Development of a Medical Screening Program for Former Los Alamos National Laboratory Workers

United States Department of Energy
Office of Occupational Medicine and Medical Surveillance

Final Phase I Needs Assessment Report

submitted by

Johns Hopkins University School of Hygiene and Public Health
Laborers' Health & Safety Fund of North America
Los Alamos National Laboratory's Environment, Safety and Health Division
National Jewish Medical and Research Center

February 1999

Department of Environmental Health Sciences
615 North Wolfe Street
Baltimore, Maryland 21205

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Executive Summary

The Department of Energy (DOE) Former Workers Medical Surveillance Program was mandated by Congress in the Defense Authorization Act of 1993. The goal is development of medical evaluation programs for former workers at significant risk for health problems from hazardous exposures they experienced while working at DOE sites. In December, 1997, a cooperative agreement was awarded by DOE to the Johns Hopkins University School of Hygiene and Public Health (JHUSHPH) to perform a Medical Surveillance Program Needs Assessment at Los Alamos National Laboratory (LANL). The objective was to identify former LANL employees who may be at significant risk for occupational disease and determine whether a medical screening program could reduce morbidity or mortality. Co-investigators in this broad collaborative project include occupational health specialists from the Health and Safety Fund of the Laborers' International Union of North America (LIUNA); the LANL Environment, Safety and Health Division; and the National Jewish Medical and Research Center (NJMRC).

Methods A semi-quantitative algorithm was developed to make needs determinations. Information on exposure, health impacts, size of exposed populations, and LANL worker concerns and recommendations was obtained. Health outcome severity was determined from the occupational medicine literature. Each of these five factors was scored from 1 to 3 and the five factors were added. The resulting summary score was then multiplied by a binary (1 or 0) intervention suitability factor (I.S.F.) which was 1 if both of the following were available: 1) a screening test with acceptable sensitivity and specificity for the health outcome of concern; and 2) an intervention that decreases morbidity or mortality. This resulted in an Intervention Needs Factor (I.N.F.) score. Scores $\geq$ 11 were selected for the first year of Phase II. Extensive data sources were reviewed as part of the Needs Assessment.

Exposure Assessment The Industrial Hygiene Sampling database, radiation databases and worker input were utilized in the exposure assessment. Quantitative and qualitative exposure monitoring information was reviewed. A job exposure matrix (JEM) was developed for determining exposure by job title. Our assessment is that former LANL workers had past exposure relevant for medical screening to: beryllium, noise, ionizing radiation, asbestos, lead, and chlorinated solvents.

Health Impacts Several occupational medicine databases, workers' compensation information, and input from former workers and health professionals were utilized to determine health impacts based on a Sentinel Health Event (Occupational) (SHE(O)) approach. Inherent SHE(O)s, such as asbestosis, chronic beryllium disease, and silicosis, were given scores of 3 for the algorithm. Non-inherent SHE(O)s, such as liver function test abnormalities and hearing loss were given scores of 2. We found evidence of inherent SHE(O)s for asbestos, beryllium, and silicosis and non-inherent SHE(O)s for chlorinated solvents, lead, noise, ionizing radiation, and cobalt.

Roster Development and Estimated Target Population Sizes The rosters for this project built on existing epidemiology databases. These databases were updated using current information from the personnel offices for University of California (UC) at LANL and Zia/Pan Am/Johnson Controls Inc. This resulted in estimates of 25,140 former UC employees and 11,273 former Zia/Pan Am/JCI employees who are still alive. These rosters were combined with the JEM to estimate the number of former workers who would be considered for Phase II screening in each exposure category.

Former Worker Concerns and Recommendations Information from former workers was obtained in several ways, including meetings with workers, focus groups, the Steering Committee of current and former workers, and a questionnaire mailing. Exposures that more than 50% of former workers identified as of concern in the focus group exit questionnaire included: noise, asbestos, and lead. Between 25 and 50% of workers expressed concern regarding exposure to welding fumes, uranium, fiberglass, carbon tetrachloride, plutonium, degreasers, beryllium, metal working fluids, sunlight, and cadmium. The majority (60%) of the respondents reported being concerned about their health because of work. In terms of the medical evaluation program, workers found a physical examination and lab tests performed by a physician to be most acceptable (80%). Results of the questionnaire are pending.

Documentation of Need for Establishing a Medical Evaluation and Notification Program After integration of the preceding sections, six exposure categories are recommended for Phase II screening. Using our systematic approach to the selection of agents, beryllium, asbestos, and noise are clearly included. Lead, chlorinated solvents, and ionizing radiation required careful consideration regarding availability of screening tests and interventions. For the reasons outlined in Section 8, they ultimately met our criteria for screening. However, we recommend focusing our efforts on selected sub-groups of workers with ionizing radiation and solvent exposures. We also recommend using selected screening strategies such as more specific tests for solvents.

1 Introduction and Background

The Department of Energy (DOE) Former Workers Medical Surveillance Program was mandated by Congress in the Defense Authorization Act of 1993. This Act directed the Secretary of Energy to develop medical evaluation programs for former workers at risk for health problems from hazardous exposures they experienced while working at DOE sites. In December, 1997, a cooperative agreement was awarded by DOE to the Johns Hopkins University School of Hygiene and Public Health (JHUSHPH) to perform a Medical Surveillance Program Needs Assessment for former Los Alamos National Laboratory (LANL) workers. Co-investigators in this broad collaborative project include occupational health specialists from the Health and Safety Fund of the Laborers' International Union of North America (LIUNA); the LANL Environment, Safety and Health Division; and the National Jewish Medical and Research Center (NJMRC).

The overall objectives of the Phase I Needs Assessment are to determine if a Phase II medical screening program for former workers employed at the LANL site is needed, to begin preparations for such a program if needed, and to assist the DOE in meeting its legislative mandate. Phase I has focused on identification of former LANL employees who may be at significant risk for occupational disease.

If needed, the overall goals of Phase II will be to:

- Notify the former LANL employees at risk for occupational disease;
- Offer them medical screening that can lead to medical intervention; and
- Integrate this program with existing LANL health and safety programs for current workers creating a system to automatically enroll appropriate current employees as they leave employment at the LANL site.

LANL was selected as the focus site for this project for several reasons. The site is a large research facility with a long tradition of industrial hygiene monitoring and medical surveillance for workers. It has been active since 1943 and current DOE plans are to expand LANL operations as the DOE nuclear weapons complex downsizes. A tri-cultural workforce is represented, including Hispanics and Native Americans. A large number of workers have retired from this site. Extensive exposure data documenting a wide range of types and levels of hazards exist. Finally, past activities have resulted in health concerns among different former worker groups.

DOE peer review feedback on proposed Phase I plans for LANL led to an initial focus on two important groups, potentially beryllium exposed former workers and machinists. Potentially beryllium exposed workers were selected due to extent of disease at other DOE sites, the availability of a sensitive and specific surveillance tool (the lymphocyte proliferation test) and available specific treatment. Machinists were selected because of

their wide range of past exposures and resulting possible adverse health effects. Although most of our effort was focused on beryllium and machinists, we broadened our data review during Phase I to look at other exposures to the extent possible in the time allotted. As a result this report presents a Needs Assessment for a broader range of exposures than initially proposed.

A Scientific Advisory Board (SAB) was recruited for the project. The mission of the board is to provide advice concerning the scientific issues and conduct of the project to the investigators, and to provide peer review of the Phase I work products and the Phase II proposal. The SAB met once during Phase I and provided advice and comments on the methodology for the conduct of the Needs Assessment. (See Section 11 - Appendix A for the minutes from the Scientific Advisory Board meeting). The SAB reviewed the Needs Assessment Report prior to its submission to the DOE.

Following this introduction and background, a section detailing the methodology used to document and prioritize the need for medical surveillance for former LANL workers is presented. The methodology is presented first because it provides a structured approach to conducting the Needs Assessment that addresses specific DOE issues and provides an outline for presenting the results of the Phase I assessment in this report. The next section of the report presents a review of the data sources at LANL, with data sources important for completing Phase I or potentially important for Phase II emphasized. Following this review, are sections titled Exposure Assessment, Evaluation of Health Impacts, Estimated Target Population Sizes at LANL, and Assessment of Former Worker Concerns and Recommendations. Information in these sections, along with judgements about the severity of health impacts potentially associated with exposure (i.e., can over-exposure potentially result in death or serious disability), provide the basis for documenting the need for Phase II. The integration of all this information, using a semi-quantitative algorithm discussed in Section 2, is presented in the final section of this report - Documentation of Need for Establishing a Medical Evaluation and Notification Program for Targeted Former Workers at LANL.

2 Methodology for Determination of Need for a Medical Evaluation and Notification Program

The DOE has directed Medical Surveillance pilot program grantees to address four specific issues in their Phase I Needs Assessment. The Needs Assessment report must clearly document the need for establishing a medical evaluation and notification program for targeted former workers. In order to accomplish this goal the following four questions, as directed by the DOE, were addressed:

1. What are the specific hazards (chemical, physical, radiological) and degree of potential exposure (duration, degree) and are they adequately documented?

2. What are the nature and extent of health impacts that are anticipated and are they well understood and appropriately characterized?

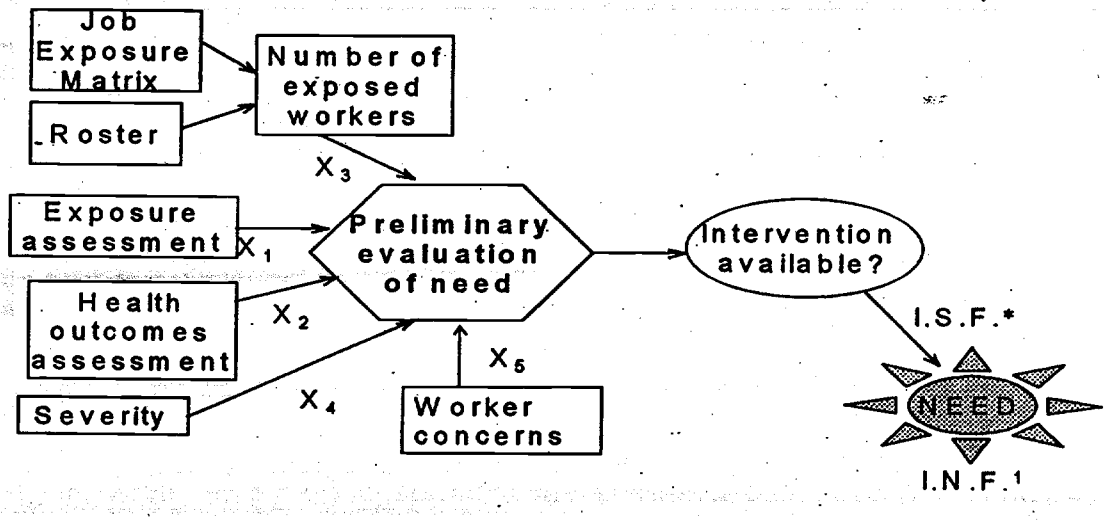
3. What is the size of the former worker target population(s)?

4. What are the concerns and recommendations of former workers?

The study team has spent the past nine months gathering and reviewing information to address these questions. The results are organized in this Needs Assessment so that each question will be addressed in order with a discussion of the methodology utilized. The final section integrates data from each preceding section in order to determine if a medical evaluation and notification program for targeted groups of former workers at LANL is needed.

The four questions listed above highlight the complexity of the needs assessment process. The final determination of need incorporates judgements about the extent of exposure to an agent, potential health impact (including any documentation of adverse health occurrence and its severity) of that exposure, the number of people exposed, and assessment of former worker concerns. The needs assessment process is further complicated by two additional factors. The first is the requirement to prioritize, due to finite resources, the hazards or conditions that are targeted for inclusion in Phase II. The second is that the targeted hazards or conditions differ in the ability of medical screening tests to validly detect the associated health effects and in the availability of medical interventions that can decrease morbidity or mortality. In order to evaluate and prioritize former worker medical surveillance needs, we have developed a systematic approach which is shown in Figure 2.1 and Equation 2.1.

Figure 2.1. Summary of Method of Determination of Need LANL, 1998



*I.S.F. = Intervention Suitability Factors
[1]I.N.F. = Intervention Needs Factor

Equation 2.1

$$I.N.F. = (X_1 + X_2 + X_3 + X_4 + X_5) * I.S.F.$$

X_1 = significant exposure?
1 = unlikely 2 = possible 3 = probable

X_2 = documentation of health effect occurrence
1 = limited 2 = non-inherent SHE(O)† 3 = inherent SHE(O)

X_3 = number of "potentially" exposed workers°
1 = ≤ 3,225 2 = 3,226 - 5,386 3 = ≥ 5,387

X_4 = outcome severity
1 = mild 2 = disability 3 = death

X_5 = worker concern
1 = ≤ 24% 2 = 25 - 49% 3 = ≥ 50%

I.S.F. = intervention suitability factor
0 = inadequate screening or intervention
1 = adequate screening and intervention

I.N.F. = intervention needs factor
If ≥ 11, need is felt to be present

† SHE(O) sentinel health event occupational
° Numbers represent the distribution of potentially exposed workers divided into tertiles

X_1: Significance of exposure. Extent of exposure was evaluated and scored on a scale of 1 through 3. A score of X_1=3 indicates that there is evidence of probable significant past exposures to former workers. The definition of significant is intentionally vague. In general, past exposures are considered to be significant if they are based on actual exposure data, or, if they were occurring today, the project investigators judge that they would probably result in a large proportion of the exposed workers being included in an ongoing surveillance program. Exposure scores are given a value of X_1=2 when the evidence to support a score of 3 is less compelling, but still indicate that significant exposure to a large proportion of former workers was possible. Significant exposures are typically judged to be possible if documentary evidence is limited. As a result, exposures with a score of X_1=2 will be further explored in proposed Phase II efforts to see if a reclassification is necessary. Finally a score of X_1=1 indicates that significant exposures were unlikely.

X_2: Documentation of health effect occurrence. In order to evaluate and score the occurrence of a health effect, the investigators utilized an approach based on the occurrence of any exposure-appropriate SHE(O).[1] Health effect occurrence was given a score of X_2 = 3 when there was evidence that the documented health effect was an inherent SHE(O), that is, the health effect was necessarily caused by an occupational exposure; examples include asbestosis, chronic beryllium disease, and silicosis. Health effect occurrence was given a score of X_2 = 2 when a SHE(O) was documented, but its link to occupational exposure is less clear, defined as a non-inherent SHE(O). Therefore, there is suggestive evidence of a health effect that was caused by occupational exposure. Examples of a non-inherent SHE(O) include noise-induced hearing loss, hepatitis, and various cancers. A score of X_2 = 1 was given when there

was only limited evidence of health impact. These health effects may be further explored in Phase II if warranted. It is important to note that the determination for X_2 does not include the calculation of epidemiologic effect measures (i.e., incidence, prevalence, relative risk).

X_3: Number of exposed workers. Assignment of scores to X_3, number of exposed workers, was based on a frequency distribution of the number of exposed workers by specific agent. A total of 41 specific agents were derived from the JEM. A score of 1 was assigned to exposures involving 3,225 or fewer workers (the lower tertile in the distribution); a score of 2 was assigned to exposures involving 3,226 to 5,386 workers (the middle tertile); and a score of 3 was assigned to exposures involving 5,387 or more workers (the upper tertile).

X_4: Outcome severity. Severity of adverse health outcome was based on accepted occupational health principles. Health conditions that could lead to death were scored highest ($X_4 = 3$), followed by conditions that could lead to disability ($X_4 = 2$) and those that resulted in mild symptoms or effects only ($X_4 = 1$).

X_5: Worker concern. Worker concern (X_5) was based on information gathered from focus groups. Workers were asked to rate their level of concern about contact with a list of agents during their work at LANL. A score of $X_5 = 3$ was given to an agent if fifty percent or greater of the respondents expressed concern (ranging from a little concerned to very concerned). A score of $X_5 = 2$ was given to an agent if twenty-five to forty-nine percent of the respondents expressed concern, and a score of $X_5 = 1$ was given to an agent if twenty-four percent or less of the respondents expressed concern. (See Section 7.1 and Section 11 - Appendix B for further discussion and focus group materials).

