our investigation, we are looking for various forms of data. We strive to find the most basic forms of data, for example the handwritten “raw data” sometimes found in logbooks or laboratory data sheets. Radionuclide releases during the early years of LASL operation were not monitored so they will have to be independently reconstructed.



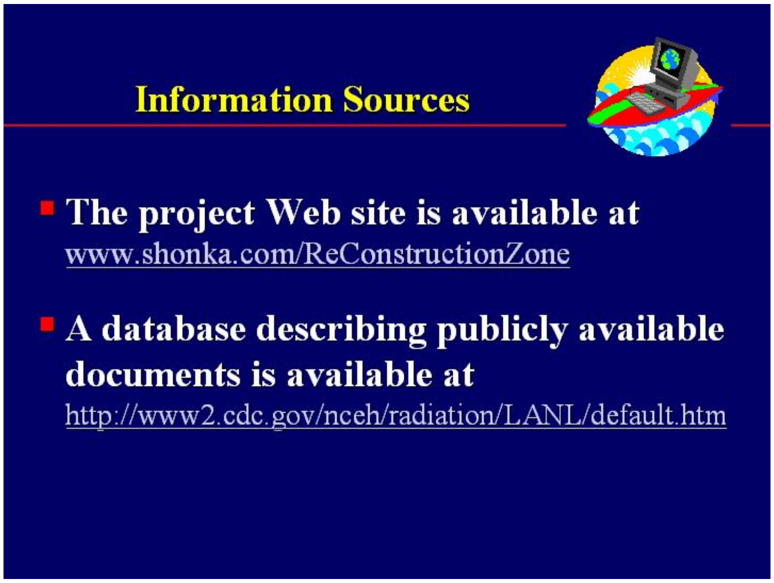
Los Alamos personnel were also involved with field operations across the country and across the world. The U.S. conducted over 1,000 nuclear tests, with LANL providing the devices for many of them and LANL personnel performing many support roles, such as flying monitoring and sampling missions through test shot clouds.



Few records were kept concerning toxic chemicals that were used, particularly before 1970. Susan Flack is our leader for investigating and prioritizing past uses of chemicals. We often work backwards after identifying the materials that were used after 1970. We find these aspects of the project to be among the most challenging. The photo shows people in Los Alamos watching a non-nuclear test shot at a Technical Area in the background.



We are collecting records of the effluent monitoring that was done by Los Alamos personnel. We have applied several adjustments to airborne radionuclide releases as reported by LANL. These are to account for deposition of some material in sample lines and for burial of some alpha particles in the filters used for airborne effluent sampling. LANL also applied adjustments like this, but they did not apply them for the early years of operation. As the first step toward prioritization, we have looked at the volumes of air or water that would be required to dilute LANL releases to maximum permissible concentrations in the environment.

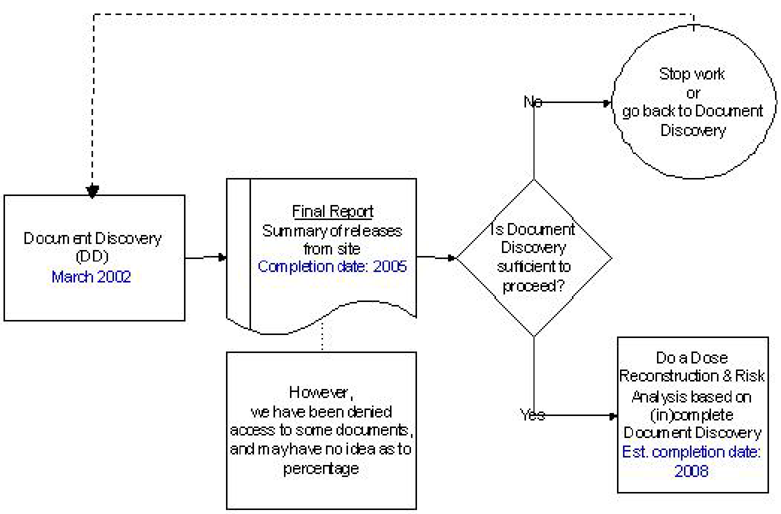


The project Web site includes the summaries of these public meetings, the draft report, and resumes of project team members. It is a general site containing information about the project. It also includes a form for asking questions or submitting suggestions and comments.

The CDC site will be expanding soon, with the summaries of the documents being added to the reading room collection. We will be glad to take the time to teach you how to use the database as a finding aid if you are having problems.

Speaker: Bob Whitcomb, CDC

(Slides are reproduced from presentation; speaker comments follow.)
(Statements are NOT direct quotes. All statements are paraphrased.)



One of the first environmental dose reconstructions was conducted at Hanford. It was initially run by DOE. There was a public outcry, saying that "the fox was guarding the hen house." Obviously, that dose reconstruction process lacked credibility. As a result, all dose reconstruction work for DOE facilities was transferred to the Department of Health and Human Services, then to CDC, who already had radiation studies in place. CDC still has work ongoing at Idaho National

Engineering and Environmental Laboratory (NEEL) and the Savannah River Site (SRS). Each is in a further stage with the document retrieval step being completed at Los Alamos.

LANL is currently our number one priority for studies of DOE sites. It is unique in that it has many more records than the other sites. At LANL, we have already gone through over 55,000 cubic feet of records and still have much more to go. At SRS, the total document collection reviewed was 55,000 cubic feet. We also have other unique challenges regarding access and denial of access to certain records. We do not want weapons information getting out (especially after September 11th), but we are still worried openness and public credibility. Today was our first success in the appeals process with review of some of the UK documents. The documents we saw turned out to not be relevant. But the effort proved that if we take the time and follow the process, we can work out the kinks and gain access to those records needed for the study.

This flow chart was developed when we realized that LANL needed to be our number one priority. The chart was generated in March 2002. The completion date for the final report is an ideal date and could change. Currently, we are still on course; however, the box below shows the catch: we have been denied access to some documents, and we do not know to what extent we will continue to face that challenge. We are trying to get arms around the number of documents that we will not have access to. We will be using the appeals process more.

We want to make sure, during this document retrieval phase, that we collect all possible pieces of the jigsaw puzzle. We may be missing some, but if we find enough pieces, we will be able to assemble the picture. If the document retrieval process is successful, we will assemble the information we need. If it is not successful, we determine if we stop or go back to collect more information. This is how we briefed our upper management, who are not familiar with the issues unique to LANL.

Public Commentary and Questions

(These statements are NOT direct quotes. All statements are paraphrased.)

Public: Have you had access to the health physics log books?
Bob Whitcomb: What we looked at today was foreign government information.
Tom Widner: Yes, we have gone through thousands of log books, some health physics, and we have extracted some records that are in database and reading room.

Public: These documents are important.
Tom Widner: We have found that the log books are a good source of basic data.

Public: Incidents with plutonium and other contamination incidents that took place are in the log books. They enter the amount and what was released.
Regan Burmeister: The quality of information in the log books is usually better than that seen in latter (summary level) reports. We have free access to log books. They are in some cases unclassified.

Public: What about surveys? There were times we had spills that may have rolled out the door.
Regan Burmeister: These are often noted in log books.
Public: You need to look at the log reports get more reliable information. The weekly and monthly reports are not written by the people doing work. They are watered down. They don't want the information getting out.

Public: Structure workers, supervisors, section leaders, rewrite again. They “sugar coat” before going to the division leader. Notebooks are kept by the person doing the experiment. They tell the truth in these reports. They put exactly how and what happened.
Public: When you get down to the section reports, they should be more accurate.
Bob Whitcomb: We have had experience looking at weekly reports, and work for others, and foreign reports.

Public: You don’t know where the skeletons are located. We can tell you where to look. LANL likes documents, but they shred; they hide.
Bob Whitcomb: We need your input and feedback.

Public: LANL didn’t check carpool calls. One janitor brought home contaminated clothes in the carpool. That isn’t reported.
Tom Widner: We’ve seen a lot of reports where contaminants were carried home .

Public: Regarding stack releases, are you familiar with giraffes? If releases are over a certain amount, they were just thrown out. Filters are often closed off.

Peter Malmgren: We want access to operational information for practical reasons. How can workers get compensation? How can you help us facilitate getting access to information they need?
Tom Widner: We are trying to streamline the process. We are getting information out as fast as we can.

Public: We can’t get access to unclassified controlled nuclear information.
Tom Widner: We’re not seeing that (UNCI) much at LANL compared to other DOE sites. We are trying to identify and use what we can release to the public.

Public: Have you seen the documentation from when the TIGER team came out? They are in the basement of CMR.

Public: How about incident reports in the medical section? The report high dosage, or cuts received on contaminated on equipment or high levels in urine.
Tom Widner: We are taking note of health records.

Public: When will you be into the linear accelerator, LAMPF?
Tom Widner: This is a new area that Jack Buddenbaum has just recently begun investigating.

Public: Thyroid cancer is still unexplained. How can I learn about the nature of materials and processes of uranium targets since the beginning? There was an incident in France where there was a target release of radionuclides. Can you change the database to capture the isotopes? Another important one is xenon. Where did the iodine that was produced go? I found documents about Omega West Reactor radionuclides (including iodine) that were helpful. These documents are in the database but I have to go to Albuquerque to look at the documents.

C.M. Wood: I asked the contractor how much it would cost to scan the documents. It would cost less to send a CD. But we don’t want to become librarians for DOE.

Public: Germantown has documents on CD regarding materials disposed of in Area G. It might be a good place to send someone.
Tom Widner: Yes, also the national archives and other collections will be searched.
C.M. Wood: We have a list of places that has records pertaining to LANL and DOE sites in general. I agree we have to look at all places. We have visited the Germantown facility on previous occasions.

Public: I would like to go back to Peter's point. You can help them and us by providing full-text searching in the database. I have gained information out of Las Vegas. I have just sent the lady there an e-mail, and she often sent me a CD. Using that database helped a man with mercury poisoning. I found five memos that were used for his case.
Bob Whitcomb: We let NIOSH know what is relevant to them. We let them know so they can include the documents in their information. We make note of documents that contain information relevant to workers.

Public: Have you checked the Los Alamos medical center?
Bob Whitcomb: I know about Project Sunshine, which was concerned about strontium-90 fallout.
Public: This was not fallout, but releases.
Bob Whitcomb: Hopefully we can find some confirmatory information.

Public: How about unauthorized autopsies?
Tom Widner: We are reviewing data about autopsies.
Bob Whitcomb: Was this related to litigation?
Tom Widner: Not to my knowledge.

Public: What criteria are used to determine if the study moves forward pas the document retrieval phase?
Bob Whitcomb: There are no regulations that set a point, no guidance is in place. That is why we bring attention to the public. When information gathering is complete, we will have to determine if we can go forward with the information in hand. We expect a lot of public involvement in that decision.

Public: We are concerned about that. I think this is the biggest meeting that has happened so far.
Bob Whitcomb: This is a process. We need people to follow it, to let us know if we are following the right paths.

Public: We are still saying that we need another reading room here. You will get more participation.
Bob Whitcomb: We are still pushing for another. Albuquerque was the easiest one to get done, but we are still pushing DOE to establish another.

Public: This is very important for people of northern New Mexico. How loud do we have to talk?
Public: We are uncomfortable with DOE controlling reading rooms. It seems like institutional flypaper. The probably have someone that notes what you are interested in. Oak Ridge has bar code. A grass roots effort may be the best way around that. Give us a CD, and we can set up our own system.

Public: You seem to focus on the environment and are ignoring worker compensation issues.
Bob Whitcomb: We are giving information to NIOSH.

Public: I would be interested in seeing your Memorandum of Understanding (MOU). Why can't NIOSH get one.
Bob Whitcomb: Our MOU is on the CDC Web site, and is updated every five years.

Public: Will you be talking to workers and technicians?
Bob Whitcomb: We are working with Peter Malmgren, who is addressing that. We have interviewed workers at other sites.
Tom Widner: We are also going to be stepping up our interviews. First, we are getting familiar with the history of LANL so we can intelligently conduct interviews. We will be conducting interviews in addition to those being conducted by Peter.
Bob Whitcomb: If you would like to be part of the interviewing process, let us know.

Public: There was a dump truck that was contaminated and they just drove it into the dump and buried it. I know a couple of guys that were truck drivers. I still remember those things.

Public: What is the issue with the documents being at Zimmerman? Who is making that decision?
Tom Widner: Zimmerman is the official DOE reading room in the area. DOE is required to support a reading room in the area. We are pushing for another that would be closer.
Bob Whitcomb: We provide well categorized, easy to locate documents. All the documents are already cataloged, we need someone to provide shelf space.

Public: Richard Espinoza shared some meeting dates dealing with the Energy Employees Occupational Illness Compensation Program. These included an August 8 stakeholder meeting for the Special Cohorts aspect of the of NIOSH program. The next advisory board meetings are August 16 and 17 in Cincinnati, and then October 15 and 16 in Santa Fe.
Public: What are the purposes of these meetings? Are they required?
Mr. Espinoza: The establishment of special cohorts is the purpose of the meeting [Special cohorts are groups of people who are eligible for benefits under EEOICPA if, after covered employment, they contracted a number of specified diseases].

Peter Malmgren: To update you on the Oral History Project, I have 109 transcribed interviews that will be placed in the NM State Archives at Santa Fe. Some of the interviews are anonymous. Most have names. They will be available in about a year.

Meeting Summary–
Los Alamos Historical Document Retrieval and Assessment Project

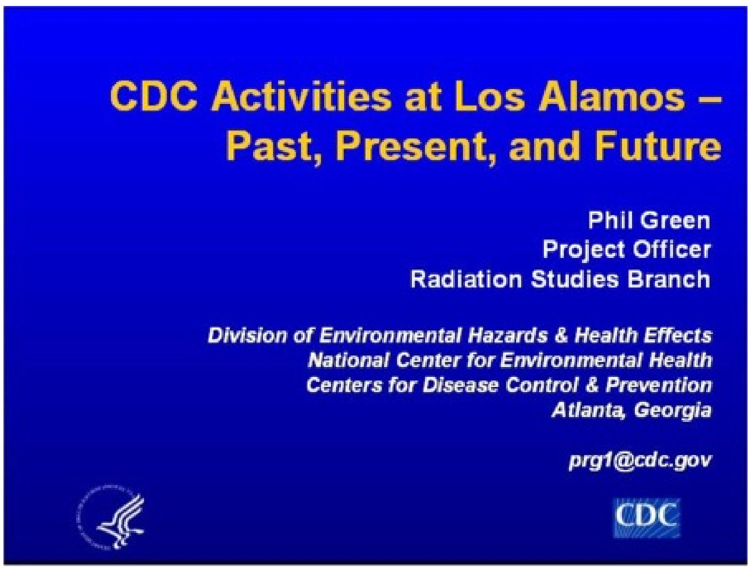
Tenth Public Meeting

Wednesday, July 9, 2003, Española, NM

Northern New Mexico Community College, 5:00 p.m. to 7:00 p.m.

Introduction: Phil Green, CDC

(Slides are reproduced from presentation; speaker comments follow.)
(Statements are NOT direct quotes. All statements are paraphrased.)

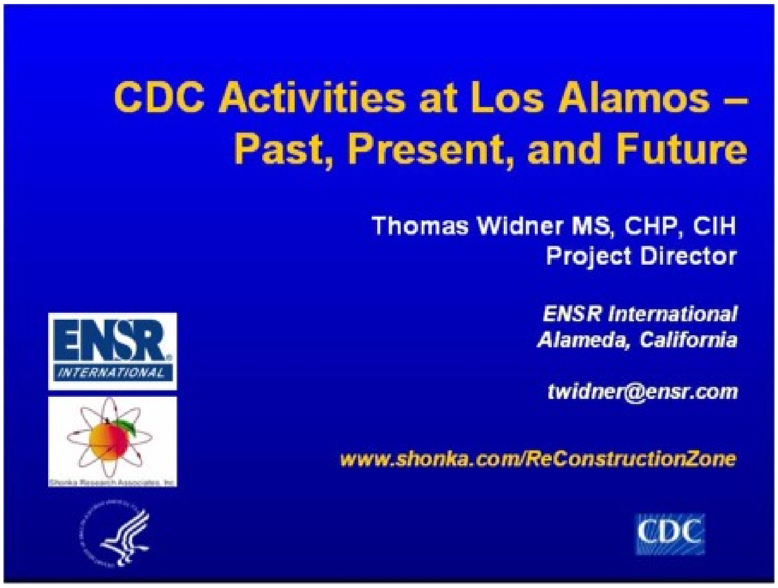


The purpose of the meeting is to discuss two issues: 1) the contract that is in place and 2) the LAHDRA project. We will discuss current work and the future of the project. Following Dr. Miller's presentation, the floor will be open for comments. We will use as much time as necessary to respond.

In 1998, the contract was awarded. The same personnel are still involved. Originally, the contract was set up for three years. In 2001, it became apparent that three years would not be enough time. Paul Renard, the project officer at that time, pushed for an extension, which was granted. An additional five years were added, extending the contract to 2006.