I. S. F: Intervention Suitability Factor. This is a binary (1 or 0) factor. Specifically, for I.S.F. to be equal to '1', two criteria had to be met:

> I) screening tests with acceptable sensitivity and specificity (as defined by the US Task Force[2]) are available for the health outcome associated with the specific exposure under consideration; and
>
> ii) an intervention that decreases severity or rates of morbidity, or rates of mortality, is available.

Our rationale for the assignment of I.S.F. scores of '1' to the exposures for which we feel there is a need for Phase II surveillance is discussed in detail in Section 8.

I.N.F.: Intervention Needs Factor. The product of ISF multiplied by the additive result of X_1-X_5 which resulted in an score greater than zero only if a beneficial medical intervention was available for the particular exposure. The final INF results were used to select exposure categories for Phase II.

Semi-quantitative algorithms are commonly used to provide a framework for reaching complex decisions. For example, the American Industrial Hygiene Association in their *Strategy for Occupational Exposure Assessment* manual utilize a similar approach to prioritizing exposure assessment needs.[3] The Industrial Hygiene Group at LANL have developed and are utilizing an algorithm to quantify and prioritize non-ionizing radiation sources and exposure concerns. In addition, NIOSH has developed and utilized a complex computerized algorithm to estimate and prioritize health risks due to chemical exposures on a national scale.[4] It is important to note however, that the algorithm utilized in this Needs Assessment does not imply risk and is simply intended to incorporate judgments about exposures, potential health effects and worker concerns in order to provide a relative quantification of former worker medical surveillance needs. A semi-quantitative approach was developed to present needs assessment decisions that were transparent and that could be evaluated thoroughly.

Information on exposure, health impacts, size of exposed populations, and worker concerns and recommendations specific for the LANL population was obtained during extensive data gathering efforts conducted as a part of Phase I. We organized our discussion of this material throughout this report by hazard categories derived from the job exposure matrix (JEM). For example, asbestos was identified as an exposure of concern in the JEM and is discussed in detail each succeeding section of this report. This exposure directed approach increases the benefits of medical surveillance since it targets workgroups that are likely to have a higher prevalence of occupational health impacts. As a result, the proportion of false positive findings from the screening program are decreased. We focused initially on beryllium and machinists but looked at many other hazards, to varying extents, during the Phase I project as outlined in the following sections. The integrated results of equation 2.1 for each exposure category are presented and discussed in Section 8, Documentation of Need for a Medical Evaluation and Notification Program.

3 Review of Existing Data Sources

Prior to addressing specific questions, pertinent data sources used to complete this Needs Assessment are summarized below. This provides important background information that clarifies subsequent methodologic discussions. Since many of the data sources are specific to the employer, a review of the two main employers at LANL is helpful in understanding this section. The University of California has been the employer for the majority of LANL employees since the 1940s. Data sources limited to these individuals are referred to as UC or UC/LANL. The primary trades contractor for LANL was the Zia company from 1946-1986. This function was taken over by Pan Am World Services from 1986-1991, at which time the contract was awarded to Johnson Controls, Inc (JCI), which holds the current contract. This company is now known as Johnson Controls of Northern New Mexico (JCNNM). Contractor data sources that cover time spans including all three employers are referred to as Zia/Pan Am/JCI. Sources specific to only one of the contractors are referred to by the individual

employer name. Fortunately, much of the contractor workforce, which is drawn primarily from the local area, has remained the same with each employer.
Since LANL is a research facility, numerous data sources were available for this project. The extensive nature of this information required the study team to review many resources and prioritize based on extent of information provided and ease of utility. The data sources fall into several categories, including data from: 1) large epidemiologic studies performed at LANL (Epidemiology Unit Data Sources); 2) medical surveillance and occupational medicine; 3) industrial hygiene; 4) personnel department; 5) union records; 6) workers' compensation records; 7) radiation health unit data sources; 8) published articles on LANL processes and health and safety activities; and 9) miscellaneous data sources, including training and security records, and old telephone books from the site.

The different data sources have strengths and weaknesses, cover varying amounts of time at LANL, and require vastly different efforts to extract, compile, and summarize. The computerized resources, which are quite extensive at least for the past 1-2 decades, have different capabilities in terms of ability to query, ability to search, and ease of access. As part of Phase I, team members examined many data sources. We met with the individuals responsible for management of the information sources, worked with them to learn what types of information could be extracted from databases, and reviewed small subsets of hardcopy information (including medical records and stored epidemiology records). We have summarized what was learned in the tables below. Additional detail on other data sources is contained in the Appendices.

Table 3-1 reviews the information sources utilized in the Exposure Assessment. The Industrial Hygiene (IH) Sampling and Workcard Databases were extensively reviewed as they contain the quantitative exposure information.

Table 3-1. LANL Data Sources Utilized in the Exposure Assessment

Data Source	*Dates*	*Description*
Industrial Hygiene Unit Data Sources		
IH Sampling Database	1991-present	• ~18,000 total sample records • Chemical/agent name, laboratory analytical results, location and date of sampling, and employee identification for personal samples • 8,100 bulk, biological, swipe, air, and atmospheric beryllium samples collected between 1949 and 1989 are entered in the database • All air and most swipe samples for beryllium dating back to October 17, 1949 have been entered; approximately 4,300 of the 8,100 samples are area and personal samples • Approximately 330 distinct chemical, biological, or physical agents sampled for since 1990 • ~8,000 non-beryllium samples, with lead second most frequently sampled for agent • A dictionary describing the fields has been developed

Data Source	Dates	Description
Workcard Form Database	1990-present	• Stores data about the location, date, and description of industrial hygiene work activities performed at LANL • All job tasks performed by ESH-5 are tracked using workcards, each with a unique identifier, allowing sampling data to be linked to specific work activity data • Workcard system was developed in the early 1990's and all tasks since then are entered in the database • Historical beryllium activities have been retrospectively assigned workcard numbers • A dictionary describing the data fields has been developed
Non-Ionizing Radiation Database	1992-present	• Results of NIR surveys, including the location, manufacturer, reported results, equipment used, and potential exposures to NIR sources is stored in this database • All 1,294 evaluations of NIR sources performed at LANL between August 30, 1992 and December 25, 1995 have been entered • No new surveys are being performed, only re-surveys • A dictionary describing the data fields has been developed
Carcinogens Use Database	1990-present	• Tracks persons and TAs that use carcinogens • Information stored includes carcinogen name, CAS registry number, user/ owner, location, and hazard rating
Automated Chemical Inventory System	1993-present	• Tracks all chemicals, including compressed gases, used on site at LANL • Data in this database includes chemical name, CAS registry number, container size, quantity, and owner or custodian, location, etc. • Tracks individual containers
Respiratory Protection Database	1997-present	• 1,482 people in new database system implemented in July 1997 • Stores data pertaining to employees fitted to wear a respirator, including name, type of respirator, potential exposure hazards, and location • All records of persons not updated within past three years are archived • Archived records exist in hard copy back to the 1960's
Concerns/ Deficiencies Tracking System	1993-present	• Tracks employee concerns and deficiencies in work and health conditions • Information stored in this database includes requests for workplace inspections, industrial hygiene monitoring, or safety controls, and abatement activities

Data Source	*Dates*	*Description*
Hoods Survey Database	1989-present	• Results of ventilation hood surveys, including uses (carcinogens, non-carcinogens), face velocity, and air flow rate in hoods are tracked • Surveys dating back to 1982 have been entered into the database
Confined Space Entry Permits	1993-present	• Electronic copies of confined space entry permits dating back to 1993 are stored in this database • Data stored includes atmospheric conditions in the confined space, persons entering the space, and the date of entry
Injury/ Illness Database	Unknown	• Stores data pertaining to injuries or illnesses that are not recorded on the OSHA 200 Log • Injury/ illnesses in this database are primarily acute in nature and very few instances of long term occupational disease is recorded
Asbestos Containing Materials (ACM) Database	1992-present	• Contains surveys performed by the Johnson Controls Inc. (JCI) Asbestos Survey Team between 1992 and 1997 • Data collected concerning ACM includes the location, type, number of employees potentially exposed, and the relative degree of hazard posed to LANL employees • Surveys indicate ACM is present in pipe or thermal insulation, tile and linoleum floor coverings, roofing materials, and wall board • Surveys are maintained in hard copy form and are retained in 98 three-ring binders
Asbestos Sampling Database	1990-present	• Exposure to asbestos during abatement projects is tracked using this database • Data is stored on two personal computers and on the ESH-5 computer server • Archived data from 1985-1989 exists in hard copy form
Hard Copy Records	1943-present	• Sampling workcards
Radiation Health Data Sources		
Skin dose equivalent databases	1940's to present	($n + \gamma + \beta + {}^{3}H$) - top 1 mm skin • 1943-1986 electronic flat files & hard copy • 1987-pres (ORACLE) • N =66,995 individuals from LANL, Zia/Pan Am/JCI, other contract workers and visitors • neutron doses since 1950

Data Source	Dates	Description
External radiation database	1944-present	External effective dose equivalent (n + γ) • 1943-1986 electronic flat files & hard copy • 1987-current available in ORACLE database tables • UC employees, Zia/Pan Am/JCI, other subcontractors, visitors • deep penetrating gamma, neutron, and shallow gamma information. • annual data summarize dose via film badges through 1979 and thermoluminescent dosimeters since 1980
Internal dose equivalent databases (Pu + U + ^{3}H) (electronic flat files, ORACLE databases, Paradox, Excel)		• Time interval - committed (to 50 y), annual • Dose categories - effective (tissue weighting); tissue and organ specific
	1943-98	Plutonium - Pu • N = 10,000 UC employees, JCI (Zia/Pan Am), and other contractor workers and visitors • urine bioassay
	1950-98	Tritium - ^{3}H • different dose measures in different places for different time periods
	1950-98	Uranium - U (similar files and variables as Pu) • limited utility (urinary U from environment)
	1945-75	Polonium - ^{210}Po (N = 1,000) • bioassay, dosimetry not calculated yet
	1955-98	Americium - ^{241}Am • bioassay, dosimetry not calculated yet
LANL Radiological Dose Assessment Team Database		• uses modeling techniques to calculate intake and committed dose • current database tables contain values of intake and committed dose • can provide cumulative doses
Other Data Sources		
Literature searching		MEDLINE and DOE Energy Science and Technology databases were searched for information on LANL hazards and health impacts • MEDLINE - 1966-present • DOE Energy Science and Technology - 7/83-12/95

Table 3-2 outlines the sources utilized in the Evaluation of Health Impacts. The health outcomes data sources were searched for the occurrence of diagnoses or laboratory test abnormalities that could be caused by exposures of interest. For example, the

audiometry database was analyzed as a means of assessing health impact in noise exposed workers and extent of restrictive spirograms was used for the asbestos health impact assessment.

Table 3-2. LANL Data Sources Utilized in the Evaluation of Health Impacts

Data Source	*Dates*	*Description*
Occupational Medicine (OM) Data Sources		
Medical surveillance examination database	1978 to present	28,000 total workers (~ 18, 000 former workers) • LANL, JCI, others (Protection Technology of Los Alamos) • ORACLE database • contains detailed special surveillance exam categories (asbestos, beryllium, hazardous waste, or lasers, or certification for respiratory use or truck driving) (categories utilized are discussed below) and routine exams • demographic table (DOB, sex, degree, previous exam date, only current job code and location (TA, bldg, room) • physical exam tables (height, weight) • lab results tables (spirometry, audiograms, chemistries, etc.); • ICD-9 diagnosis • some tables contain ~ 60,000 exams
Beryllium special surveillance category	1980-present	452 total workers in database; 305 current participants • Lymphocyte proliferation tests performed on 87 current workers since 1997 as part of a research project
Chemistry test results	1978-present	20,673 individuals; 81,880 total liver function test panels
Audiometry database	1978-present	19,875 individuals; 61,054 total audiograms • 11,584 subjects with≥ 2 audiograms • median duration from first to last = 6.9 years
Spirometry	1991-present	5,919 individuals; 12,480 total spirograms • spirometry without predicted values from 199, predicted values included since 1994
X-ray database	1981-present	26,631 Xrays • 25,077 Chest Xrays

Data Source	Dates	Description
ICD-9 Diagnoses database	1972-present	203,360 separate diagnoses from 75,220 visits to LANL Occupational Medicine
Hard copy medical records	1943 to present	65,000 active or terminated workers • 1943-80 microfiched • Medical histories & examinations; spirometry, audiograms, laboratories, EKGs, X-ray reports • records have last known address, updated job title and location information
Workers' Compensation Data Sources		
Database	1995-pres	Variables include: • name, date of injury, type of injury, dollar amount spent on claim, other demographic information obtained by linking to Payroll Database • some long latency occupational disease cases included, but most are injuries
Hard copy records	1948 - pres	Similar information
Other Data Sources		
Literature searching		MEDLINE and DOE Energy Science and Technology databases were searched for information on LANL hazards and health impacts • MEDLINE - 1966-present • DOE Energy Science and Technology - 7/83-12/95

Table 3 -3 summarizes databases used to develop the former worker rosters and estimate the target populations sizes. These data sources were obtained from a wide variety of departments and from both UC and JCI sources.

Table 3-4 includes additional reviewed data sources that will be used more extensively if a Phase II program is funded. Information on the extent of Union records and databases was gathered during the second half of Phase I. This information will be very useful for current addresses in Phase II.

Table 3-3. LANL Data Sources Utilized in The Estimation of Target Populations Sizes

Data Source	*Dates*	*Description*
Epidemiology Unit Data Sources		
UC employee roster database	1943-77	23,241 UC employees • Z number (the unique LANL identifier), age, DOB, race, education, first hire date, first job title, last termination date and last job title as of 1977 • Vital status through 1990 with underlying cause (ICDA 8th Revision) and place of death
Zia/Pan Am/JCI employee roster database	1946-78	15,039 Zia/Pan Am/JCI employees • Z number, age, DOB, race, education, first hire date, first job title, last termination date and last job as of 1978 • Vital status through 1990 with underlying cause (ICDA 8th Revision) and place of death
Personnel Department Data Sources		
Premise Imaging System	1991 to present	21,182 UC employees (7,300 terminated employees) • scanned in image of entire personnel record • active employees after 1991 • image indexed by name, Z-number, DOB, SSN, type of form • work history included in the form of personnel forms
Employee Information System (EIS) database	1976-present	~ 178,000 individuals with Z-numbers • jointly maintained by Payroll and Human Resources • all UC employees since 1976, inc short-term temps • some information in database on non-UC employees such as JCI • 7 - 9,000 UC employees per year in the database • wide range of personal and employment information • variables included are names, z-number, sex, ethnicity, hire date, job location (changes computerized since 1992 but data limited), job assignment, job classification, all college level degrees and granting institutions, address, and emergency contacts • rosters for end of fiscal years available on-line for previous 2 years (1996-98) and on tape from 1976-81

Data Source	*Dates*	*Description*
Data Warehouse (DW) Reports of EIS data	1981-present	Report Generating Software that produces data tables from the EIS system. Information generated for Phase I thus far includes: • roster of UC workers from 1981-current • demographics • complete work history (job titles, group, salary, status)
JCNNM Human Resources Database	1991 - present 1986-1991	All JCI employees • demographic information, current job code, cost center, status, hire/term date, and location (group level) Pan AM employees • similar information but stored on damaged tapes
JCNNM Labor Relations Department Craft database	1991-pres	Seniority lists for non-salaried JCI, JCNNM employees • variables include name, Z-number, cost-center,(an organizational assignment), hire date, termination date, job code, job description
JCNNM hard copy	1997-current	Supervisor form • sent to the union to request workers • lists possible risks/hazards associated with job Termination check-out sheet • place for workers to self-report exposures
Hard Copy records -UC in LANL Archives in Los Alamos	1943-present	• hard copies & microfiched • entire personnel record for employees • may contain employment applications, personnel action forms for salary or job changes, correspondence • variables include name, SSN, Z number, birth date, sex, race, education, complete work history, including dates, job titles and work group
Hard Copy records - JCI in JCNNM Archives in Los Alamos	to 1986 1986-91	• variables include job location, job title, dates • access limited since these are Zia records Work cards for PanAm, JCI employees • variables include name, address, Z-number, DOB, race, SSN, crew number, job number, classification, and some additional job-realted information • microfiched Zia records in Epi collection

Data Source	Dates	Description
Miscellaneous Data Sources		
Apprentice Machinists Program List	1943 to present	Apprentice Machinists Program computerized file with the names of 75 current and 25 former apprentices
Others	varies	Security records - Defense Nuclear Facility information Old telephone directories - have Division, Group, Room Hard copy lists of machine shop workers • 10/45 - 1/77 • include names and job title (e.g. machinists, toolmakers, welders, machine helpers) of all the employees in each shop • some copies of very poor quality

Table 3-4. LANL Data Sources with Potential Future Utility

Data Source	Dates & Description
Union-Based Data Sources	
Laborers' International Union of North America	Membership records including retirees • computerized 1998, hardcopy from 1988 • death benefit Pension records • contains current address Health & Welfare records • information on individual contractors
International Union of Operating Engineers	Membership records including retirees • computerized 1981, hardcopy from 1954 • death benefit Pension records • contains current address Health & Welfare records • information on individual contractors
International Brotherhood of Electrical Workers	Membership records including retirees • computerized 1989, hardcopy from 1945 • death benefit Pension records • contains current address Health & Welfare records

Data Source	*Dates & Description*
Teamsters	Membership records including retirees • hardcopy 1974 Pension records • contains current address
Insulators and Asbestos Workers	Membership records including retirees • death benefit Pension records • contains current address
Bricklayers and Allied Craftworkers	Membership records including retirees • computerized 1993, hardcopy from 1968 • death benefit Pension records • contains current address Health & Welfare records • information on individual contractors
Iron Workers	Membership records including retirees • hardcopy 1988 • death benefit Pension records • contains current address Health & Welfare records • information on individual contractors
Plasterers & Cement Masons	Membership records including retirees • hardcopy 1948 • death benefit Pension records • contains current address Health & Welfare records • information on individual contractors
International Union Electrical Contractors	• death benefit
Sheet Metal Workers	Membership records including retirees • hardcopy 1958 • death benefit Pension records • contains current address Health & Welfare records • information on individual contractors

4 Exposure Assessment

Exposure assessment for the Phase 1 Needs Assessment addressed the following question:

> What are the specific hazards (chemical, physical, radiological) and degree of potential exposure (duration, degree)?

Since the focus of the Phase 1 effort at LANL was on beryllium exposed workers and machinists, the exposure assessment concentrated on these two groups with beryllium providing the greatest opportunity to quantify exposure. In an attempt to be as inclusive as possible, however, other exposures were also evaluated in order to make a broader needs assessment determination. Quantitative as well as qualitative estimates of exposure were used. Exposures were assessed by first reviewing and summarizing readily available quantitative monitoring information using IH databases and secondly, by developing an overall job exposure matrix (JEM) for the site. The JEM contained qualitative exposure assignments for all jobs at the site.

Of the 12 IH-related databases reviewed, two were utilized to develop quantitative exposure information: the Industrial Hygiene Sampling and the Industrial Hygiene Workcard Form databases. These databases are the primary electronic sources of quantitative chemical exposure data maintained at LANL. All industrial hygiene sample results in the sampling database are linked to the workcard database via a workcard number. The information contained in these databases is summarized in Table 3 -1. More complete database dictionaries are contained in Section 11- Appendix C.

The IH Sampling Database is used to store and maintain industrial hygiene exposure monitoring information. This database includes the sampling date, workcard number of sampling job performed, the substance sampled for, laboratory analytical results, and calculated exposure results. Sampling activities performed after 1990 are entered into the database. All beryllium air samples and most swipe samples known to exist at LANL have been entered into the database dating back to October 17, 1949. This extensive effort was undertaken by LANL as a part of this project and to implement beryllium programs for current workers. A query of this database revealed that approximately 330 distinct chemical, biological, and physical agents have been sampled for at LANL since the early 1990's. A query for beryllium samples entered between 1949 and 1989 returned over 8,100 sample results. After removal of bulk, swipe, and atmospheric samples, 4,528 area and personal beryllium air samples collected in 16 different LANL technical areas (TA-01, -03, -06, -15, -16, -18, -22, -33, -35, -39, -40, -41, -43, -46, -53, and -59) were identified.

Industrial hygiene work activities are tracked at LANL using the Workcard system. All job tasks are summarized and catalogued using a workcard data sheet with a unique

identification number. The Workcard Database is used to store and maintain workcards in electronic form, including the name of the person submitting the workcard, a description of activities performed, location of sampling, and date the task was performed. As with sampling data, all workcards generated after 1990, have been entered into the database. All historical workcards that mention the word beryllium or are part of a report involving beryllium air sampling (workcard generated post hoc) have been entered retrospectively as an ongoing effort to support this project. LANL is currently working to retroactively enter all beryllium swipe sample data. The earliest workcard for beryllium tasks dates to 1949.

4.1 Significant Exposures at LANL

The following sections present an overview of significant historical exposures at LANL. Although the main emphasis is on beryllium and machinists, other exposures relevant to medical surveillance considerations are also discussed. Published literature and IH sampling databases were used to provide baseline information on the original two foci of our Phase I year, as well as several other important hazards.

4.1.1 Beryllium

Historical Overview. Beryllium has been a well known hazard at LANL since the 1940s. Dr. Harriet Hardy, an early beryllium expert and pioneer in US occupational health, was employed at LANL as head of the Occupational Health Program in the late 1940s. Many exposure controls were recommended by her as early as 1948.[5] The Industrial Hygiene group, under the direction of Harry Schulte, began air monitoring at that time as well. Publications from the 1950s discuss monitoring results and show examples of early exposure control methods.[5] Hyatt and Milligan report that beryllium metal was processed in the shops and metallurgical labs and soluble beryllium salts were handled in the chemical labs.[6] Although machinists comprised the largest number of exposed workers, employees with exposure to powdered beryllium and soluble beryllium salts were considered the most difficult to protect.

Industrial hygiene records (which contain work area and operation information), published literature, and interviews with current LANL workers familiar with historical aspects of beryllium operations at the site were used to develop an understanding of beryllium use at LANL beginning in the late 1940s. IH records indicate that activities involving beryllium have been performed at 20 technical areas (TA's) between 1948 and 1980. An historical profile of each of the 20 TA's where beryllium work has been performed between 1948 – 1980 is presented below. It should be noted that this profile is the initial step in an ongoing effort to characterize historical beryllium use at Los Alamos. In many instances, there is no mention of the amount of material used or the dates when the incidents that are described occurred. A more complete historical profile of beryllium use will evolve throughout Phase II of this project.

TA-01: The old town site or TA-01 was the original TA of the Manhattan Project. Beryllium work was performed at the Delta, Gamma, I, M, Sigma, and V-shop buildings of TA-01. At the Delta building beryllium metal was welded and machined and at the M building beryllium oxide materials were used. The Sigma building at TA-01 is also referred to as "old Sigma" because, in 1962, the operations were moved to TA-03, building sm-66 (south mesa-66), which became known as "new Sigma." A variety of work activities involving beryllium were performed at the old Sigma building, including extrusion work, welding, heating beryllium in a furnace, and flame plating beryllium onto substrates.

The V-shop building at TA- 01 was a foundry and machine shop where a variety of metals, including beryllium were processed. In the original Manhattan Project plans for TA-01, V-shop was a drafting room and machine shop for the design and fabrication of laboratory tools and instruments, primarily to serve the Experimental Physics (P-Divisions) and Chemistry-Metallurgy (CMR) Divisions. The original V-shop was 8000 square feet and designed for 30 toolmakers and machinists. In addition to drafting and machining duties, in 1946, the responsibility for controlling and recording metal stock was transferred from the S Warehouse to the stockroom in the V-shop.[7] In 1952, CMR work moved from TA-01 to TA-03, building sm-29 and in 1953 the beryllium shop followed and moved to TA-03, building sm-39, the new shops building. The last monitoring for beryllium was atmospheric samples collected from the roof of the Clement & Benner (CB Fox) department store from March to June in 1970.

TA-03: Over half of all LANL employees work at TA-03, the largest and most complex TA at the lab. Based on industrial hygiene records, sampling for beryllium has been performed at numerous buildings within TA-03 including; buildings sm-16, -29, -30, -39, -40, -43, -49, -66, -141, -184, -218, and -287. Building sm-16 is also called the Van de Graaf lab, where work included sanding of beryllium targets by P-9 employees. The CMR building or sm-29 was designated as the New CMR building in 1952 after being moved from TA-01. Records from 1953 indicate that groups performing beryllium work in the new CMR building included CMR-2, CMR-5, and CMR-7. Activities performed with beryllium in CMR included chemical work, synthesis of beryllium salts, hydride beryllium work, experimental induction soldering, beryllium vaporizing for films on carbon, casting rods from beryllium-copper alloy, purification of beryllium by vacuum distillation and/or sublimation, and sanding beryllium-copper alloy.

Sm-39, the shops building, houses the beryllium shop, the primary user of beryllium at LANL. The beryllium shop is located in room 16 of sm-39. Groups that worked with beryllium in the shops building include P-2, P-9, Shops Department (SD)-1, SD-3, and SD-5. In the beryllium shop beryllium-steel plates were unsoldered and beryllium-copper alloy was heat treated in a vacuum

furnace. Beryllium metal was machined, milled, ground, sandblasted, brazed, cut on an electrical discharge machine, and heated in an oven. Also, beryllium oxide cylinders and slugs were machined and sheets were drilled, an ultrasonic machine was used to make holes in it, and hemispheres were cut with a diamond saw. In 1963, sm-102, an addition to the shops, was constructed. In the 1970's sm-102, room 132 (shop 13) housed tape controlled machines that performed cutting tasks by executing coded program tapes. Among the programmed machines in sm-102 were the excello, numerical, and automatic tape machines. Beryllium metal hemispheres were machined using the excello and numerical tape controlled machines and the automatic tape machine was used for a variety of other machining tasks. The Physics building, sm-49, worked extensively with beryllium metal and beryllium alloy foils. The P-12 group began making beryllium foils in 1955 and, in 1965, P-4 group was working with beryllium-copper foils. The thin foils needed to be handled in the open, so surface contamination was regularly checked. Beryllium work was even performed at the Administration building, sm-43. Group P-15 worked with beryllium foils and J-12 used beryllium oxide rods as insulators for a thermal couple wire, and GMX-9 polished beryllium mirrors.

In 1959, the electrochemical group was one of the first groups to move into the new Sigma building at sm-66 and, in 1961, the CMB-6 ceramics group moved in. By December of 1962, the new Sigma building was in full use and there were no more documented beryllium operations at the town site Sigma building. CMB-6 worked with a variety of metal, metal alloy, and metal-nonmetal mixtures. At the Sigma building, beryllium oxide cylinders were coated with other metals, beryllium metal was etched, brazed, anodized, flame sprayed with zirconium oxide, used to coat glass microspheres, and cast into spheres in the induction furnace of the shop foundry. Other beryllium compounds worked with included compressed beryllium-fluoride discs, electron beam welded Matex (a metal alloy), and welded localloy (metal alloy). The coating of glass spheres with beryllium was also performed in sm-141, the Rolling Mill building. Industrial hygiene sampling records were also found for sm-30 (Warehouse), sm-32 (Center for Material Science), sm-184 (old Occupational Health Lab), sm-218 (Magnetic Energy and Storage Facility), and sm-287 (Scyllac Building). However, no information was found concerning the type of operations performed at these locations using beryllium.

TA-06: The GMX-7 group worked with beryllium at TA-06, also called the Two-mile mesa. Employees made beryllium foils by evaporating beryllium metal under vacuum and also made x-ray windows using beryllium metal.

TA-08: Beryllium Fluoride and beryllium oxide was stored in building 1 at TA-08, which is also called Anchor site west.

TA-09: Groups J-13 and P-8 worked with beryllium at Anchor site east or TA-09. Group J-13 experimented with beryllium fluoride and attempted to fuse the substance in a ventilated furnace. At the Cryogenics building, Group P-9 would change beryllium targets.

TA-14: The Q site at TA-14 was used for testing explosives that may have contained beryllium.

TA-15: At the R-site of TA-15 large detonations were set off. In 1954, two beryllium-TNT combinations were fired off and each contained several pounds of beryllium metal. Between 1956 and 1958 at least eight shots were detonated and each contained kilogram quantities of beryllium metal. The Phermex facility is also located at TA-15 and in 1963 group GXM-11 fired a beryllium oxide sphere. Between 1966 and 1975, groups GXM-11 and M-2 detonated numerous devices that contained up to 2 kilograms of beryllium at times.

TA-16: A variety of beryllium work was performed at TA-16 or S-site. Beryllium contaminated laundry was washed at TA-16 up until the 1970's and group WX-3 operated a burn pit where various agents such as TNT, beryllium, tantalum and fiberglass were combusted. In addition, molds, cutters, and machining fixtures were made at S-site. In 1944, the design and fabrication of spheres for use in the radio-lanthanum implosion tests began at S-site.[7]

TA-18: At TA-18, also called Pajarito site, groups N-2 and Q-14 worked with beryllium. The N-2 group handled and processed beryllium-uranium blocks and handled beryllium oxide rods for critical assembly experiments and group Q-14 employees used an ultrasonic process to clean beryllium components.

TA-21: Beryllium activities were performed at both the DP east and TD sites of TA-21. At TD site, beryllium-copper alloy was machined and beryllium oxide was ball milled. Group CMB-3 arc-melted gram quantities of beryllium pellets at DP east. The pellets were made from beryllium, vanadium, and molybdenum alloy sintered in an induction furnace. The pellets were then tested for superconductive properties.

TA-33: Metals, including beryllium, were machined using a method X machine at TA-33, HP site. The method X machine could cut shapes in beryllium, producing airborne beryllium dust. As a result the machine was moved to a ventilated area and had permanent ventilation installed. In 1955 group W-3 conducted an experiment at TA-33 where a device exploded and large pieces of Be were thrown all over the firing area.

TA-35: At Ten site, TA 35 soluble beryllium salts and beryllium carbonates were handled at high temperatures in a ventilated lab.

TA-39: Group GMX-6 test fired a number of assemblies containing beryllium at TA-39, Ancho Canyon. In 1954, there was beryllium exposure during test firing of beryllium pieces in conjunction with explosives. In 1956, GMX groups fired pieces of beryllium metal, in 1965 GMX-6 ejected beryllium discs from a gun into a chamber lined with wood, and in 1969 they fired beryllium components in a gas gun at Ancho Canyon, TA-39, building 105.

TA-40: In 1954 work on evaporating beryllium onto Zapon films was started, but then discontinued the next year. Beryllium was also milled at the DF site and vaporized in a spark gap shot at TA-40 (DF site) pad 4.

TA-41: At TA-41 beryllium spheres were sanded and a piece of beryllium was shattered during a test at TA-41-4 (icehouse).

TA-46: At the WA site of TA-46, groups N-1 and N-5 worked with beryllium. Activities included using beryllium oxide as an insulator and heating beryllium metal with other metal oxides.

TA-53: Formerly called the Los Alamos Meson Physics Facility (LAMPF), TA-53 is now called LANSCE. Groups MP-7, MP-8, and MP-10 work with beryllium at this site. Activities include using beryllium as a target, sandblasting beryllium oxide 'windows', sintering and pressing beryllium oxide targets to form a ring, and using beryllium as a beam stop.

TA-11 (K site), **TA-43** (Health Research Lab), and **TA-48** (Radiochemistry site) all have industrial hygiene records implicating beryllium use and exposures at these sites. However, no information as to the nature of these uses and exposures can be gleaned from the available records.

Historical reconstruction of beryllium exposures. The 4,528 air samples entered into the IH Sampling Database were used to retrospectively estimate the possible extent of employee exposures at LANL. Greater than 90% of the air samples were collected in TA-03, followed by approximately 2% in TA-01. The remaining samples were collected at beryllium operations in the other 14 TA's scattered throughout LANL. The fact that almost 96% of all samples were collected in TA-01 and -03 is consistent with the history of beryllium use at LANL. TA-01 is the old town site where, until closing in the early 1960s, the Sigma, Delta, and V shop buildings were located. The Beryllium shop was also located at TA-01 until it was moved to TA-03 in 1953. Since this time, TA-03 has been the primary location where beryllium operations are performed at LANL.