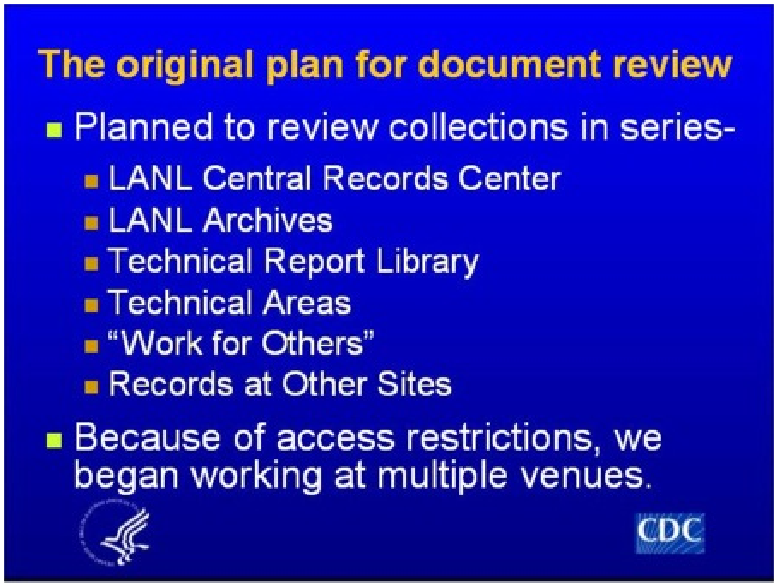
There are two elements to this type of contract: 1) a time limit and 2) a funding limit. We are within 10 percent of the contract ceiling of $4.2 million. It is not policy to increase the contract ceiling substantially. We are at the point where the ceiling will soon be reached, and there is still much to me done. CDC has asked ENSR to prepare a final report about the project and what has been accomplished to date. The draft is due in December, and a final version should be issued in March 2004. CDC will use the report to determine if they will award another contract.

Thomas Widner, Project Director
(Slides are reproduced from presentation; speaker comments follow.)
(Statements are NOT direct quotes. All statements are paraphrased.)

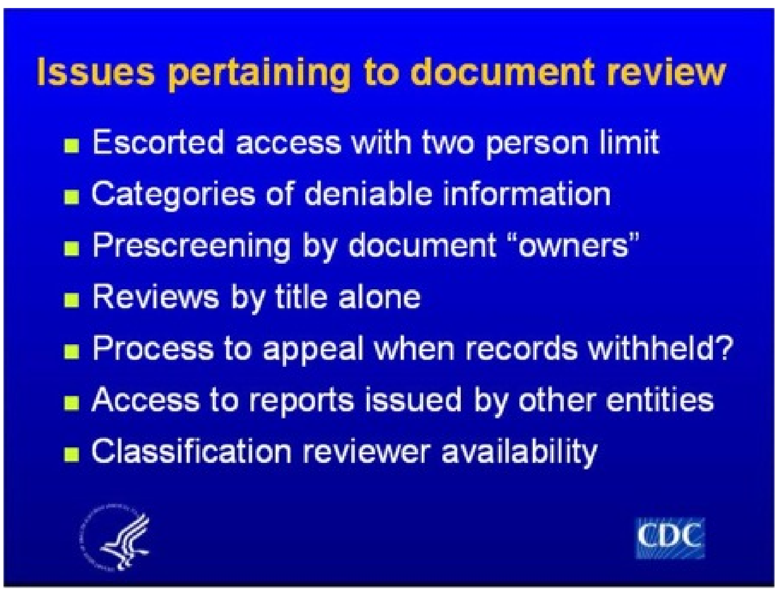


We have been in the information gathering stage for the last four years.

Tonight we will report the status of the document review effort and describe the work products that we will be delivering over the next year. These work products will include a report, a database of relevant information that we have located, and copies of relevant records in paper form and as scanned images.



We originally planned to review record collections in series. For example, we planned to complete the Central Records Center and then move on to the LANL Archives. But, because of restrictions placed on the number of people allowed to work in particular areas at a given time, we had to change the contract so we could spread out and work in a number of records centers at one time.

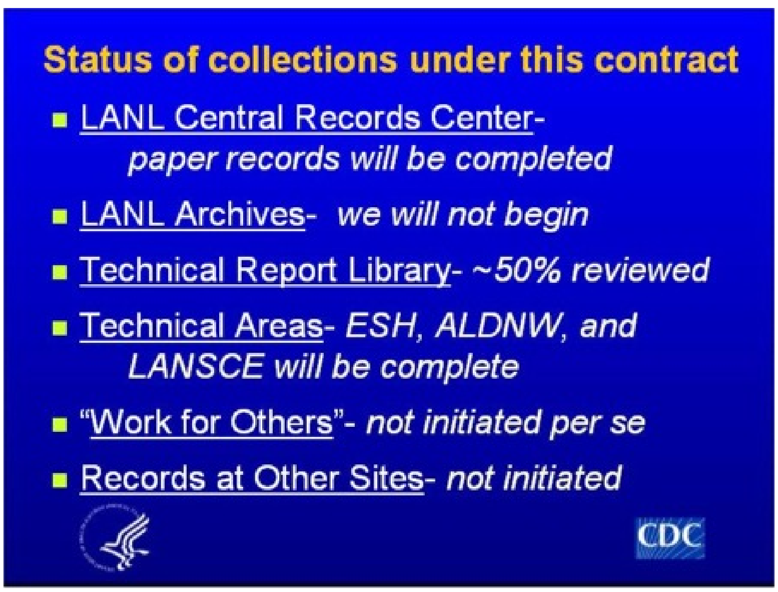


One of the questions we are asked is, "why aren't we further along?" This slide presents a summary of the issues we encountered:

- We are required to be escorted when we enter a records repository at LANL. This has not been the case in projects we have conducted at other DOE sites. The availability of laboratory staff to act as escorts is limited, and this has had an impact on productivity.
- Five, and later six, categories of information were identified by LANL personnel, to which we are to be denied access.
- LANL imposed a requirement that all documents be prescreened by their "owners" before our Q-cleared analysts can review them Under approved security procedures, LANL staff

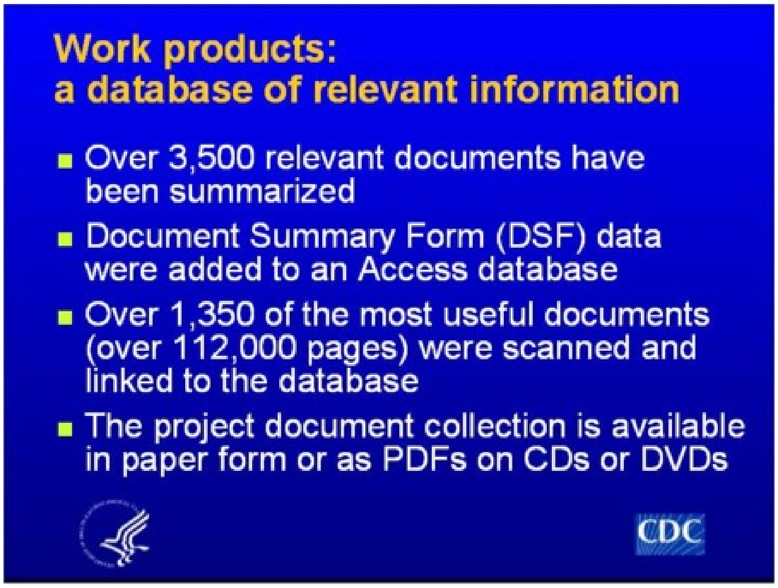
are required to separate out "deniable category material." This has been a requirement that Lab staff have had a hard time meeting.

- Document owners or custodians have in many cases asked us to review documents by title alone. We prefer to not follow this practice, as titles can be misleading or are often poor indicators of a document's contents.
- A process was put onto paper under which we could appeal the cases when we are denied access to documents that we believe we should be able to review. In December 2001, we submitted our first appeal. We have still not received a response on that appeal letter, except for a request that it be resubmitted to a different person. We have not received any response to the resubmitted appeal letter either. The defensibility and public credibility of our project depends on our ability to have unhindered access to records that may be relevant to off-site releases or health effects.
- We were initially allowed to review some classified technical reports in the LANL Reports Collection that were issued by other entities. But then LANL officials decided that they could not grant us access to documents that they did not produce.
- The availability of classification reviewers has also been limited. Two reviews are required to declassify or downgrade some documents. For some time, only a single reviewer was available, and recently the LANL contract for providing classification reviewers expired. The availability of classification reviewers is currently a bottleneck in the process for public release of relevant historical documents.