The reconstruction of historical beryllium exposures at LANL was an extensive undertaking. The Industrial Hygiene Group, with support from this project, went through hundreds of boxes of old sampling records (assigning them workcards) and entered relevant beryllium information into the Sampling and Workcard Databases. Although the compilation of exposure information is impressive, there are some limitations associated with inadequacies typical of historical documentation. For example, in many cases, historical sampling reports did not include sample times, or did not indicate whether the samples were personal or area. In other cases, aggregate or summary information was the only information available. For example, a report from the 1950s may say that 50 air samples were collected and no significant exposure was detected. Or it may say that 95% of the samples were less than 2 $\mu g/m^3$. Exposure results were also sometimes presented as undetectable, without giving a limit of detection or a sample volume. As a result, the data in the following Tables should be viewed cautiously. The summarized air sampling results are presented to indicate the range of beryllium use and possible exposures. These results are not intended to imply specific exposures but rather, in the broader context of this needs assessment, can be used to document a need for medical surveillance and suggest areas to concentrate Phase II efforts. A more comprehensive evaluation of actual personal exposures will be conducted as needed should a Phase II program be funded.

Table 4-1 contains a summary of airborne beryllium sampling results extracted from the LANL air sampling database. Results are presented by TA and cover 1949 to the present. Ninety four percent of all air sampling was conducted in TA-03. Where samples were reported as less than detectable a LOD value of 0.01 $\mu g/m^3$ was assumed. All summary statistics were calculated by substituting the LOD/$\sqrt{2}$.[8] The overall geometric mean for all beryllium air concentrations for all TAs is 0.04 $\mu g/m^3$. The geometric mean airborne concentrations are (average mean = 1.67 $\mu g/m^3$) less than the current 2.0 $\mu g/m^3$ control limit, and are much less than the arithmetic means due to presence of a few extreme values which skew the arithmetic mean. Of all the samples collected approximately 3% are greater than 2.0 $\mu g/m^3$. Maximum airborne concentrations vary by TA with the greatest airborne concentration equal to 2,100 $\mu g/m^3$ collected in TA-53. The 2,100 $\mu g/m^3$ sample collected in TA-53 illustrates the difficulty of using these data. The exact situation under which it was collected is not known. Although this value is an extreme outlier, it is included in this table for completeness and the reader is further cautioned to avoid using these data to imply specific personal exposures. In addition, we have used a cut-off of 2.0 $\mu g/m^3$ for standardization purposes, although we realize that chronic beryllium disease can still occur from exposures below this level.

Table 4-1. Airborne beryllium concentrations (µg/m³) summarized by technical area (TA)

TA	N	Mean	Std. Dev.	GM*	GSD†	Max.	%> 2 µg/m³
01	89	7.07	25.24	0.34	15.40	180.00	25.8
03	4243	0.99	21.00	0.04	6.47	909.00	2.6
06	8	48.23	88.14	1.78	61.30	247.49	62.5
15	19	2.46	8.85	0.06	13.70	38.80	10.5
16	31	2.96	8.25	0.14	11.70	38.00	16.1
18	45	1.99	7.30	0.19	9.23	45.00	8.9
22	7	0.03	0.01	0.03	1.38	0.04	0
33	8	0.04	0.02	0.04	1.38	0.07	0
35	28	0.13	0.39	0.02	9.51	2.09	3.6
39	2	0.72	0.98	0.22	13.58	1.41	0
40	1	1.62	-	1.62	-	1.62	0
41	16	0.57	0.72	0.12	9.15	2.00	0
43	3	1.07	1.10	0.25	22.51	2.20	33.3
46	5	1.25	2.66	0.15	8.05	6.00	20.0
53	18	117.42	494.79	0.38	21.5	2100.00	16.7
59	5	0.09	0.07	0.07	2.05	0.20	0

* GM = Geometric Mean † GSD = Geometric Standard Deviation

An evaluation of beryllium exposures by decade (Table 4-2) indicates that exposures have remained (on average) relatively constant since the 1950's with GMs below the PEL. These data indicate that exposure in the 1940's were generally highest. Although this conclusion is not unexpected, it is based on a small number of samples.

Table 4-2. Airborne beryllium concentrations (µg/m³) summarized by decade

Decade	N	Mean	Std. Dev.	GM*	GSD†	Max.	%> 2 µg/m³
1940s	8	31.94	64.08	0.93	34.71	180.00	37.5
1950s	410	2.30	15.43	0.12	7.28	247.49	10.0
1960s	310	0.25	0.95	0.03	7.16	10.00	3.2
1970s	2599	1.34	41.74	0.03	6.09	2100.00	2.4
1980s	1201	2.36	38.20	0.04	7.49	909.00	3.4

* GM = Geometric Mean
† GSD = Geometric Standard Deviation

Since most of the historical beryllium work occurred in TA-03, we analyzed the beryllium exposure data for this technical area in more detail. The annual average airborne beryllium concentrations for TA-03 are presented in Table 4-3. Overall, only 2.6% of the samples collected in TA-03 were above 2.0 µg/m^3. In general, exposures in TA-03 appear to have been well controlled since the 1950's with only a few samples ever exceeding the 2.0 µg/m^3 control limit.

Table 4-3. LANL beryllium concentrations (µg/m^3) in TA-03 summarized by year

Year	N	Mean	Std. Dev.	GM*	GSD†	Max.	%> 2 µg/m^3
1953	52	0.75	1.04	0.12	13.62	4.90	11.5
1955	60	0.11	0.29	0.04	2.36	1.77	0
1956	6	0.52	0.70	0.11	10.57	1.41	0
1957	90	0.48	1.99	0.12	2.67	16.90	4.4
1958	80	0.14	0.39	0.09	1.72	2.85	2.5
1959	2	0.02	0.02	0.02	2.44	0.04	0
1961	1	<0.01	--	<0.01		<0.01	0
1963	10	1.49	2.77	0.32	7.90	9.09	20.0
1964	1	4.11		4.11		4.11	100
1966	2	0.04	0.00	0.04	1.00	0.04	0
1967	4	0.12	0.19	0.03	10.81	0.40	0
1968	2	0.04	0.01	0.04	1.28	0.05	0
1970	252	0.16	0.74	0.02	6.44	10.00	2.0
1971	241	0.26	3.24	0.01	3.52	50.00	0.8
1972	261	0.97	8.22	0.02	7.02	126.00	4.2
1973	352	0.14	0.61	0.02	5.28	5.60	2.3
1974	397	0.05	0.14	0.02	3.81	2.00	0
1975	254	0.21	2.84	0.02	3.38	45.20	0.4
1976	319	0.11	0.26	0.05	3.99	3.55	10.6
1977	227	0.11	0.15	0.06	3.64	1.40	0
1978	181	2.65	21.41	0.09	10.41	283.30	8.8
1979	178	1.46	8.55	0.17	6.78	105.00	5.6
1980	117	0.47	1.73	0.08	4.94	11.00	3.4
1981	34	0.10	0.24	0.02	5.22	1.18	0
1982	177	1.39	15.76	0.04	6.47	209.70	2.3
1983	121	2.24	20.63	0.02	4.71	223.00	1.7
1984	213	0.05	0.17	0.01	4.20	1.17	0

Year	N	Mean	Std. Dev.	GM*	GSD†	Max.	%> 2 µg/m³
1985	196	0.31	1.13	0.03	8.06	11.87	2.6
1986	245	7.72	81.94	0.07	5.75	909.00	3.7
1987	20	0.22	0.38	0.04	12.16	1.40	0
1988	64	0.53	1.13	0.15	4.62	5.71	7.8
1989	84	2.57	8.10	0.17	14.37	57.00	14

* GM = Geometric Mean
† GSD = Geometric Standard Deviation

An evaluation of exposures by building within TAs-01 and -03 is presented in Table 4-4. The majority of samples collected in TA-01 were from the Sigma building with approximately 25% being in excess of the 2.0 µg/m³ control limit. For TA-03, the majority of samples were collected in the shops areas (buildings 0039 and 0102) with approximately 2% of the samples in excess of the control limit. Other building areas in TA-03 with significant sampling activity include CMR, New Sigma, and the Rolling mill. This analysis is in good agreement with Mitchell and Hyatt's publication on 4 years of beryllium air monitoring in the TA-03 beryllium machine shop (1953-56) for beryllium machining.[5] Of the 1314 samples, only 1% were above 2 µg/m³, none were above 25 µg/m³, and the median was equal to the limit of detection of 0.05 µg/m³. This publication also reports that results of breathing zone air samples collected in a janitor during cleaning operations were usually below 0.1 µg/m³. They described exposure controls including locally exhausted hoods on each machine and housekeeping techniques. Paraoccupational exposure potential was reduced by providing showers and work clothes for employees.

Table 4-4. Airborne beryllium concentrations (µg/m³) summarized by building in TA-01 and -03

TA	Bldg No.	Bldg Name	N	Mean	Std. Dev.	GM*	GSD†	Max.	%> 2 µg/m³
01	D000	Delta	7	0.19	0.39	0.03	7.77	1.05	0
	S000	Sigma	78	4.81	16.83	0.35	13.4	88.30	25.6
	V000	V-Shop	4	63.82	82.94	14.35	14.28	180.00	75.0
03	0016	Van de Graaf Generator	2	1.30	0.14	1.30	1.12	1.40	0
	0029	CMR	57	0.69	1.01	0.08	12.52	4.90	10.5
	0034	Cryogenics Research Facility	3	0.10	0.09	0.07	2.83	0.20	0
	0039	Shops	364	0.60	16.29	0.03	5.30	909.00	1.3
	0040	Branch Shop	4	0.03	0.02	0.02	3.16	0.04	0

TA	Bldg No.	Bldg Name	N	Mean	Std. Dev.	GM*	GSD†	Max.	%> 2 µg/m³
	0043	Administration	2	0.02	0.02	0.02	2.44	0.04	0
	0066	New Sigma	125	5.24	23.90	0.12	12.11	223.00	17.6
	0102	Shops	290	3.64	53.37	0.13	5.25	909.00	4.8
	0141	Rolling Mill	89	2.69	7.87	0.17	18.47	57.00	20.2
	0184	Old Occupational Health Lab (OHL)	19	0.45	0.32	0.23	5.58	0.97	0
	0218	Magnetic Energy and Storage Facility	4	0.57	0.62	0.30	4.17	1.40	0
	0287	Scyllac	4	2.05	0.21	2.04	1.11	2.3	50

* GM = Geometric Mean
† GSD = Geometric Standard Deviation

Mitchell and Hyatt also summarized the results of 538 samples collected in the TA-01 shops, reporting that approximately 3% of the samples were in excess of 2.0 µg/m³.[5] In 1953, Hyatt and Milligan reviewed over 1,000 beryllium air samples collected in TA-01 noting that the average was below the Atomic Energy Commission's (AEC) permissible level of 2 µg/m³.[6] Air samples from "isolated, infrequent processes" requiring PPE were found to be "considerably above" the AEC limit.

Taken in aggregate, these data present a historical picture of beryllium usage indicating potential past exposures sufficient and widespread enough to warrant consideration for Phase II medical surveillance. As a result, an exposure assessment score of X_1 =3 was assigned to beryllium for use in equation 2.1.

4.1.2 Machinists

Machinists are potentially exposed to a large number of occupational hazards. Hazards include metals (arsenic, beryllium, cadmium, lead, nickel, thorium and uranium), solvents (carbon tetrachloride, trichloroethylene, methylene chloride and other degreasing solvents) cutting oils and coolants, and a variety of other chemical agents (asbestos and crystalline silica). A 1952 review of machine shops ventilation at LANL indicates, for example, that "there are few metals in the periodic table which have not been handled in the Los Alamos machine shops."[9] Specific historical exposure information for machinists is not readily available from industrial hygiene databases since computerized workcard and sampling records only go back to the early 1990s.

Hyatt and Milligan reported that carbon tetrachloride exposures during machining operations ranged from 50-105 ppm when used carelessly.[6] Carbon tetrachloride exposures were significantly lower (<50 ppm) when spill cleanup was practiced. An investigation of liver function abnormalities in machinists in the 1980s (see section 5)

identified inadequately controlled chlorinated solvent exposures as the likely cause. In addition, during focus group meetings, machinists listed a wide variety of past exposure concerns including radiation, solvents, beryllium and explosives (see section 7.1).

Machinists were potentially exposed to a wide variety of agents. Our Needs Assessment has been structured in an agent-specific manner. Therefore, a detailed discussion of machinists's exposures is not included as a separate category. Instead, information on agents they were potentially exposed to is included in the specific exposure discussions in this section.

4.1.3 Other Exposures

Noise. Noise exposure monitoring at LANL has focused on the shops (machine, wood), the compressed gas facility, test firing, drilling and grinding operations, injection molding and construction work. The range of full-shift personal exposures for selected noise exposed job titles (based on review of hearing conservation program data from 1983-1997) are summarized in the Table 4 -5.

Table 4-5. Summary of noise exposure for selected job titles

Job	Noise Exposure
Construction work	83 - 88 dBA
Compressed Gas Facility	83 - 92 dBA
Drilling	81 - 85 dBA
Equipment rooms	82 - 95 dBA
Shops (carpentry, machine)	77 - 106 dBA
Grinding	88 - 110 dBA
Injection molding	74 - 87 dBA
Test firing	> 140 dB (peak)

Based on documentation of current exposure levels, noise has been assigned an assessment score of $X_1 = 3$ for use in Equation 2.1.

Asbestos. Not surprisingly, asbestos has been widely used at the LANL site. A survey for asbestos-containing materials (ACM) conducted at the laboratory from 1992 to 1997 identified a wide variety of materials including thermal insulation on pipes and boilers, acoustic surface treatments, floor coverings, gaskets, friction products, and transite wall board. ACM are present in every TA with some TAs having ACM in every building.

Although historical exposure data were not accessible for this needs assessment, it is reasonable to assume that exposures to employees in a variety of craft occupations (such as, plumbers and pipefitters, insulation workers, and construction workers) were likely. In addition, asbestos worker is a job title at LANL. Our rosters show 84 former workers with this job title, all from Zia/Pan Am/JCI. In addition, former workers reported that metallurgists made their own asbestos ovens and aprons in the past, resulting in asbestos exposure to workers in this job title.

The wide-spread use and the resulting likely elevated historical exposures have resulted in assigning asbestos an exposure assessment score of $X_1 = 3$ for use in equation 2.1.

Chlorinated Solvents. Chlorinated solvent exposures to machinists have been discussed above. In addition, many other job activities at LANL may have had chlorinated solvent exposures. These exposures are more difficult to characterize because they occurred in many of the non-specific job titles, such as staff members, scientists, or technicians. Many of the chlorinated solvent uses in these jobs were likely associated with research scale quantities utilized in laboratory environments.

Historical information suggesting significant carbon tetrachloride exposures to machinists in the late 1940s and 1950's, and the observation that chlorinated solvent exposures may have contributed to liver function abnormalities in machinists in the 1980s (see Section 5), has resulted in assigning chlorinated solvents an exposure assessment score of $X_1 = 2$ for use in equation 2.1.

A more detailed exposure assessment for chlorinated solvent exposures to machinists and other potentially exposed job titles will be conducted as a part of Phase II.

Ionizing Radiation. Los Alamos workers have worked with many different types of radiation, with the most common being external whole body radiation (including tritium) and plutonium. In addition, Los Alamos has handled americium, polonium, uranium, cesium and other radioactive materials. Exposures to these substances have been monitored since the 1940's using pocket chambers, film badges, thermoluminescent dosimeters, urine bioassays, whole body counting, area monitoring and other methods.

The widespread use of radioactivity at LANL is well documented. Practically "every conventional industrial process encompassed laboratory and manufacturing operations involving radioisotopes."[6] The levels of exposures have varied widely, ranging from below detection to three fatalities occurring in separate radiation criticality accidents. Exposures range from routine maintenance work to fires and explosions involving pyrophoric metals, and reactor and other source leaks. Langham et al. published a review of urinary plutonium excretion data on LANL employees between 1945 and 1960.[10] The fraction of maximum permissible body was historically estimated for 4,215

employees with urinary plutonium measurements. The body burden fractions ranged from <0.1 to >4 with the majority being <0.1. Sixty eight of these individuals had ≥ 50% of the maximum permissible body burden (0.033 μCuries set by the Atomic Energy Commission).