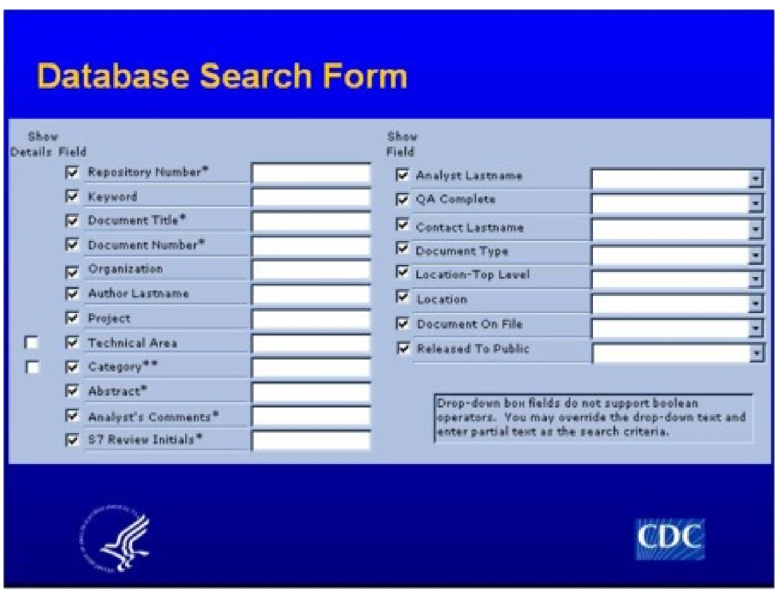


The status of our progress is summarized here:

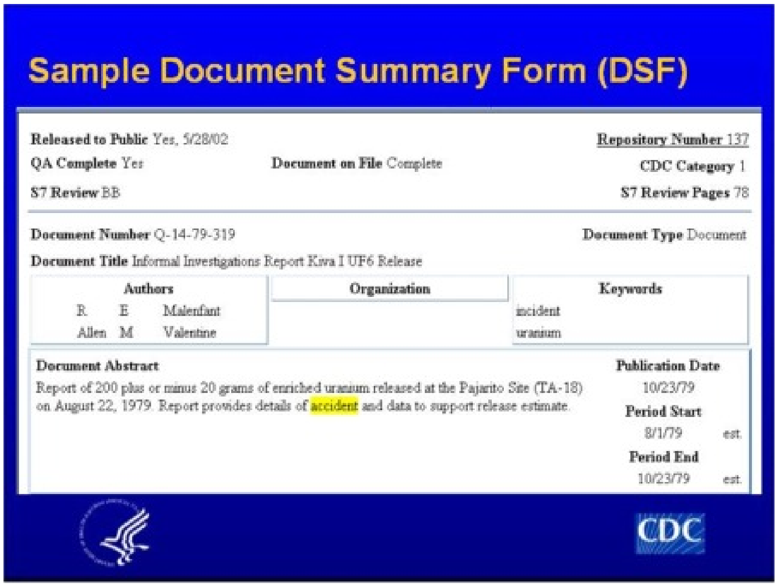
- LANL Central Records Center: The project team will have reviewed all paper records by the time our work under this contract is complete.
- LANL Archives: The Archives are in the same building as the LANL Central Records Center. Because we have been working at the Records Center under a two-person limit, we have not begun review at the Archives portion of the building.
- Technical Areas: We will complete review of the documents at ALDNW (Nuclear Weapons Directorate), ES&H, and at LANSCE.
- Work for Others: We have come across some documents related to work for others, but we have not conducted specific searches targeting collections of these records.



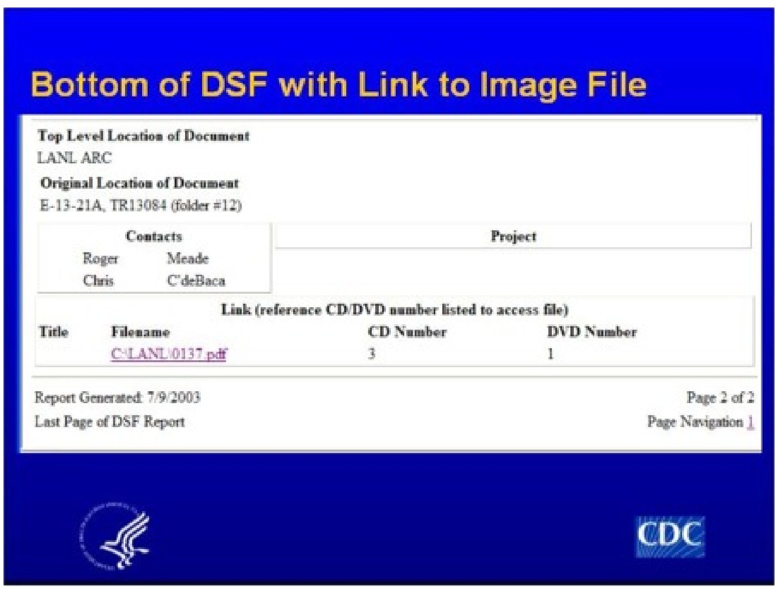
More than 3,500 relevant documents have been summarized. Information from the associated document summaries has been added to project information database. More than 1,350 of the most useful documents were scanned and are linked to the database. The collection is currently available in paper form at the Zimmerman Library of the University of New Mexico in Albuquerque. We are currently working on ways to make the collection available at other locations, since it will soon be available as scanned images on a DVD or 6 CDs. We will try to make the collection available at Northern New Mexico Community College in Española, Mesa Public Library in Los Alamos, and Santa Fe Community College.



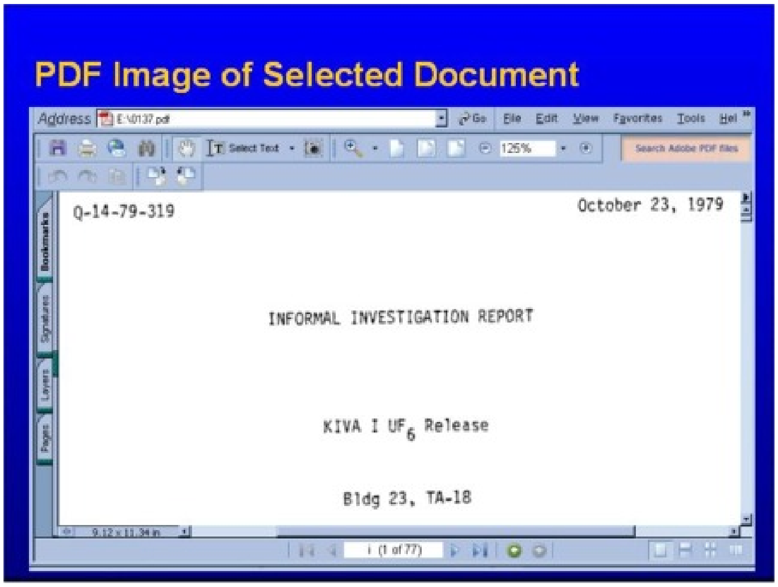
Joe Shonka will be available after our presentations to demonstrate how to search the database and access document images. This is a portion of the basic search form in the Microsoft Access database. You enter any search term. In this example, I chose "accident."



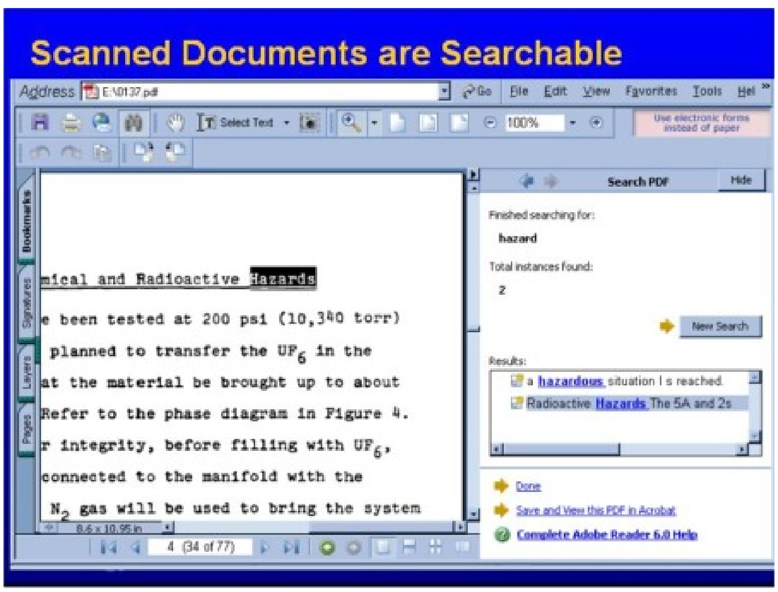
The query yields a series of document summary forms, including this one about an enriched uranium release event. This portion of the results screen shows the document's title, authors, original document location, etc. from the document summary form (DSF).



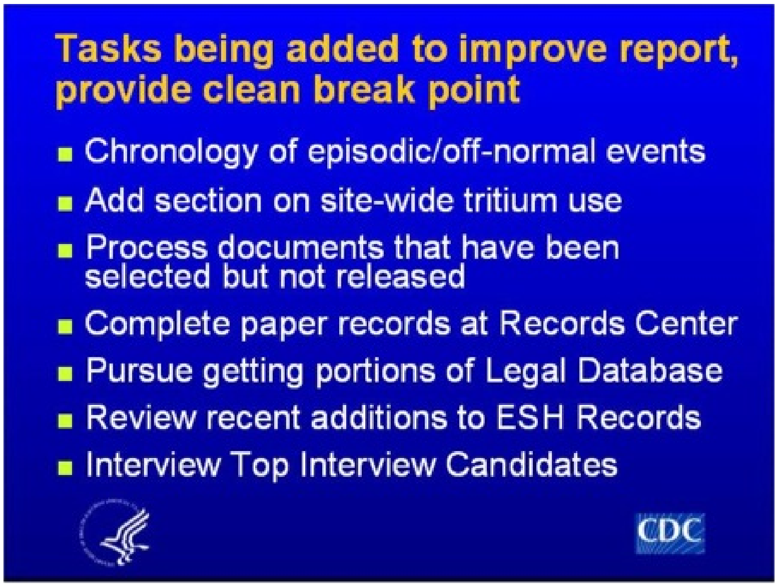
At the bottom of the DSF, there is a link to the scanned document's image file in PDF format. If you have the image file on your hard drive, it will be opened when you click on the link. Otherwise, you can insert the DVD or the numbered CD that is indicated.



This shows the actual PDF image of the scanned document. This is the first major dose reconstruction project in which the documents have been available in this way.

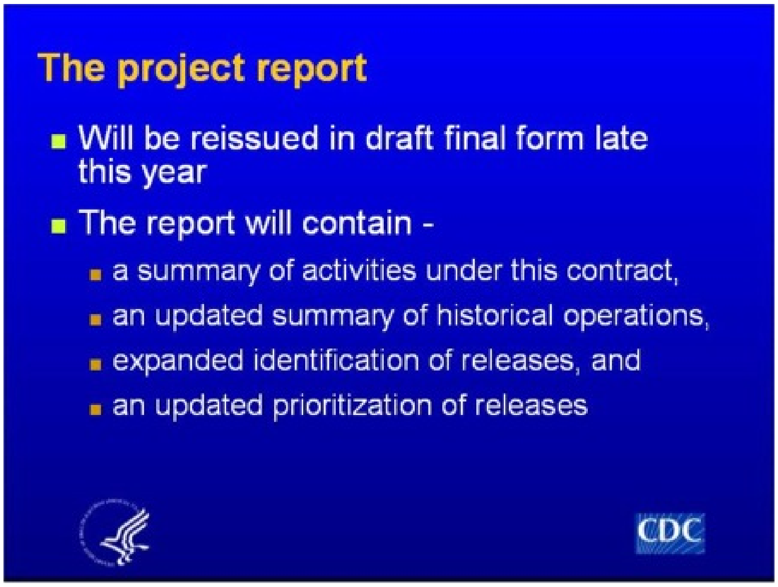


The documents, although scanned, are searchable because application of an optical character recognition (OCR) program was part of the scanning process. Currently, the Acrobat Reader search feature can be used to search within a document that is open. Soon, we hope to have a search engine that will search across *all* the scanned documents in the collection. This will be a powerful research tool for finding information about a particular subject in our document collection.

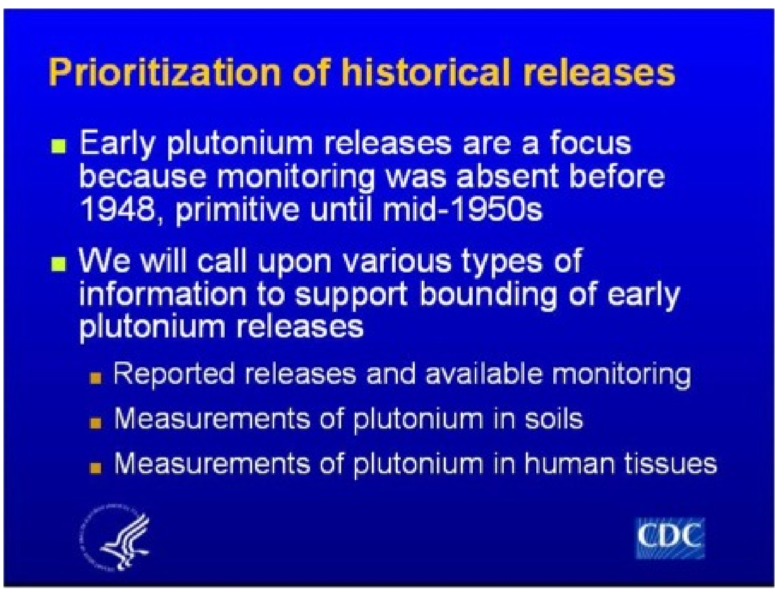


CDC has asked us to tie up the project using existing funding. Given that this must occur, we suggested to CDC that the following tasks be undertaken as high priority:

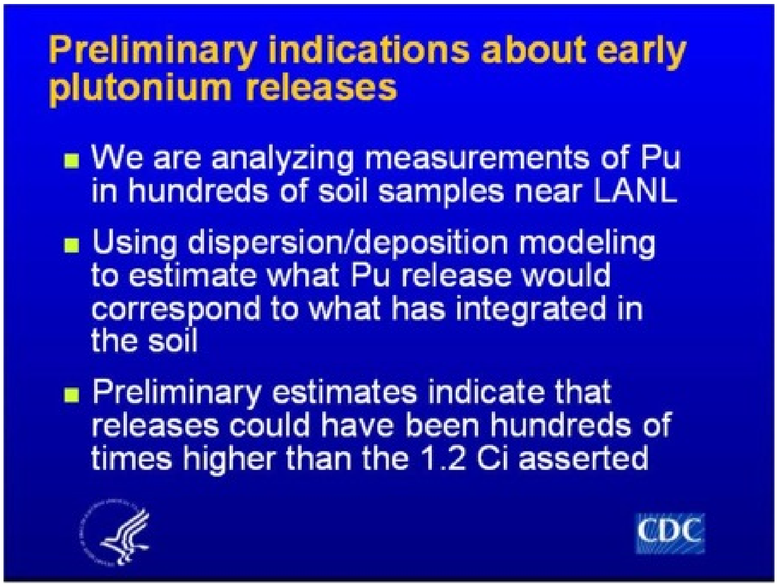
- We will go through the incident reports and other documents to develop a chronology of episodic or off-normal events. This will be helpful to identify release pathways, such as unmonitored releases or incidents that resulted in contamination being tracked home by workers.
- We are adding a section on tritium use. Reported tritium releases before 1968 are considerably lower than those after 1968. At the same time, we have seen reports of tritium release events before 1968 that appear to not be included in official release estimates. We will include information from the 1950s and 1960s under the thermonuclear weapon programs.
- Some documents are stuck in the pipeline. That is, we have selected them as relevant, but they have not yet been cleared for public release. We will make sure that as many documents as possible are released before we finalize our report.
- We are pursuing records from the Legal Database. Records were assembled by LANL in support of various lawsuits, including some dealing with brain cancer litigation and the Clean Air Act. The Legal Database includes a fairly extensive collection of documents that were scanned and indexed.
- We will review recent additions to the ESH Records Center.
- We will interview top interview candidates. We had a relatively slow start with interviewing because we wanted to be knowledgeable about LANL before we conducted interviews. We will spend a week or so with top priority candidates to fill in gaps in our knowledge and make sure we are correctly interpreting key documents..



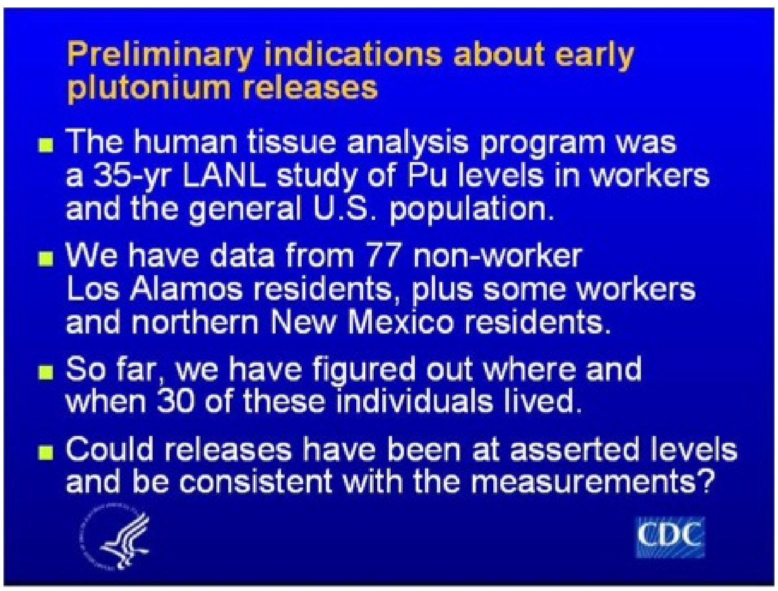
We put out a preliminary draft report last year. We will work as long as we can to review documents and evaluate their contents. We will deliver a draft final report in December. It will contain a summary of activities, as summarized on this slide. The report will start to identify those releases that are most important as off-site health hazards.