The well documented evidence of historical ionizing radiation exposures at LANL has resulted in assigning radiation an exposure assessment score of $X_1 = 3$ for use in equation 2.1.

Lead. The use of lead at LANL parallels its regulatory history. As more restrictive control measures were implemented through federal legislation the Laboratory activities utilizing lead and lead containing materials diminished. Over A forty year period there were several foundry operations. The Laboratory used numerous lead products, e.g., lead foil, powders, bricks, blocks, wool, and sheets and other types of shielding. Also, powders of lead were used by the ceramics and powder metallurgy sections of Sigma Complex and lead was machined and formed in the JCI machine shops. [11]

In the foundries lead products were made and recycled. At the foundry in Sigma Complex (TA-3, SM66), workers melted and cast lead ingots and lead materials used for radiation shielding for use in various Laboratory programs. In about 1985, a fire occurred at the SM-66 foundry when lead that was to be recycled, had some magnesium chips in it. When workers tried to melt the lead, the pot caught fire and smoke filled the entire open area of the foundry, requiring extensive cleanup. After the incident, lead smelting for recycling was terminated at SM-66. The foundry at SM-66 continued solely on an occasional basis to cast small lead items for research and experiments. At TA-3, lead recycling and smelting operations (ingot production) were conducted in a foundry operated by ZIA company. This operation was terminated during the same time period as the foundry operation at SM-66 and the area cleaned.

In addition to the casting of ingots and lead shielding, high pressure, water jet cutting, equipment resided in the iron workers shop at TA-3, SM-38. This equipment may still be present at SM-38 and could be used to cut lead and steel if a future requirement exists. Of significance is that most of the lead particulate is captured in the water tank beneath the cutting jets. The lead settles effectively at the bottom of the tank, and there was virtually no contamination of the water.

Lead was also used in the explosives research conducted at multiple sites throughout the Laboratory. Lead is one of the materials believed to be used in "shots." Other sites performed metal forming operations where non nuclear materials were fabricated for use in high explosives research and development. Copper jacketed lead bullets were produced for use in testing the sensitivity and performance of explosives at the firing sites. Lead and cadmium were used in shielding at these sites.

Pipefitters worked with lead throughout the Laboratory in their craft. Operations typical of maintenance work included sewerage piping (cast iron with lead joints and seals) and lead soldering. Lead was melted and poured by the worker at the site of the job. In addition, lead-based paints were used by painters and other construction workers and were also removed from surfaces by a variety of craft workers.

Other operations involving lead include using gas torches to melt lead and the use of lead-acid batteries. Finally, LANL security force employs a live fire range for target practice and training exercises. An armory is operated for the maintenance of firearms.

In the more than fifty years of LANL, the major utilization of lead was for radiation shielding and the storage of shielding. However, the wide spread use of lead throughout LANL in a variety of production and construction processes as well as the use of lead in the weapons research programs has resulted in assigning lead an exposure score of $X_1 = 3$ for use in equation 2.1.

4.2 Development of Job Exposure Matrix (JEM)

In order to take a more comprehensive approach to possible medical surveillance at LANL (beyond the proposed focus on beryllium and machinists) and to estimate the numbers of individuals historically exposed to various agents, a general JEM relating job title to exposures was constructed for LANL. The procedure used to develop the JEM is outlined in Figure 4.1. Information for the JEM was primarily obtained from a series of workshops involving study team members and current and former LANL employees familiar with production and ESH activities.

Development of an overall job exposure matrix for LANL included several steps. The first step involved classifying all job titles at LANL into a common classification scheme. Job titles at LANL were identified from a number of sources. The primary source was the previously constructed epidemiologic rosters from which the first and last job titles of individuals employed from the mid 1940s to the late 1970s were obtained. (See section 6.1 Development of Roster for a complete discussion of roster development and sources of job title information.) The job titles taken from all databases were initially sorted and cleaned up by condensing based on abbreviation and typing of entries. For example, the job title secretary may have been listed in one of the roster databases as SEC, sec., or secretary. For the epidemiologic database, this initial cleaning resulted in collapsing approximately 12,000 job titles into 2,000 titles.

The next step in the process involved assigning a common code based on an accepted classification scheme to all job titles. There are a number of such schemes available, however, this investigation chose to use Common Occupation Classification System (COCS) to further collapse all LANL job titles.[12] COCS codes were selected for use in this study because they represent a common occupational taxonomy developed for the

DOE and have been used by other Phase I Medical Surveillance projects. Primary COCS code categories are listed in Table 4-6. For the purposes of this project, four new code categories (A000 - unknown job title, N000 - Nevada test site workers, Y000 - staff members, and Z000 - faculty, students and visitors) were created. In addition, coding postscripts were utilized to identify students and technician level scientists for possible future analyses.

Figure 4.1. Development of a job exposure matrix, LANL, 1998

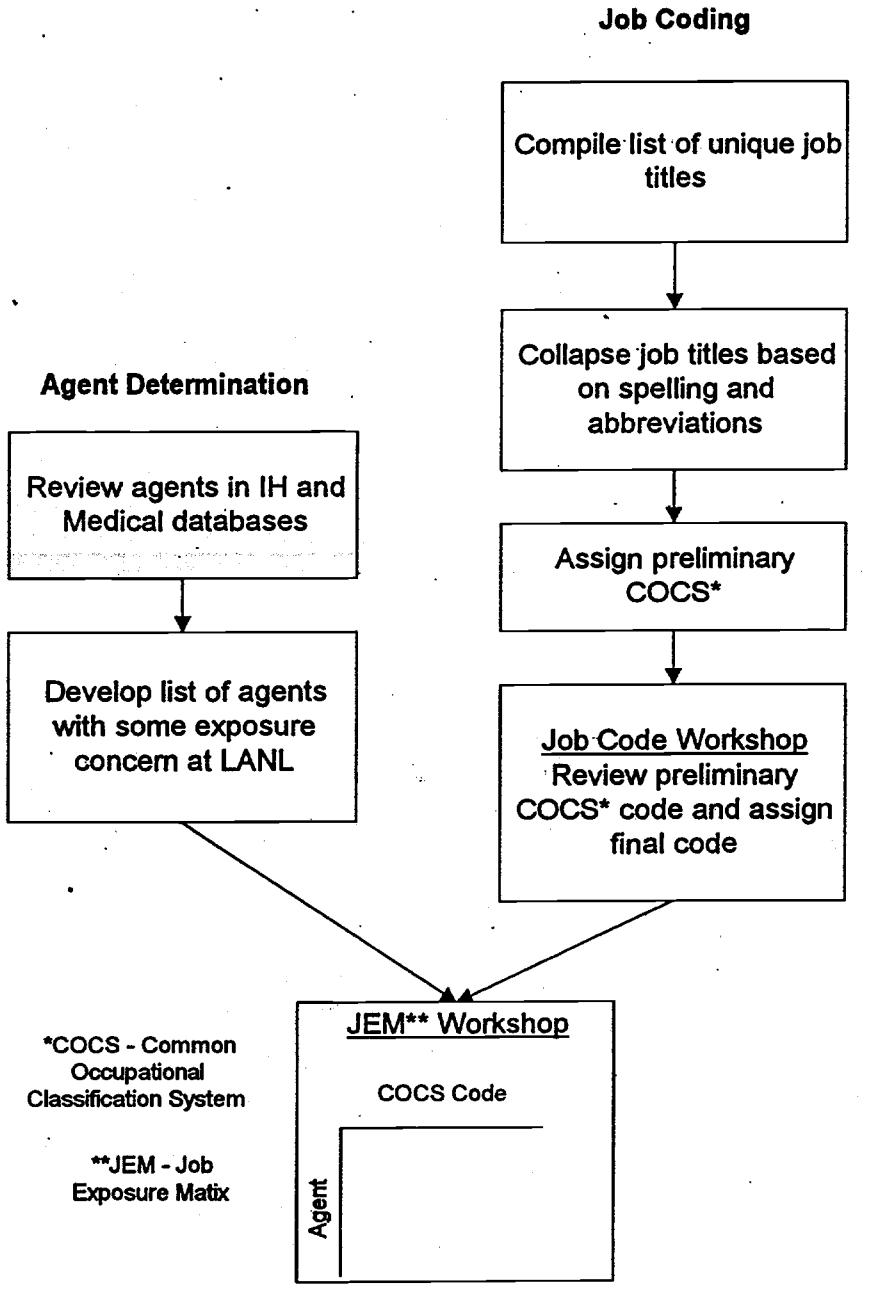


Table 4-6. Description of Primary COCS Code Categories, LANL, 1998

COCS Code	Description
A000	Unknown Job Title
C000	Crafts
E000	Engineers
G000	General Administrative, Secretarial, and Clerical Support Staff
L000	Laborers and General Service Workers
M000	General Managers, Executives, First Line Supervisors, and Program/Project Managers
N000	Nevada Test Site Workers
P000	Professional Administrative and Related Occupations
R000	Operators
S000	Scientists
T000	Technicians
Y000	Staff Members
Z000	Faculty, Students, and Visitors

Cleaned job titles were independently assigned unique COCS codes by at least two study team members. If two or more individuals similarly coded a job, it was preliminarily assigned that code. Where two or more coders disagreed on a code the differences were reconciled and a preliminary consensus code was assigned. Once a preliminary code was assigned to each job title, a two-day job title coding workshop was convened at LANL on 6/24-25/98. This workshop consisted of study team members from JHU and LANL. In addition, staff from the Human Resources Department who are familiar with LANL job titles and individuals with expertise in health and safety and production history at LANL participated. A list workshop participants is contained in Table 4-7. The result of the workshop was a consensus classification of all job titles into unique COCS codes. In addition, the two-day discussion provided an excellent historical orientation for study team members.

Table 4-7. List Job Coding Workshop Attendees, LANL, 1998

Name	Affiliation
Patrick N. Breysse	Johns Hopkins University - Industrial Hygienist
Aleks Stefaniak	Johns Hopkins University - Industrial Hygienist
Maureen Cadorette	Johns Hopkins University - Occupational Medicine
Laurie Wiggs	Los Alamos Laboratory - Epidemiologist
Harry Ettinger	Los Alamos Laboratory - Industrial Hygienist
Marvin Tillery	Los Alamos Laboratory - Industrial Hygienist
Jeff Schinkel	Los Alamos Laboratory - Industrial Hygienist
Dan Macdonell	Los Alamos Laboratory - Industrial Hygienist
Jim Van Hecke	Los Alamos Laboratory - Human Resources
Yvonne Martinez	Los Alamos Laboratory - Human Resources
Bruce McReynolds	Los Alamos Laboratory - Human Resources

In order to create the other axis of the JEM, the LANL IH Sampling and Workcard Databases were queried to provide a listing of all agents sampled for from 1990 to present (i.e., the time period for which these databases are active). In addition, agents with exposure driven medical surveillance categories at LANL were also reviewed. These activities resulted in a preliminary listing of agents for the JEM.

The JEM was completed at a second two-day workshop convened in 8/98. Individuals participating in this workshop are listed in Table 4-8. The workshop began with a discussion of the structure of the matrix and the rationale for selecting agents being assessed. Subsequent discussions resulted in the consensus assignment of exposures to COCS job codes. An agent was given a score of "1" in the JEM if there was possible/probable exposure to the agent by workers in the COCS job code.

The majority of job titles were independently considered and assigned specific exposures. However, a number of job titles (primarily craft-related) were recognized to be mobile in nature. As a result, exposures associated with being a plumber, electrician, or a construction worker would vary depending on where they were working within the Laboratory. This made it difficult to assign specific exposures. Our approach was to assign these jobs a wide range of possible exposures and to include exposure to asbestos or radioactive materials where it was reasonable to assume that there may have been an opportunity for exposure to these agents. When the JEM was

used in conjunction with the roster to determine numbers of former workers exposed to a given agent, it was recognized that not all workers in the mobile category had all exposures assigned to that category. For example, all construction workers were assigned asbestos and radiation exposure. During Phase II, we will attempt to refine the exposures to the mobile categories as more information becomes available.

The complete JEM is contained in Section 11 - Appendix D of this report. The JEM assigned exposures to job title by decade. In most cases however, the assigned exposure covered the entire matrix time period. As a result, job exposures were not evaluated based on decade of employment.

Table 4-8. List JEM Workshop Attendees

Name	Affiliation
Patrick N. Breysse	Johns Hopkins University - Industrial Hygienist
Aleks Stefaniak	Johns Hopkins University - Industrial Hygienist
Brian Schwartz	Johns Hopkins University - Occupational Medicine
Maureen Cadorette	Johns Hopkins University - Occupational Medicine
Hugh Smith	Los Alamos Laboratory - Occupational Medicine
Laurie Wiggs	Los Alamos Laboratory - Epidemiologist
George Voelz	Los Alamos Laboratory - Occupational Medicine
Marvin Tillery	Los Alamos Laboratory - Industrial Hygienist
Jeff Schinkel	Los Alamos Laboratory - Industrial Hygienist
John Conwell, Jr	Los Alamos Laboratory - Toxicologist
Joe Lopez	Johnson Controls International - Manager Environment, Safety and Health - Retired
Michael Garcia	DOE Albuquerque - Industrial Hygienist
Matthew Pacheco	Laborers' Union - Local Union Study Team Member

5 Evaluation of Health Impacts

This section characterizes the nature and extent of health impacts potentially related to occupation in former LANL workers. The information obtained will be used to quantify factor X_2 (documentation of health effect occurrence) in Equation 2.1. During Phase I, we evaluated information for our two priority concerns, beryllium exposed workers and

machinists, and expanded our efforts to obtain as comprehensive an overview of the types and magnitude of health effects in LANL workers as possible in the time allotted.

In order to identify occupational disease, we used a Sentinel Health Event (Occupational) [SHE(O)] approach, guided by the main exposure concerns in the workplace.[1] Review of current and past data about exposures at LANL, coupled with information from current and former workers and current occupational health professionals, suggested that the main exposures of concern were beryllium, noise, asbestos, chlorinated hydrocarbon solvents, radiation, and certain heavy metals (i.e., lead). We were thus able to focus our search for health outcomes to those adverse health effects that are known, or suspected to be, caused by these exposures. There are several important limitations of this approach. For example, 1) many occupational medical surveillance programs do not evaluate the occurrence of important health effects associated with some of these exposures (i.e., central or peripheral nervous system effects of solvents or lead); 2) the available screening tests for some occupational diseases are insensitive (i.e., BUN and creatinine for renal disease); 3) recognition of the work-relatedness of occupational diseases can be difficult, due to long latency, non-specificity of presentation, and multifactorial etiology (i.e., peripheral neuropathy, certain cancers); and 4) the use of existing data sources is inherently limited by what was looked for, diagnosed, and reported in the past.

Because of these limitations, we have taken the general approach that the occurrence of any exposure-appropriate SHE(O) [an inherent SHE(O), necessarily caused by occupational exposure - examples include asbestosis, chronic beryllium disease, and silicosis] is strong evidence of health effect occurrence ($X_2 = 3$). When a SHE(O) is documented but its link to occupational exposure is less clear [a non-inherent SHE(O) - examples include noise-induced hearing loss, hepatitis, and various cancers], we considered this as suggestive evidence of health effect occurrence ($X_2 = 2$). This assessment did not include the calculation of epidemiologic effect measures (i.e., incidence, prevalence, relative risk) because the existing data were inadequate in this regard; thus, our determination for X_2 does not hinge on numbers of cases, attributable risk of disease, observed to expected numbers, or other epidemiologic measures.

As summarized in Table 5-1, several sources of information were utilized to confirm or refute the occurrence of health effects that could be work-related. We

- analyzed existing medical surveillance data which was provided to us in complete databases (e.g., ICD-9 database, chemistry database, x-ray database) with personal identifiers removed by our LANL team members;
- interviewed current and past occupational physicians at LANL to learn which occupational diseases have been diagnosed in workers;
- met with current and former workers in many forums (i.e., steering committee, focus groups, informational meetings); and

- utilized publications of LANL ESH and other DOE staff that reported morbidity and mortality results in selected groups of workers.

In the near future, we will also have information from our questionnaire mailing that will be of assistance if the Phase II program is approved (see Section 6.4).