One area of particular focus as we are prioritizing past releases is early plutonium releases. Airborne plutonium releases were not monitored until 1948, and monitoring was primitive up to the mid-1950s. We are looking at these releases from different angles to evaluate what could have been released. Sources of information include effluent monitoring data that are available, soil measurements, and measurements in human tissue samples.



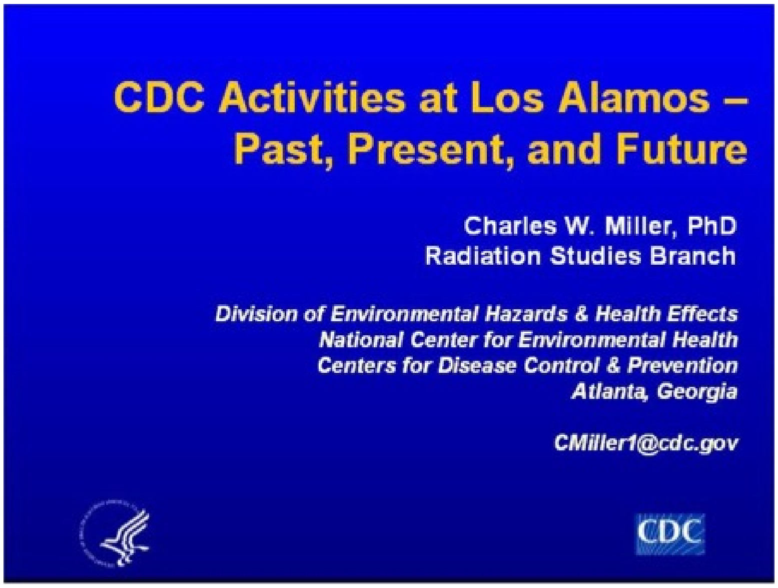
To help us prioritize plutonium releases, we are looking at soil samples. Because soil serves as an integrator of plutonium that deposits on the ground, soil samples can be valuable indicators of past airborne releases. Modeling helps us determine how high airborne releases would had to have been to be consistent with levels found in soil samples. Our preliminary estimates indicate that airborne plutonium releases could have been hundreds of times higher than the 1.2 Ci asserted by LANL. We are doing our best to put past plutonium releases in perspective. At a minimum, we believe that early plutonium releases warrant a closer look in any follow-up work.



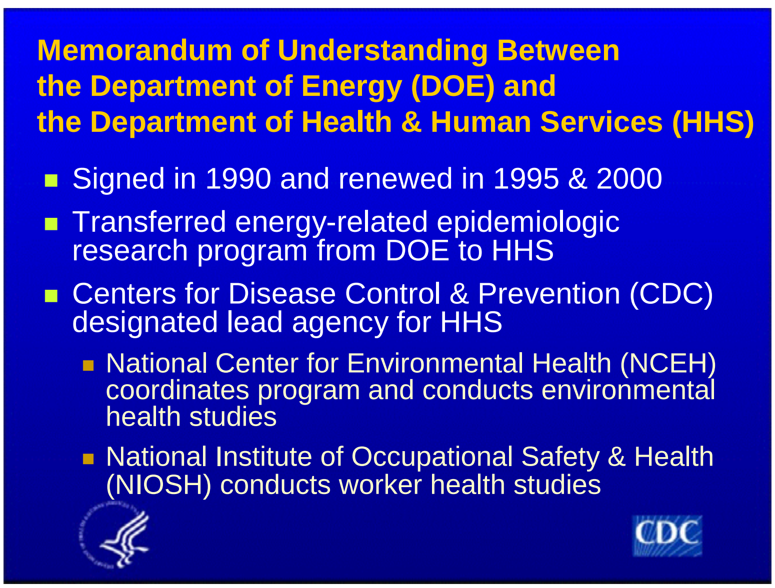
Human tissues were collected by LANL to see how much plutonium was present in the bodies of people who lived in New Mexico and across the country. While the identities of the tissue donors is protected, we have been able to identify where and when the people lived based on public records such as obituaries, cemetery records, and old telephone books. The draft final report will contain our analysis, and we will hold another meeting in December to describe our findings.

Charles W. Miller, CDC Radiation Studies Branch

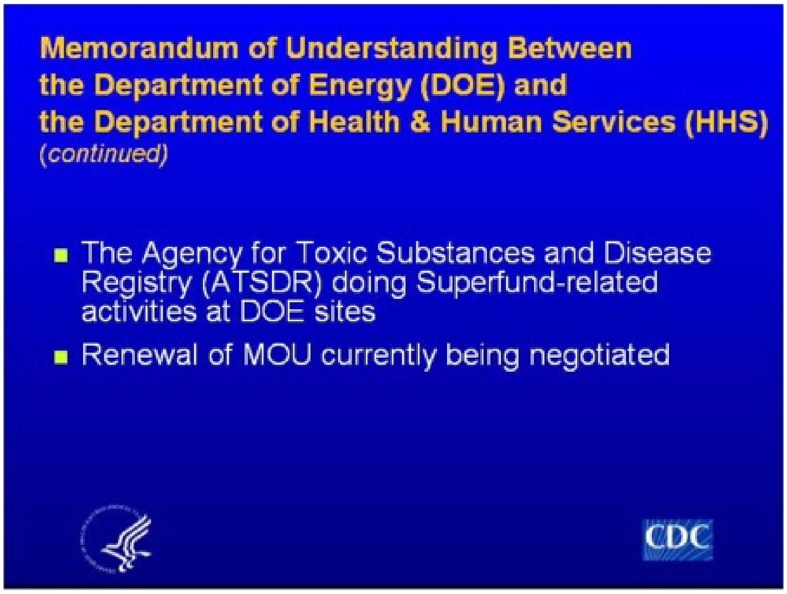
(Slides are reproduced from presentation; speaker comments follow.)
(Statements are NOT direct quotes. All statements are paraphrased.)



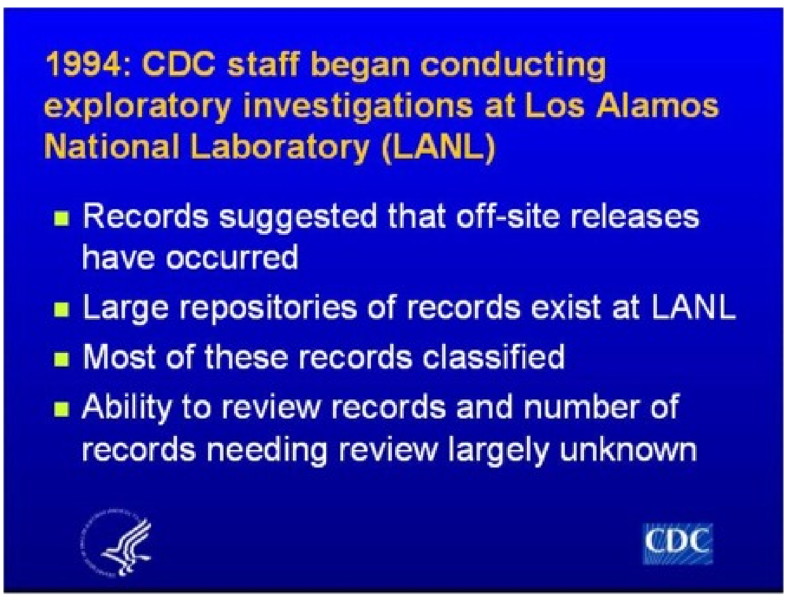
I would like to talk about how we got where we are and where we are going.



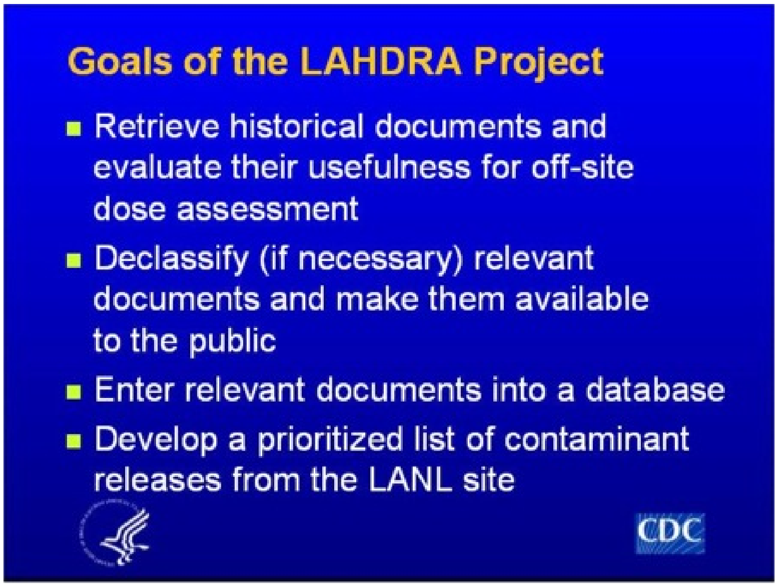
CDC is here under the auspices of a Memorandum of Understanding (MOU) signed in 1990 and renewed in 1999 and 2000. CDC is designated by HHS as the lead agency for these types of investigations.