A summary of the different types of health effects that were searched for, by exposure, is contained in Table 5-1.

Table 5-1. Health effects searched for by exposure of concern at LANL, 1998*

Exposure	Health Effect	Data Source
Beryllium	diagnosis of CBD	ICD-9 database
	restriction/obstruction on spirometry	Spirometry database
	interstitial disease on CXR	Chest x-ray database
	positive LPT's	Current worker study
Noise	diagnosis of NIHL	ICD-9 database
	STS on audiogram	Audiometry database
Asbestos	diagnosis of asbestosis	ICD-9 database
	restriction on spirometry	Spirometry database
	interstitial disease on CXR	Chest x-ray database
	diagnosis of mesothelioma	ICD-9 database
Solvents	liver function test elevations	Chemistry database
	toxic hepatitis diagnosis	ICD-9 database
	acute or chronic CNS effects	No evaluation tool
	acute or chronic PNS effects	No evaluation tool
Heavy metals	diagnosis of poisoning, acute	ICD-9 database
	acute or chronic CNS effects	No evaluation tool
	acute or chronic PNS effects	No evaluation tool
	abnormal BUN, creatinine	Chemistry database
Radiation	diagnosis of acute illness	ICD-9 database

Exposure	Health Effect	Data Source
	hematopoietic effects	Not evaluated
	diagnosis of leukemia	ICD-9 database

* CBD = chronic beryllium disease; ICD = International Classification of Diseases; CXR = chest x-ray; LPT = lymphocyte proliferation test; NIHL = noise induced hearing loss; STS = standard threshold shift; CNS = central nervous system; PNS = peripheral nervous system.

When available, LANL results are compared to similar medical screening/surveillance data located in the published literature or other DOE site Needs Assessments. Such comparisons provide further documentation for the numerical values given to these data to provide a final score for each hazard using equation 2.1.

Certain databases for examination of health outcomes were used to assess outcomes for several different exposures, and will thus be summarized here.

ICD-9 Database. The ICD-9 Diagnosis database was an important data source that we analyzed to determine disease occurrence. Diagnoses in this database are generated by worker visits to LANL OM for medical surveillance and illness care. This database (diag.lis) consisted of 75,220 records. The database consisted of multiple records for each employee, by visit date, and multiple diagnoses per record. The DIAG_CODE variable consisted of a series of ICD-9 codes separated by commas; there were typically three to five diagnoses per visit (per DIAG_DATE). Before analysis, this database was converted to a flat file, with one record per diagnosis, by employee and by visit date. After conversion, there were 203,360 records, each containing a separate diagnosis. The first and last visit dates in the database were March 1, 1972 and September 22, 1998, respectively.

The data were then analyzed so that one person could only contribute once to each diagnosis, because most of the occupational medicine diagnoses of interest were chronic, not acute, diseases. The ICD-9 codes were linked to the appropriate text fields in the icd9.lis database, which consisted of 20,159 separate ICD-9 codes with text descriptions. After this linkage, analysis resulted in a list of ICD-9 codes, the linked text description, and the number of individuals who had the ICD-9 code on at least one (but not more than one) of their clinic visits.

The final linked file was searched for the presence of the following text: "skin cancer", "melanom", "asbest", "silic", "toxic", "hepat", "lead", "beryll", "hear", "solv", "pneumoc", "cadmium", "mercury", "urani", "pluto", "polo", "neurop", "carpal", "meso", "plaque", "pleura", "sclerosis", "fibro", "leuk", and "interstit". In addition, the list of diagnoses in descending order of frequency was manually reviewed by 2 of the team members for relevant diagnoses.

X-ray database. The x-ray database contains 26,631 records consisting of 50 variables, including Z-number (personal identifier), examination date, and 45 variables coded as categorical variables that described what was seen on the x-ray. Personal identifiers, such as, Z-number and social security number, were removed from the data before they were released for analysis. Of note, several of the variables assessed the presence of a number of occupationally-relevant conditions, including pleural thickening/scar (PLE_TCK), pneumoconiosis (PNMCOIS), silicosis (SLICOIS), and pulmonary fibrosis (PUL_FIB). Several additional variables of possible occupational relevance were also present in the database, including blunted costophrenic angle (BLN_COS), sarcoidosis (SRCOSIS, because of the possible confusion with beryllium disease), carcinoma (CARCNMA), and emphysema (EMPHMIA). The file was read and detailed frequencies were evaluated for all variables. The database included x-rays from December 3, 1981 to September 16, 1998. The database consisted of 25,044 PA and lateral chest x-rays, 33 PA only chest x-rays, and 1,269 other location x-rays. Occupationally-relevant and possibly relevant diagnoses are summarized in tables in the applicable sections and in Table 5-4. Please note that the denominator varies for each variable; all variables had some missing data (ranging from 801 to 3,451).

Table 5-2. Prevalence of abnormal chest x-rays, x-ray database, 1981 to 1998, LANL

Variable	Name	Number	Percent
Total number of x-rays		26,631	100%
Any "significant abnormality on the x-ray"	ABNRML	32	0.14%
"Fine nodularity"	FIN_NOD	3	0.01%
"Pleural thickening or scar"	PLE_TCK	113	0.44%
"Blunted costophrenic angle"	BLN_COS	43	0.17%
"Diffuse infiltration"	DIF_INF	3	0.01%
"Sarcoidosis"	SRCOSIS	1	0.00%
"Pneumoconiosis"	PNMCOIS	1	0.00%
"Silicosis"	SLICOIS	7	0.03%
"Pulmonary fibrosis"	PUL_FIB	6	0.02%
"Lung carcinoma"	CARCNMA	3	0.01%
"Emphysema"	EMPHMIA	60	0.23%

The vast majority of chest x-rays were normal. The relevance of the other specific diagnoses will be discussed under the appropriate exposure sections, below.

5.1 Health Impacts Due to Beryllium

Due to the known toxicity of beryllium, a chronic beryllium disease (CBD) case tracking system, involving physician review of medical records, is used at LANL. In contrast to disease prevalence at other DOE sites, CBD has been an uncommon diagnosis at LANL. Of the 7 known cases, two received their beryllium exposure prior to working at LANL and most were diagnosed in the early decades of LANL operation. In comparison, CBD has been diagnosed in 1-2% of workers at some DOE sites and in as high as 10.2% of machinists at Rocky Flats.[13] Y-12 at Oak Ridge has a total of 25 workers with CBD and Rocky Flats has 83 as of April 1998.[10]

Workers who had prior or have current exposure to beryllium are actively enrolled in the beryllium medical surveillance program. The results of these exams has been computerized since 1980. Workers examined include machinists, metallurgists, custodians, industrial hygienists, and anyone else who has had potential exposure to airborne beryllium. Entry criteria include low as well as higher level exposure and rely on industrial hygiene recommendations based on appropriate worksite assessment.

In addition to a targeted history and physical, surveillance participants have spirometric testing and chest x-rays, and in the last year, lymphocyte proliferation testing has been offered as part of a research protocol. Surveillance test results have been computerized since 1980 and information on workers is kept in the database even after they leave employment at LANL. As of April 1998, test results from 147 former and 305 current workers were contained in the database.

The use of lymphocyte proliferation testing (LPT) in beryllium exposed workers can improve medical screening for CBD by identifying those workers who have become sensitized to beryllium and are at increased risk for developing CBD.[14] This test measures ^{3}H-thymidine incorporation into newly synthesized DNA of lymphocytes exposed in vitro to beryllium sulfate. To date, a total of 87 current LANL employees have had blood sent for LPT testing to Dr. Newman's lab at the National Jewish Medical and Research Center (NJMRC). Two of them have had abnormal LPTs. One of these subjects has undergone clinical evaluation at NJMRC, and there was no evidence in support of a diagnosis of CBD. Clinical evaluation of the other worker is pending.

Blood samples from these same 87 workers have also been sent to Dr. Babetta Marrone's lab at LANL for lymphocyte proliferation testing that utilizes flow cytometry. One test uses incorporation of a nucleotide analog (bromo-deoxyuridine) to indicate the percent of lymphocytes synthesizing DNA (similar to information from ^{3}H-thymidine incorporation). The second test measures the cell cycle to indicate whether there is a significant percent of lymphocytes undergoing cell growth in response to beryllium. For both tests, the results are given in terms of total lymphocytes and T helper (CD4) and T

suppressor (CD8) cell subsets. Dr. Marrone's lab found 1/87 positive by nucleotide analog (one of the two positive at NJMRC) and none positive by the cell cycle test.

Another new tool that is potentially useful in assessing risk for development of CBD in beryllium exposed workers is the major histocompatibility complex (MHC) class II marker, HLA-DPB1Glu69. Presence of this appears to confer increased risk for future development of CBD in exposed workers. Although the numbers of workers was limited, Richeldi et al found that CBD was present in 4/16 (25%) machinists with the marker but only 1/31 (3.2%) without.[15] The presence of this marker is also being measured in those workers undergoing LPT testing in Dr. Marrone's lab.

The ICD-9 database was also utilized in the assessment of possible health effects from beryllium. For beryllium, we assessed whether other cases of CBD were present in addition to those noted in the beryllium case registry. As shown below, this database contains four individuals with beryllium related diagnoses and 18 with sarcoidosis, that prior to LPT testing, was a potential CBD misdiagnosis.

Category	ICD	Number	Description (from ICD-9 code database)
Beryllium	985.3	4	toxic effect of beryllium and its compounds
Sarcoidosis	135	18	sarcoidosis

In summary, these data provide evidence of an inherent SHE(O) from beryllium at LANL. Therefore, $X_2 = 3$ for use in Equation 2.1.

5.2 Health Impacts in Machinists

Machinists are exposed to a large number of potential occupational hazards, including numerous metals (arsenic, beryllium, cadmium, lead, nickel, thorium and uranium), solvents, cutting oils and coolants, and a variety of other chemical agents (asbestos and crystalline silica). In the future we will be able use our rosters to link job titles to health outcomes. This will allow us to examine the specific health outcomes of machinists in more detail. For purposes of the Needs Assessment, health outcomes in machinists considered by applicable exposure category and results from surveillance exams performed in these workers is included in each test database. For example, the audiometry database includes results from exams in machinists.

Information obtained thus far does reveal a past episode of liver function test abnormalities detected by LANL OM personnel in routine medical screening in machinists in the mid- to late 1980s. A subsequent industrial hygiene and occupational medicine evaluation attributed these increases to inadequately controlled chlorinated solvent exposure, including carbon tetrachloride, trichloroethylene from degreasing tanks, and a product whose trade name was Simcool. The specific ingredients were a

trade secret at that time, however, it is likely that methylene chloride was a significant component. Work practices were implicated as well and included dermal solvent contact without gloves and spraying of Simcool. Work practice and exposure controls were improved and the LFT abnormalities resolved.

5.3 Health Impacts Due to Chlorinated Hydrocarbon Solvents

Liver disease is an important health outcome caused by solvents that we could assess using existing data sources. It should be noted that there are several other important health outcomes associated with solvents, but, because of the lack of acceptable screening tests for medical surveillance programs, existing data sources are inadequate to assess the occurrence of these outcomes (i.e., PNS and CNS effects). Three categories of exposures were considered relevant to this assessment: carbon tetrachloride; chlorinated solvents, in general; and degreasers, the majority of which were felt likely to contain chlorinated solvents.

In order to assess the magnitude of the liver function test abnormalities, we analyzed the chemistry database that includes results from chemistry panels on LANL employees from 1978 to the current year. In the past decade, 4,000-5,000 employees have had a chemistry panel obtained each year. In the previous decade, the range was somewhat lower, approximately 2,500-3,500. We evaluated the number and percent of specific liver function tests that were greater than or equal to twice the upper limit of normal by year (cutoffs defined in Table 5-5; abnormals by year are summarized in Table 5-6).

Table 5-3. Cutoffs used to define abnormality for liver function tests at LANL

Specific Liver Function Test	Upper Limit of Normal	
	before 3/3/97	after 3/3/97*
Bilirubin	1.3 mg/dl	1.4 mg/dl
Alkaline Phosphatase (AP)	125 IU/L	150 IU/L
Lactate Dehydrogenase (LDH)	242 IU/L	850 IU/L
SGOT	36 IU/L	70 IU/L
SGPT	40 IU/L	78 IU/L
Gamma glutamyl transferase (GGT)	65 IU/L	82 IU/L

*LANL started using a new lab on 3/3/97 with a different normal range

Some outliers were present in the data, but they were overall of good quality. In order to assess the effect of outliers, we reanalyzed the data without high value outliers which were defined by distributions of all results for each LFT. The cutoffs were 400

IU/L, 400 IU/L, 1,000 IU/L, and 50 mg/dl for SGOT, SGPT, GGT, and total bilirubin, respectively. Reanalysis showed essentially no difference in the results, with the exception of total bilirubin in 1978, which was reduced to only four abnormals (0.6%). Depending on year, approximately 1.5 to 3% of SGPT and GGT were more than twice the upper limit of normal. As expected, the transaminases, particularly SGPT and GGT were more frequently elevated than bilirubin.

Table 5-4. Liver function tests greater than twice the upper limit of normal, 1978 to 1998, LANL

	Liver Function Tests Number (%) > 2 times upper limit of normal					
Year (Total No.)	Bilirubin	Alk phos	LDH	SGOT	SGPT	GGT
1978 (737)	51 (6.9)	1 (0.1)	1 (0.1)	20 (2.7)	12 (1.8)	24 (4.3)
1979 (1963)	5 (0.3)	1 (0.1)	0	15 (0.8)	29 (1.5)	56 (2.9)
1980 (2428)	3 (0.1)	1 (0)	3 (0.1)	20 (0.8)	33 (1.4)	47 (1.9)
1981 (2465)	5 (0.2)	4 (0.2)	1 (0)	19 (0.8)	38 (1.5)	52 (2.1)
1982 (2653)	4 (0.2)	1 (0)	0	32 (1.2)	46 (1.7)	47 (1.8)
1983 (2225)	4 (0.2)	4 (0.2)	1 (0)	26 (1.2)	31 (1.4)	57 (2.6)
1984 (3641)	3 (0.1)	3 (0.1)	1 (0)	33 (0.9)	59 (1.6)	43 (1.2)
1985 (3800)	6 (0.2)	1 (0)	0	36 (0.9)	67 (1.8)	61 (1.6)
1986 (4287)	12 (0.3)	7 (0.2)	2 (0)	48 (1.1)	94 (2.2)	103 (2.4)
1987 (5796)	17 (0.3)	5 (0.1)	2 (0)	42 (0.7)	114 (2.0)	103 (1.8)
1988 (4124)	16 (0.4)	2 (0)	1 (0)	26 (0.6)	77 (1.9)	75 (1.8)
1989 (3530)	8 (0.2)	3 (0.1)	1 (0)	30 (0.8)	76 (2.2)	71 (2.0)
1990 (4561)	16 (0.4)	1 (0)	2 (0)	44 (1.0)	101 (2.2)	92 (2.0)
1991 (4160)	14 (0.3)	2 (0)	3 (0.1)	35 (0.8)	97 (2.3)	77 (1.9)
1992 (5645)	18 (0.3)	5 (0.1)	0	43 (0.8)	134 (2.4)	131 (2.3)
1993 (5318)	21 (0.4)	2 (0)	1 (0)	45 (0.8)	149 (2.8)	143 (2.7)
1994 (4752)	22 (0.5)	1 (0)	2 (0)	36 (0.8)	127 (2.7)	112 (2.4)
1995 (5509)	20 (0.4)	1 (0)	2 (0)	44 (0.8)	137 (2.5)	131 (2.4)
1996 (4243)	19 (0.4)	2 (0)	2 (0)	47 (1.1)	97 (2.3)	120 (2.8)

	Liver Function Tests Number (%) > 2 times upper limit of normal					
1997 (4188)	6 (0.1)	1 (0)	1 (0)	14 (0.3)	43 (1.0)	124 (3.0)
1998 (2305)	4 (0.2)	1 (0)	0	2 (0.1)	22 (1.0)	72 (3.1)
TOTAL No. of abnl individuals	NE*	32	NE*	479	946	872

*NE = not evaluated

In order to address the issue of persistent abnormalities, we determined the number of individuals with abnormal results. The total number is summarized, by liver function test, in the bottom row of Table 5 -6 and in Table 5 -7.

Table 5-5. Abnormal liver function tests: total number of abnormal tests and individuals, LANL, 1978-1998

Test	Number of Abnormal Tests	Number of Individuals
Alk phos	49	32
SGOT	657	479
SGPT	1,583	946
GGT	1,741	872

For SGPT, 636 individuals had only one abnormal measurement, 176 had two, 55 had three, and 79 had four to ten. For SGOT, 384 had only one abnormal measurement, 53 had two, 26 had three, and 16 had four to nine. For GGT, 482 had only one abnormal measurement, 182 had two, 101 had three, and 107 had four to eleven. These data suggest that a small number of individual workers had ongoing liver injury over a period of multiple years.

Liver function test screening, although commonly used for medical surveillance, is not specific. This is due to the fact that many factors are known to cause elevated LFTs. We performed this analysis using values that were twice the upper limit of normal to avoid including minimal elevations such as could be seen from infrequent but excessive weekend alcohol use. This strategy should also result in abnormal results that are less than the usual 2.5% above the upper limit of the normal distribution, although this was not the case for SGPT and GGT for all years.

Currently alcohol and viral infections are the most common causes of LFT abnormalities in the US. In the past, occupational chemical exposures made a more significant contribution to liver disease because exposure levels were higher. The episode of liver function test abnormalities in machinists in the 1980s at LANL is

consistent with this pattern. Taken together, this information suggests that exposure to solvents, particularly the chlorinated solvents documented in the past in machinists, may have had the potential to cause liver disease. Should a Phase II program be initiated, these liver function test results will be combined with our rosters by linking Z-numbers. This will allow us to determine which COCS codes are over represented in the abnormal liver function test group. Workers in these groups, particularly those with repeatedly abnormal liver function tests, would be a screening priority.

We also analyzed standard renal tests (BUN and creatinine) from the Chemistry database since solvents have been associated with renal disease. We assessed number and percent of results above the upper limits of normal. For BUN, this was 24 mg/dl before and 25 mg/dl after 3/3/97. For creatinine, the normal limits were 1.5 mg/dl before 3/3/97. Normal limits after 3/3/97 were different by gender: 1.4 mg/dl for males and 1.1 mg/dl for females. BUN results above the upper limit of normal ranged from 0.7% (n=16) to 3.1% (n=111). Creatinine results above the upper limit of normal ranged from 1% (n=52) to 5.7% (n=42) (the latter result was at the beginning of the database in 1978 when fewer test results were obtained). Elevated values for creatinine tended to be present more in the late 1970s and 1980s and declined over time.

The ICD-9 database was also utilized in the assessment of possible health effects from chlorinated solvents. We searched the database for toxic and "hepati" and excluded those that mentioned viral and alcohol. No diagnoses of toxic hepatitis were found.

Category	ICD	Number	Description (from ICD-9 code database)
Hepatitis	573.3	69	hepatitis
	571.40	12	chronic hepatitis
	571.41	1	chronic persistent hepatitis
	571.49	1	other chronic hepatitis
	TOTAL	83	

In summary, these data provide evidence for a non-inherent SHE(O) (i.e., health impacts have been observed, but the linkage to occupational exposure is not definite) from chlorinated solvents at LANL. Therefore, $X_2 = 2$ for use in Equation 2.1.

5.4 Health Impacts Due to Noise

The OM Audiometry Database has audiogram data on 19,875 subjects from 1978 to the present, with 61,054 total records, for a mean of 3.1 audiograms per subject. A total of 7,567 subjects have only one audiogram, 3,831 have two, 2,482 have three, 1,844 have four, 1,313 have five, and 2,839 have six or more, with a maximum of 24

audiograms for a single subject in the database. For subjects with two or more audiograms, the median duration from the first to the last audiogram is 6.9 years, ranging from a few months to over 50 years.

Detailed range and data quality checking revealed that the data need some cleaning, but overall the data are internally consistent and of good quality. In order to complete the data analysis for this Needs Assessment, data were analyzed without further cleaning.

The median decrease in hearing from the first to last audiogram for subjects with two or more measurements was 3.3 dB in the left ear and 5 dB right ear, at 2, 3, and 4 Khz. The corresponding mean change was 5 dB in both ears. Characterizing these results by presence or absence of a Standard Threshold Shift (STS) provides a more clinically relevant measure of health impact. The standard STS definition was used: an average decrease of ≥ 10 dB (A) at 2,000, 3,000, and 4,000 Hz in either ear. For the purposes of this analysis, first and last audiograms were utilized.

Table 5-8 summarizes the number of persons (and %) with a STS, by the year of their last audiogram (Year 1975 refers to all results from the 1970's).

Table 5-6. Standard threshold shifts (STS) by year, 1975 to 1997, LANL

YEAR	STS	N	PERCENT
1975	37	156	23.7
1980	34	147	23.1
1981	66	208	31.7
1982	54	233	23.2
1983	45	223	20.2
1984	181	559	32.4
1985	198	669	29.6
1986	270	835	32.3
1987	224	779	28.8
1988	382	1211	31.5
1989	435	925	47
1990	203	321	63.2
1991	161	284	56.7
1992	98	258	38
1993	444	891	49.8
1994	178	560	31.8
1995	181	542	33.4
1996	261	821	31.8
1997	620	1962	31.6
Totals	4072	11584	35.2

A mean of 6.3 years (median of five years) elapsed between the first and last audiograms for the 7,512 workers whose monitoring did not reveal an STS. For these employees, the mean change in dB(A) between the first and last audiograms at 2, 3, and 4 KHz was 1.0 (median of 1.7) in the left ear and 1.3 (median of 1.7) for the right ear. The mean elapsed time between the first and last audiogram for the 4,072 workers with an STS present was 10.3 years (median of 10 years) and the mean changes were, as expected, higher. The average decrease in dB(A) between the first and last audiograms at 2, 3, and 4 Khz was 12.9 (median of 11.7) in the left ear and 13.4 (median of 11.7) in the right ear.

These results show that substantial numbers of individuals experienced hearing losses while employed at LANL. Clearly some change is expected due to age alone, however, we do not have age in the database to assess its impact. A MEDLINE literature search for articles reporting extent of STS occurrence in other populations found 2 relevant articles. Adera, et al., reported a 33.8% cumulative incidence of STS in a group of 588 males followed over a 9 year surveillance period.[16] Criteria for entry into their surveillance program was exposure to ≥ 85 dB (A) as an 8 hour TWA. Another publication reported that 28.3% of 283 workers experienced STSs during an 8 year follow-up period to unspecified noise levels.[17] Our results are strikingly similar. The LANL STS incidence is approximately twice that found in the Hanford production workers according to the University of Washington's Needs Assessment, however they did not report the average number of years between first and last test and we do not know if ages were comparable.

For the last audiogram of all subjects (only audiogram in those with just one test result), analysis of frequency-specific hearing acuity revealed an average median deficit of 10 dB(A) and mean (± SD) of 15.05 ±16.64 dB(A) in the left ear at 2, 3, and 4 kHz. Corresponding values for the right ear were median of 8.33 dB(A) and mean (± SD) of 13.07 ± 15.84 dB(A) at the same frequencies. When compared with Hanford production workers, LANL mean values at 2, 3, and 4 kHz are higher. In addition, the actual health impact of hearing loss in these workers is likely minimized by inclusion of workers with only one test; such tests are more likely to be normal because they include more baseline results obtained at a relatively early age before noise exposure.

Similar analyses for the 4,072 workers who experienced an STS provides a better estimate of potential severity of hearing loss. The median deficit on the last audiogram was 23.3 dB(A) with a mean (± SD) of 27.5 ±18.8 dB(A) in the left ear for the average of 2, 3, and 4 kHz. Corresponding values for the right ear were median of 20 dB(A) and mean loss (± SD) of 24.8 ± 18.2 dB(A) at the same frequencies. Ten percent of these workers had average deficits ≥ 50 dB(A) consistent with moderate-moderately severe hearing loss.[18] These results indicate hearing impairment in a subset of workers who sustained an STS during their employment monitoring at LANL.

Our analysis of the ICD-9 database also confirms hearing loss as a frequent diagnosis at LANL. Over 7,800 individuals had at least one clinic visit that indicated a diagnosis of hearing loss, as summarized in Table 5-9.

Table 5-7. Diagnoses of hearing loss in the ICD-9 database, 1972 to 1998, LANL

Category	ICD	Number	Description (from ICD-9 code database)
Noise	398	5,773	hearing loss
	389.9	1,939	unspecified hearing loss
	389.8	71	other specified forms of hearing loss
	389.10	27	sensorineural hearing loss
	388.12	15	noise-induced hearing loss
	389.12	9	neural hearing loss
	389.2	5	mixed conductive & sensorineural HL
	389.0	4	conductive hearing loss
	389.00	2	conductive hearing loss
	389.18	2	sensorineural HL of combined types
	TOTAL	7,847	

In summary, these data provide evidence for a non-inherent SHE(O) from noise at LANL. Therefore, $X_2 = 2$ for use in Equation 2.1.

5.5 Health Impacts Due to Asbestos

Asbestos exposed workers are monitored in a specific surveillance program. The majority of workers included are those involved in abatement. However, some of the JCI employees who had extensive past exposure have been added when that exposure was identified during a medical surveillance exam for other reasons, such as audiometry. If a chest X-ray reveals asbestos changes, such as plaques or asbestosis, employees are also added to the program. Records on workers remain in the database even after they leave employment at LANL. Based on surveillance and other case identifying mechanisms, one to two workers have been diagnosed with mesothelioma each year since 1991. In addition, 28 current employees are known to have asbestosis. LANL OM physicians who were interviewed as part of the Needs Assessment identified the need to include asbestos exposed former workers in a screening program. This recommendation was based in part on the occurrence of these diagnoses.

Our analysis of the ICD-9 diagnosis database identified a total of 23 employees with asbestos related diagnoses and 6 others with pneumoconiosis not otherwise specified. In addition, 2 cases of mesothelioma are noted. The surveillance case identifying mechanisms mentioned above proved to be a better case identifying strategy for mesothelioma.

Table 5-8. Diagnosis of asbestos-related diseases in the ICD-9 database, 1972 to 1998, LANL

Category	ICD	Number	Description (from ICD-9 code database)
Pneumoconiosis	505	6	pneumoconiosis
Asbestosis	501	21	asbestosis
Mesothelioma	163.9	1	malignant neoplasms of the pleura
	158	1	malignant neoplasms of the peritoneum

Asbestos-related disease was also confirmed through workers compensation records. Of JCNNM workers who are covered for diseases of the respiratory tract, five have asbestosis. They are all pipefitters and include three current, one former, and one worker whose work status was not available.

Asbestosis and, sometimes, severe pleural plaques cause restrictive lung disease. This can be screened for by routine spirometry. Therefore, we evaluated the spirometry database for its possible relevance to asbestos exposure. This database contains exams performed on workers for a variety of reasons, including hazardous exposures and respirator use. Data for the last 4.5 years were analyzed for the Needs Assessment since the database included % predicted values with the individual results only during this time. Number and percent of values below standard accepted cut points were determined. For Forced Vital Capacity (FVC) and Forced Expiratory Volume in 1 second (FEV1), we used a cut point of < 80% predicted. For the FEV1/FVC ratio we used < 70%. If an individual worker had more than one spirometry performed in the same year, only the first was retained for analysis. Abnormal results are displayed as number and percent in Table 5-9, along with total number per year.

Table 5-9. FVC, FEV1, and FEV1/FVC ratio abnormalities 1994 to 1998, LANL

Variable	1994 (n=2,615)	1995 (n=2,302)	1996 (n=2,493)	1997 (n=2,555)	1-6/98 (n=1,490)
FVC <80%	94 (3.6%)	78 (3.4%)	79 (3.2%)	101 (4.0%)	63 (4.2%)
FEV1 <80%	168 (6.4%)	128 (5.6%)	133 (5.3%)	150 (5.9%)	84 (5.6%)
Ratio <70%	21 (0.8%)	11 (0.5%)	12 (0.5%)	21 (0.8%)	7 (0.5%)

Spirometry results were analyzed according to pathophysiologic categories (Table 5-10). Restriction, such as would be observed with asbestosis or other pneumoconioses, was defined as an abnormal FVC with a normal ratio; obstruction was defined as an abnormal ratio with a normal FVC; and the mixed category consisted of those with spirometric abnormalities in both FVC and the ratio.

Table 5-10. Prevalence of spirometry patterns of restriction, obstruction, and mixed, 1994 to 1998, LANL

Pattern	1994 (n=2,615)	1995 (n=2,302)	1996 (n=2,493)	1997 (n=2,555)	1-6/98 (n=1,490)
Restriction	87 (3.3%)	74 (3.2%)	74 (3.0%)	87 (3.4%)	60 (4.0%)
Obstruction	17 (0.7%)	10 (0.4%)	10 (0.4%)	13 (0.5%)	5 (0.3%)
Mixed	4 (0.2%)	1 (0%)	2 (0.1%)	8 (0.3%)	2 (0.1%)

Our interpretation of these results is limited since we have yet to link these data to job titles in the roster. In addition, reference values are generally established from data in Caucasian adults and may not be as clinically useful in populations with higher proportions of Hispanics and other minorities such as is seen in NM.[19] Abnormalities consistent with restrictive lung disease were present in 3-4% of test results each year. Although this pathophysiologic pattern has several non-occupational etiologies, it is more likely to be due to occupational exposures, such as asbestos, beryllium or other mineral dusts, than are obstructive changes which are generally smoking related.

Table 5-10 reveals a low prevalence of obstructive spirograms. We confirmed with LANL OM that the low rate of obstructive changes is not due to exclusion of workers with an abnormal ratio from respirator use and thus an artifact of the database. Decreased smoking rates are likely to be an explanatory factor. Individual smoking data are not contained in any of the medical surveillance databases. However, epidemiologic studies have documented a lower smoking rate for LANL workers than the rest of the US population. In the 1980s, 24.3% of LANL employees smoked compared to the then current rate in US smokers of 32.5%.[20]

A MEDLINE search failed to provide useful comparison data since spirometry is generally adjusted for age and smoking and then compared by exposure group. The data analysis performed by the University of Washington team at Hanford found similar overall rates of restriction. They were able to further analyze those data for high risk COCS codes and found 6.2% with a restrictive pattern in COCS codes likely to have had past asbestos exposure compared to 3.9% in those codes with unlikely exposure. We plan to perform a similar analysis of our data when we have linked our roster to the Occupational Medicine databases. This will allow us to better prioritize any Phase II screening efforts. Until then, we cannot draw conclusions on the extent of pulmonary

disease in this population from these data.

We also analyzed the X-ray database to look for evidence of pneumoconioses due to occupational exposure to asbestos and other mineral dusts.

Table 5-11. Abnormal chest x-rays of relevance to asbestos exposure, x-ray database, 1981 to 1998, LANL

Variable	Name	Number	Percent
Total number of x-rays		26,631	100%
"Pleural thickening or scar"	PLE_TCK	113	0.44%
"Fine nodularity"	FIN_NOD	3	0.01%
"Blunted costophrenic angle"	BLN_COS	43	0.17%
"Pneumoconiosis"	PNMCOIS	1	0.00%
"Pulmonary fibrosis"	PUL_FIB	6	0.02%
"Lung carcinoma"	CARCNMA	3	0.01%

The vast majority of chest x-rays were normal. However, of the relevant abnormalities, pleural thickening or scar was the most common and could represent asbestos related changes. Various other abnormalities such as fine nodularity and fibrosis could also be consistent with asbestos-related disease.

Overall, these data provide evidence of an inherent SHE(O) from asbestos at LANL. Therefore, $X_2 = 3$ for use in Equation 2.1.