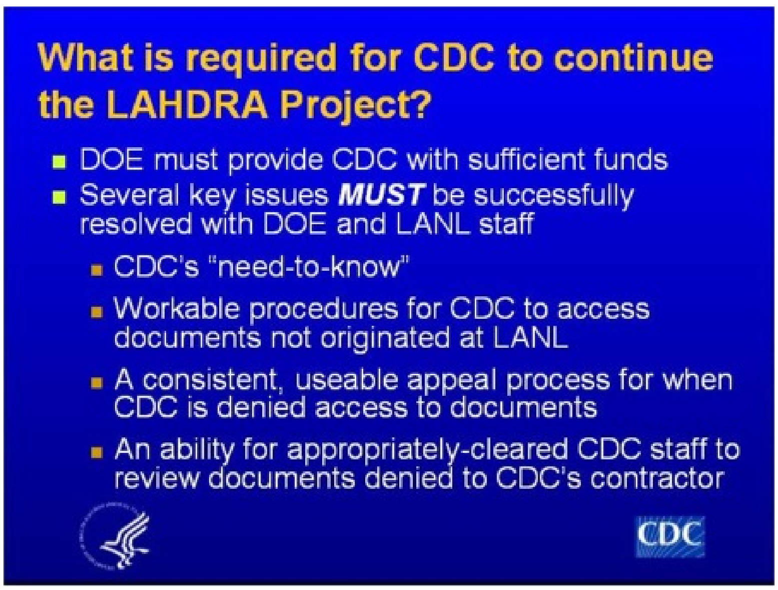
Under the MOU, Superfund programs are the basis many activities, particularly for ATSDR. Negotiations to renew the MOU are again underway.



How did we come out to LANL? We began preliminary investigations at LANL in 1994. We knew less about LANL as compared to the other DOE sites. During our exploratory work, we located records that suggested that off-site releases probably occurred. We found large repositories of records. We didn't know how many there were. We knew most records were classified, but the numbers and types of records were unknown. When the contract for this project was written, we made our best guesses of the time and money that would be needed to complete the project. We greatly under estimated the effort.



This slide summarizes the goals of the project. Tom mentioned that the draft of the final report would be issued this year. We will use the report to determine if additional work will be funded. We want your comments on the report.



As Phil mentioned, we will use the report to support a decision on whether to set up a new contract. We will determine if we will continue beyond the current contract. Regarding the first bullet on this slide, all of our activities are a line item from Congress– we can't do anything if we don't have the money we need to do it. To continue work at Los Alamos, four key issues must be resolved:

- Need-to-Know: Even though we have the security clearances, we must also have a good reason to look at documents. We are continually working at LANL to establish CDC's need-to-know to allow document review to occur.
- Access Procedures: We need to be able to review all relevant documents.
- Appeal Process: We need a process that works and is followed, within specified time limits.

- CDC Review: We need appropriately cleared staff at CDC to be able to review documents that have been withheld from our contractors, to verify that those documents do not contain relevant information. I think we are making progress, but we'll see.

Public Commentary and Questions

(These statements are NOT direct quotes. All statements are paraphrased.)

Public: What is the extent of your willingness and energy to pursue another contract? Could roadblocks cause by the September 11th events prevent another contract?
Charles Miller: Yes. A lot of issues facing us are really exacerbated by the September 11th aftermath. People are really concerned about what is being released to the public. If we don't make progress to resolve the issues I have listed, yes, we probably won't continue the project.

Public: Where can we put pressure?
Charles Miller: Let LANL and others know of your interest in the project.

Public: Would the congressional delegation be any help?
Charles Miller: I don't know.
Public: From the Bush administration down to senator Dominici, we have to let them know there are a lot of claims for compensation resulting from exposure to radiation. A lot of people need the information from this project to document their claims. We need this documentation. The job is only done half way. It's all political; Sen. Pete Dominici needs to be contacted. We need to have you guys with need-to-know to show what was released that could have affected the residents of northern New Mexico. We don't have a way of obtaining documents otherwise. When it comes to LANL, there is always the secrecy of LANL. I think there is a lot of information that still needs to come out to the public.
Charles Miller: We will do our best.

Public: How does this project compare to Hanford or ORNL?
Charles Miller: They were a quite a bit different.

Public: Why was LANL one of the last sites studied?
Charles Miller: When started, there was a lot of pressure from Hanford, in terms of prioritizing. LANL was not on the top of the list because of the amount of documents and the security issues.

Public: What was the original objective of the contract? A lot of activity related to LANL occurred at other sites. Is this information being included? Personally, I saw more nuclear bombs go off than any other person. I'm a down-winder. Without places like LANL, we might not be here now.
Charles Miller: The purpose of this project is to retrieve and evaluate historical documents. When Hanford documents were released, it was discovered that there had been releases to the environment. As a result, we performed an epidemiological study. Document reviews look for significant evidence in a systematic way. Tom's job is to review, evaluate and release relevant documents. You can use the documents for your own issues.
Public: Why are some of these issues not addressed in the MOU?
Charles Miller: We thought the MOU did address many of these issues satisfactorily. The MOU is very general. It recognized that each site is different. We have had to conduct negotiations at each site. Frankly, I thought the MOU did cover some of these issues.

Public: Will the final report address tissue sample reports?
Charles Miller: Yes.

Public: With regard to the contract, how much was spent on security issues related to Wen Ho Lee and the missing hard drives?
Charles Miller: There were no security issues related to CDC or its contractor. Certainly, we encountered delays. However, during those lockouts, Tom's staff was working on other project work.
Tom Widner: We worked on reports, interviews, or unclassified reviews during the lockouts. The cost was in terms of time delay more than cost.

Public: It is disingenuous to call this a final report. You are not looking at everything as you said you were going to do.
Charles Miller: We have been trying to figure out what to call the report. It is a report that wraps up and summarizes work under the current contract.

Public: In regards to the implicit contract with the people of northern New Mexico, you said you would go through and complete Phase 1 to determine if you were going to go through Phase 2. Do you think the completion of half of Phase 1 will provide enough evidence to go ahead with Phase 2?
Charles Miller: Phase 2 amounts to a source term analysis to determine the magnitude of off-site releases. Tom and his people have developed some preliminary and very rough estimates. We can't say more until we see Tom's report.

Public: What have you determined from autopsy reports?
Tom Widner: Preliminary indications exist that people that lived around LANL do have elevated levels of plutonium compared to people, lets say, around Denver, and that the plutonium exposure most likely occurred in the earlier years of Los Alamos operations. Our analysis is very preliminary, and we cannot draw definite conclusions yet. Indications are is that this deserves a closer look.

Public: Did your folks cover Area G or DP West? For example, I worked as a heavy operator, but I am not up to date with measurements. A lot of these folks can't get medical records to substantiate levels. People are not being compensated because NIOSH could not conduct a dose reconstruction.
Joe Shonka: I would note that our interim report from last spring contains 5-6 pages regarding autopsy reports. You can read about our analysis there. The report is available on our Website. Our project is focused on off-site people. NIOSH is studying workers' health and exposure. We are coordinating our efforts with NIOSH. We have maintained a log that identifies records that seemed relevant to their study. I have sent memos to NIOSH noting relevant documents. Informally we have upgraded some documents for release on NIOSH's request. They made copies of commentary and medical records. We try to help NIOSH, but it is a separate study. We believe that the database will be released to NIOSH before its release to Zimmerman Library.

Charles Miller: If we have data, it will be in our database, which will be given to NIOSH and will be available for you to use.

Public: Are you monitoring missing information? They don't show what I was burying.

Tom Widner: Missed doses are going to be one of the greatest challenges for the NIOSH project.
Public: If there are not records, how are you folks and NIOSH going to determine missing doses?
Joe Shonka: On this project we won't.

Public: How much radiation came out of acid canyon?
Charles Miller: With this project we are releasing documents that have been found. We will turn over the documents to NIOSH. They have people who do dose reconstruction for workers. These are important questions, but we can't give you answers now.

Public: The conversation seems focused on radiation. What about other toxins?
Charles Miller: Work is being done on all type of releases, not just radiological. Historically, people, companies and institutions have been more careful to monitor or look for radioactivity than other chemicals. For example, Savannah River Site (SRS) used boxcar loads of acids and other chemicals but kept very few records. We are trying to compile data on all chemicals.
Tom Widner: Susan Flack is our leader on chemical releases. She is assembling the puzzle.

Public: What is your Website address?
Tom Widner: http://www.shonka.com/ReConstructionZone/. There you will find a summary of our meetings, copies of slides, draft reports and other good information about the project.
Joe Shonka: The preliminary draft report and data are available on web. It summarized releases as of that time. We are further along now.

Public: Are you examining records from the Technical Areas?
Joe Shonka: We have retrieved data from TA-1 and other TAs. Remedial Investigation Feasibility Study (RIFS) reports and other various reports aren't showing anything for 1940s monitoring at TA-1. We are well aware of its history as a very historic site, and we are collecting all relevant information that we find.
Charles Miller: Please review our reports. If you know of something that is missing, contact Tom so we can get this information.

Public: This effects more than the LANL area. How do I tell you that there are people from Santa Fe to Albuquerque who, like me, knew there was something wrong? People are complaining that the government was saying there was nothing wrong with the site. When they were working on the atomic bomb I used to haul out of there. In fact, I got contaminated and so did part of my house. They said they would pay for it. They were going to take my house apart. I worked for them for 30 years. After I got sick, I asked for my records and found that that none of that is on record. That's what I would like to have. They say you would help us. We were never notified of what we were doing, and we went through a lot. We dealt with plutonium.

Public: I am an anti-nuclear activist. This man over here said if we didn't use the bomb, we wouldn't be here tonight. Everyone that lives in New Mexico has radiation. LANL is the most contaminated lab. Food, groundwater, soil, are all contaminated. Are we going to see if something is wrong? Our officials, Richardson, senators, congressmen, the President, all took oaths, but they have violated the Constitution. We are in a nuclear holocaust! We have radiated our troops. We need to send all politicians to prison for what they have done to the human race. This is sick! They have made a mess all over the country. Our own government has terrorized us! We are the super power of the world, but we are stupid. WIPP is a failure. Millions of drums are being stored there. They are leaking and going into water; gases go up and down the caves. It is sad that you act like you know nothing. This is sad that you continue to do this to the human race and all the animals.

Where is the media? They should be here to inform us how the military industrial complex is poisoning us. Radioactivity is rampant in New Mexico and the oceans. Politicians are prostitutes!

Public: We have come here to voice our opinion regarding the injustices of elite institutions. CDC is in good company hearing excuse after excuse. Attorneys tried to gather information; state regulators tried; employees can't get records. LANL is third from the bottom in the time it takes to respond with records for NIOSH. This is the racket at LANL. I am very interested in the interactions between CDC and LANL. If we could start passing these out, please. They are stamped postcards, filled out and ready to send to the head of NCEH at CDC. We need to support the extension of the MOU and the project.

Public: How much higher are the levels of plutonium?
Charles Miller: We don't have final numbers. The slide shows their estimates.

Public: I am puzzled by the trap CDC got into because they don't have people on the other side to get into areas [LANL personnel for escorting and document prescreening]. Is there funding in the MOU for them?
Charles Miller: That is something that needs to be addressed.

Public: When you talked about a workable appeals process, what is that?

Charles Miller: When LANL denies access to documents, we can appeal to DOE to see if they agree with LANL. If DOE agrees, we need a process where a CDC employee, a federal employee, can review the document.

Public: Have any appeals been successful?
Charles Miller: We have made two different sets of appeals, and we have not received a response from the laboratory on either.

Public: Is there a time limit for appeals?
Charles Miller: We would like to have a reasonable time limit, but that hasn't happened.

Public: Have you noticed any appreciable difference with the new management regime at LANL?
Charles Miller: I have noticed that we are now getting more attention at the right levels, but nothing has happened yet.

Public: I have a recommendation for future meetings: involve personnel that are involved in the project and invite NIOSH to participate.
Charles Miller: Thank you.

Public: Have you conducted tissue studies or are you just reviewing documents about tissues studies?
Charles Miller: We are using documents about tissue studies done by others.

Public: It is important to consider that Rocky Flats is 13 miles away from homes and LANL is about 1 mile away. I just want to make sure you are taking that into consideration. What is the University of California's (UC) commitment to the project at this time? What do you see as negotiable for this project to continue?

Former worker, UC Office of the President: I am no longer a representative of UC. The University supports LANL. There is no funding from CDC for LANL employees to support this effort. I have no reason to believe they are not supportive in the completion of this project. They would like to see this project come to closure.

Public: Lets talk about the by University of Colorado and UC contract.
Charles Miller: I am not familiar with that particular contract.
Public: In February, UC signed a contract with University of Colorado for a risk assessment with respect to LANL. One of the things the community is asking is why so much money is being put into a prospective or contemporary risk assessment when the LAHDRA project is not getting the support it needs. The LAHDRA project is getting the historical information that the people need.
Charles Miller: I don't know the source of funding or motivation for that contact.

Public: I will email you their work and their legal requirements. With regard to plutonium soil samples, is that data available now?
Tom Widner: It will be made available in our upcoming report.

Public: If this contract is not extended, this work will not be completed and will be bad for New Mexico and the nation. If you need our help, let the people in this room know that the contract will not be extended so we can rally the troops. You should hire local people. They can help extend your staff.
Charles Miller: We're committed to doing our best. We're not looking for a way out. Issues have arisen. If they can't be resolved, we can't do the project.
Public: Those issues don't seem that big of a deal.
Charles Miller: I agree. They are surmountable.

Public: What money is needed?
Charles Miller: CDC has money to finish what Tom is doing. By law, we can't give him more money to go beyond the ceiling, so we must bring the contract to an orderly close.
Public: Why haven't you been working on this sooner?
Charles Miller: We are using the funding committed to the contract. We have seen it coming, and we were hoping to get an extension. We were told by legal counsel that we can't add significantly more money. We have been working on this for months. We scheduled the meeting when we determined we didn't have a choice. This is the best solution.

Public: I am incredulous that you think LANL would have any incentive to cooperate with the project. They haven't in the past. That is why we are cynical. Considering UC is willing for the project to go forward is incomprehensible.
Charles Miller: I hope this will be the exception.

Public: How much money is needed to finish the whole project?
Charles Miller: I don't know if we have developed those figures. Even if we have, we wouldn't be allowed to discuss what we think it would cost; we can't give that information to potential bidders. Money is not the issue. We get money every year from Congress. I don't think money would be the issue in the future. If we can get the other issues resolved, I believe the money will be there.

Public: When will money be available?
Charles Miller: I think we would have money next year.

Public: What is the most important thing, in terms of keeping the project going?
Charles Miller: To get together with LANL and DOE to resolve issues. It is your right to do all you can to influence decision makers.

Public: I hope this is not a cover up so people around the country won't know what LANL has been doing. I don't trust it. You need to go forward and complete this project. You need to let the people know what has gone on up there.
Charles Miller: We will do our best.

Public: How do you intend to notify the people what is happening?
Charles Miller: Another meeting will be held this year. You may also drop me a line via e-mail. We'll be around. Be sure to check out the project's Web site.

Appendix L: Rules for Specifying Dates and Names in Database Records when Incomplete Information is Available

DATE FIELDS

For any date field in a table, another field will be added called "Estimated". The "Estimated" field is a Boolean data type. All date fields shall be stored in mm/dd/yyyy format.

DATE HANDLING

Below are the date data handling cases:

PD - Publication Date
SD - Start Date
ED - End Date

Case	Publication Date	Start Date	End Date	Default Values
1	Blank	Blank	Blank	Default to PD, SD, ED to January 1, 1900
2	Blank	Blank	Given	Default PD to December 31st of ED year, default SD to January 1st of ED year.
3	Blank	Given	Blank	Default PD and ED to December 31st of SD year.
4	Blank	Given	Given	Default PD to December 31st of ED year.
5	Given	Blank	Blank	Default SD January 1st of PD year, default ED.
6	Given	Blank	Given	Default SD January 1st of ED year.
7	Given	Given	Blank	Default ED to PD.

Rule	Action	Default Value
1	Publication date *month* missing	Default to December
2	Publication date *day* missing	Default to 31st
3	Start date *month* missing	Default to January
4	Start date *day* missing	Default to 1st
5	End date *month* missing	Default to December
6	End date *day* missing	Default to last day of month
7	Year is vague, i.e., 1960's	Default to January 1st of the given decade
8	The ED cannot be greater than the PD	Set ED equal to PD
9	If any of the date cases, rules or exceptions are applied	Check "Estimated" field for the corresponding date field

NAME FIELDS

Anywhere a name field exists, it will be broken into the following fields:

- Personal Title
- Given Name
- Middle Name
- Last Name
- Generation Qualifier
- Initials

Some examples are shown below:

- Personal Title: Dr, Honorable, Senator, and Representative
- Given Name: James, J, Jim
- Middle Name: E
- Last Name: Evans
- Generation Qualifier: II, III, Jr, Sr
- Initials: JE

NAME HANDLING

Rule	Action
1	Any field may be left blank.
2	Initials are first and last (if only 1 initial is known leave this field blank).
3	No periods (.) or commas (,) may be entered into these fields. Only alphabet characters allowed.