5.6 Health Impacts Due to Ionizing Radiation

LANL radiation exposed workers have been the focus of both epidemiologic mortality studies and medical surveillance. In fact, the LANL plutonium cohort constitutes an early (and possibly the first) example of former worker medical surveillance at DOE. Their surveillance began in 1952, when a cohort of 26 wartime plutonium workers was identified. These workers have been provided medical surveillance at five-year intervals since that time and were recently at LANL getting updated examinations more than 50 years after their entry into the surveillance program. They receive a comprehensive evaluation that includes history, physical, audiometry, X-rays (chest, pelvis, dental, femur, knee), EKG, spirometry, sputum cytology, CBC, chem panel, and

lymphocyte subset analysis.[21] Several of the surveillance modalities, such as lymphocyte subset analysis, were utilized when they were first developed for use in high risk populations. Exposure assessment includes urine collection for plutonium measurement and in vivo organ and whole body measurements. The plutonium exposures range from 5% of the former lifetime occupational protection guideline of 1480 Bq to over twice that limit.21 Effective doses range from 0.1 to 7.2 Sv with a median of 1.25 Sv.[22] Therefore, exposure in this group was much higher than current allowable limits.

In general, the diseases present in the workers or resulting in their death represent the normal spectrum of diseases seen in an aging male population. Overall, the total SMR was lower for this group compared to both the general population and a cohort of LANL workers. The SMR for cancer was lower compared to the general population. When compared to the cohort of LANL workers, the SMR was 1.5 but was not statistically significant.22 One of the 26 developed osteosarcoma of the sacrum. This type of malignancy has been reported in dogs exposed to plutonium experimentally and in radon exposed humans. Three lung cancers were seen; this is also a type of cancer reported in exposed animals.

LANL epidemiology staff have followed the mortality of 15,727 males initially hired at LANL from 1943-1977 through 1990.[23] Mortality was assessed in relation to internal plutonium depositions and whole body ionizing radiation exposure. No statistically significant elevations in all cause or cancer SMRs were found, however, dose-response relations for whole body dose from external ionizing radiation and tritium were observed for brain and esophageal cancer and Hodgkin's disease.

Our analysis of the ICD-9 diagnosis database identified a total of 27 employees with unspecified effects of radiation. These are likely to be acute effects of radiation. The ICD-9 database also revealed the presence of radiation related cancers such as leukemia; 13 individuals had a diagnosis of leukemia, of various cell types, in the database. Although we cannot be certain as to the etiology of these latter conditions, we feel these cases are suggestive evidence for the occurrence of the health effects of concern.

Table 5-12. Health impacts of radiation documented in the ICD-9 database, 1972 to 1998, LANL

Category	ICD	Number	Description (from ICD-9 code database)
Health effects of radiation, not otherwise specified	990	27	effects of radiation

In summary, these data provide possible evidence an inherent SHE(O) based on acute effects and evidence of a non-inherent SHE(O) based on chronic health impacts from ionizing radiation at LANL. Therefore, $X_2 = 2$ for use in Equation 2.1.

5.7 Health Impacts Due to Other Agents

The LANL OM group has developed a number of special surveillance categories designed to monitor workers with exposures to specific hazards or with unique job requirements (crane operators, drivers). We reviewed surveillance information on 31 chemical exposure focused categories. This review provided information on the experience of current workers which can be used to estimate expected effects in former workers. In addition, several categories, such as beryllium and carcinogens, permanently retain workers' results in the databases, even after they leave employment. Categories containing substantial numbers of workers (e.g., > 200) had information analyzed above or were discussed with LANL OM personnel to determine whether health impacts had been noted during surveillance. One such category is lead medical surveillance, which primarily includes security personnel whose exposure is mainly from target practice at the training academy. Lead levels drawn before and after exposure have remained normal.

ICD-9 diagnosis database analysis identified some other potentially occupational adverse health impacts. These are displayed in Table 5-13.

Table 5-13. Health impacts due to other agents, ICD-9 database, 1972 to 1998, LANL

Category	ICD	Number	Description (from ICD-9 code database)
Carpel tunnel syndr.	354.0	143	carpal tunnel syndrome
Contact dermatitis	692.9	293	contact dermatitis and other eczema
	692	36	contact dermatitis and other eczema
	692.4	15	contact dermatitis due to other chemicals
	692.0	6	contact dermatitis due to detergents
	692.89	6	contact dermatitis - other specified agents
	692.2	2	contact dermatitis due to solvents
	692.2	2	contact dermatitis - other specified agents
	692.83	1	dermatitis due to metals
	TOTAL	361	

Category	ICD	Number	Description (from ICD-9 code database)
Toxic effects	987.9	44	toxic effect of unspecified gas
	985.0	7	toxic effect of mercury and its compounds
	983.1	6	toxic effect of acids
	987.8	6	toxic effect of other specified gases
	986	5	toxic effect of carbon monoxide
	989.8	4	toxic effect of other substances
	984.9	3	toxic effect of unspecified lead compound
	985.8	3	toxic effect of other specified metals
	987.1	3	toxic effect of other hydrocarbon gas
	E866.1	3	accidental poisoning by Hg compounds
	982.0	2	toxic effect of benzene
	985	2	toxic effect of other metals
	985.9	2	toxic effect of unspecified metal
	OTHERS	10	987 (2), 987.0 (2), 989 (2), 982.3 (1), 983.2 (1), 985.2 (1), 989.3 (1)
	TOTAL	100	
UV Skin Effects	702.2	65	actinic keratosis
	V10.83	64	history of other malignant neoplasm of skin
	173	49	other malignant neoplasm of skin
	173.9	24	other malignant neoplasm of skin
	173.1	3	other malignant neoplasm of skin of eyelid
	173.2	7	other malignant neoplasm of skin of ear
	173.4	7	other malignant neoplasm of scalp & neck
	173.5	7	other malignant neoplasm of skin of trunk
	173.6	3	other malignant neoplasm, skin-upper limb
	TOTAL	229	

Category	ICD	Number	Description (from ICD-9 code database)
Pneumoconiosis	500	8	coal worker's pneumoconiosis
	502	1	pneumoconiosis due to silica or silicates
	TOTAL	9	
Neuropathy	356.9	14	unspecified idiopathic peripheral neuropathy
	356	5	hereditary & idiopathic periph. neuropathy
	357	4	inflammatory and toxic neuropathy
	358.2	1	toxic myoneural disorders
	TOTAL	24	

Because of concerns expressed by workers on past lead exposures and their perception that their risk of lead-related health effects was high, we attempted to use all available data sources to characterize the occurrence of lead related health effects. The ICD-9 database documents the existence of probable acute lead poisoning (ICD 984.9 - toxic effect of unspecified lead compound) in at least three individuals. Existing data sources are particularly problematic, however, in the documentation of chronic health effects of lead. First, many of these conditions are not routinely evaluated in medical surveillance programs (i.e., non-specific CNS symptoms due to chronic lead encephalopathy, non-specific PNS symptoms due to mild lead neuropathy). Second, some conditions that are routinely monitored are evaluated with screening tests that are not sensitive (i.e., renal effects of lead). Third, several health outcomes of lead are highly prevalent and multi-factorial in etiology (i.e., high blood pressure). Finally, chronic lead toxicity can have protean, non-specific manifestations that can be difficult to recognize and link to lead. Despite these inherent limitations, the ICD-9 database documents the occurrence of several instances of, for example, such conditions as toxic neuropathy, which could be due to chronic lead exposure.

In addition, as discussed in section 5.2, a range of BUN and creatinine results above the upper limit of normal was found by analysis of the chemistry database. BUN ranged from 0.7% (n=16) to 3.1% (n=111). Creatinine results above the upper limit of normal ranged from 1% (n=52) to 5.7% (n=42) (the latter result was at the beginning of the database in 1978 when fewer test results were obtained). Elevated values for creatinine tended to be present more in the late 1970s and 1980s and declined during the monitoring period.

Based on the above information, we conclude that evidence for a non-inherent SHE(O) from lead at LANL is present. Therefore, $X_2 = 2$ for use in Equation 2.1.

6 Roster Development and Estimated Target Population Sizes at LANL

A complete roster of all former workers ever employed at LANL is needed to determine the number of employees in COCS codes that had specific exposures. The number of employees exposed in each occupational hazard category comprises the third factor in Equation 2.1 - X_3 or target population size. In addition, roster completeness is essential for identification of these workers should a Phase II program be offered. Therefore, this section is necessary in both Phases of a former worker screening program at LANL.

6.1 Development of Roster

The former worker roster must contain identifying and demographic information, as well as job title and location history when available. Ultimately, the roster can be linked by z-numbers and SSNs to health outcome databases to allow improved specificity of a medical screening program. The staff of the former epidemiology program at LANL identified the value of such rosters early on and have developed databases covering approximately two thirds of the time span that LANL has been in existence. We updated that work and based the structure of and variables in our rosters on those databases. We continued to divide the information into two separate rosters, one for the UC former employees and one for the subcontractor (Zia/Pan Am/JCI). This approach is required since major differences in job activities exist between the two employers. The epidemiology databases consist of information only through 1977 with vital status to 1990 for UC employees and 1978 with vital status to 1990 for Zia/Pan Am/JCI. Therefore, additional databases were used to include former workers from the late 1970s to the present.

The UC roster currently contains the original epidemiology database which covers workers from 1943-1977. The personnel EIS database was utilized through Data Warehouse (DW) to add workers employed from 1981-current (see Table 3-3 for description of Data Warehouse). A three year gap remains for workers whose employment was limited to the 1978 to 1980 time period. We are currently exploring options to reduce that gap such as the EIS annual rosters for that period, which are stored on tape. However, we do not feel this is likely to be a substantial problem because only workers whose employment period is wholly contained during those three years would be missed. All of these workers would have employment durations of less than three years. Workers with such short employment durations are not likely to be at a high risk for occupational diseases. In addition, the site had a hiring freeze in 1980 which reduced the number of employees hired during that time and further minimizes the effect of the data gap on our estimates.

The JCI roster includes the original epidemiologic database which covers workers employed by the Zia Company from its inception in 1946 through 1978, and the JCNNM Human Resources database covering all workers employed from 1991 to the present. In addition, the JCNNM Labor Relations craft database, which included an additional 16 workers not present in the human resources file, was added. Therefore, workers hired and terminated between 1978-91 are not included. We are currently locating additional sources of information that would cover this time period. Demographic and employment data on workers in the time period 1986-1991 were stored on data tapes; however, these have been damaged during storage and are not usable at present. Labor Relations at JCNNM has hard copy workcards from 1986-1991 which can be added to the roster in Phase II. We are still assessing data sources for information on workers employed at end of the Zia years (1978 to 1986). Potential sources include the hard copy personnel records in the JCI archives, Union records, the LANL EIS database, occupational medicine surveillance databases, health physics databases, and security badging.

Job location information, such as technical area (TA) and building, is very useful for exposure assessment and in selection of workers for Phase II screening programs. Unfortunately, it is difficult to obtain for former LANL workers. This information will be added to the rosters when it is included in the database being merged. In general, we only have most recent job location and then only in the EIS data. The epidemiology rosters did not have this information nor is it readily available in the JCI data sources. The Occupational Medicine databases have limited utility for this purpose since only about 50% of the records have location information (TA, building and room number). Linkage for the existing data is a problem since they cannot be linked to employment information due to absence of a time stamp. However, the radiation databases do have some location data and may be of use. Questionnaires and worker histories that include location information will need to be utilized for selection purposes for any Phase II program determined to be necessary at LANL.

The definitions of specific job titles have remained relatively stable throughout the years which allowed us to combine job titles across databases from different time periods in our final rosters. However, it should be noted that the last job title (LJT) from the epidemiology databases is as of 1978 for Zia and 1977 for LANL. Therefore, individuals who were actively employed when the databases were completed have the job they held at the time listed as LJT unless they are included in the later databases with more recent job titles. In order to determine the affect this might have and how accurate first job title (FJT) and LJT are as predictors of entire job history, we ran a few worker histories through the Data Warehouse reports containing complete LANL occupational histories for workers hired after 1981. Although we plan to explore this more extensively, the five histories examined thus far show that 2 changed from student status at entry to regular employment. This resulted in a minor COCS code change from Y003 to Y000 (student to staff member). The others remained unchanged. Additional analysis are pending, including a cross-tabulation of FJT by LJT, for both

LANL and Zia employees. This analysis may offer further support to the notion that FJT and LJT are adequate surrogates for work history at LANL.

The final rosters will be used for target population size estimates and tracing/tracking of workers. The following variables are included:

1) Identifiers - Name, Z-number, Social Security No., PID No. (not used at JCNNM)
2) Demographic - Last known address, birth date, race, ethnicity, gender, education, degree
3) Employment history - first job title (FJT), last job title (LJT), COCS codes for FJT and LJT, FJT hire date, FJT termination date [not currently in epidemiology databases], LJT hire date [not currently in epidemiology databases], LJT termination date
4) Complete Work History when present in databases merged into rosters (thus far present only in Data Warehouse accessed EIS data).

6.2 Roster Size and Demographics

For the UC roster, merging of the two initial databases (epidemiology and Data Warehouse databases) resulted in 37,600 workers ever employed. Of these, 4,197 are known to be deceased based on the 1990 vital status update. This leaves 33,403 individuals, of which 8,263 are currently employed as of 1/1/98. Therefore 25,140 UC former workers are enumerated for consideration in the former workers screening program.

For the Zia/Pan Am/JCI roster, merging of the three initial databases (epidemiology, Human Resources, and Labor Relations craft databases) used resulted in 17,999 workers ever employed. Of these, 5,217 are known to be deceased based on the 1990 vital status update. This leaves 12,782 individuals, of which, 1509 are currently employed as of 1/1/98. Therefore, 11,273 former Zia/Pan Am/JCI workers are enumerated for consideration in the former workers screening program.

The current rosters, while not entirely complete, contain a total of 55,600 individuals prior to removal of deceased and current workers. This is in close agreement with our original estimate of 60,000 - 75,000 individuals ever employed at the LANL site.

Adding former Zia/Pan Am/JCI and UC workers gives an estimate of 36,413 former workers who were alive as of 1990. This number is an overestimate because it does not include those who have died since the last vital status update and underestimates those who were both hired and terminated during 1977-1981 for LANL and 1978-1991 for JCI. As noted above, the hiring freeze in 1980 minimizes the effect of the data gap on our estimates. Additionally, we have limited information on "sub-sub contractors" consisting of those workers employed for contractors other than UC and JCNNM and its

predecessors. We have not yet tried to enumerate these workers. Security badging information and Union records may be helpful, but this group will likely remain hard to enumerate and contact. However, this will increase the numbers in the LANL former worker roster to the extent that we can locate these workers. Table 6-1 displays demographic information on those workers currently in the roster.

Table 6-1. Summary of demographic variables for former workers, LANL, 1998

	UC total n=25,140	Zia/Pan Am/JCI total n=11,273
Mean age in 1998	56 years (n=25,040)	70 years (n=9,328)
Gender		
Males	16394 (65.2%)	6261(55.5%)
Females	8586 (34.2%)	1009 (9.0%)
Missing	160 (0.6%)	4003 (35.5%)
Race (Male Employees)		
White	12400 (75.6%)	5137 (82%)
Oriental/Pac Island	408 (2.5%)	2 (0.03%)
Native American	144 (0.9%)	77 (1.2%)
Black	176 (1.1%)	14 (0.2%)
Missing	3266 (19.9%)	1031 (16.5%)
Race (Female Employees)		
White	7025 (81.8%)	768 (76.1%)
Oriental/Pac Island	149 (1.7%)	1 (0.1%)
Native American	133 (1.5%)	14 (1.4%)
Black	118 (1.4%)	1 (0.1%)
Unknown	1161 (13.5%)	225 (22.3%)

6.3 Specific Medical Screening Target Population Size Estimates

In order to estimate the number of former workers in the categories to be targeted initially, we combined the JEM with the UC and JCI rosters. This allowed us to

determine the number of former workers in each COCS exposed category. We included workers if they had either a first or last job title in the specific COCS while avoiding double counting those workers with both a first and last job title in the COCS of interest.

Table 6-2 displays the target population size estimates for specific JEM exposure categories. This is an initial estimate for the following reasons. First, we are missing 5,664 FJT for ZIA. However, this is likely to have a minimal impact since the ZIA jobs remained fairly stable and we have LJT for all but 526. Second, if workers in a particular COCS code were exposed only during some decades, all workers in that code were considered exposed. Finally, the exposures of workers in the mobile COCS categories without specific job locations were very difficult to estimate. As described in Section 4, a mobile COCS job category is any craft worker whose job tasks will allow him/her to be in areas where there is the possibility of exposure to a wide range of agents including asbestos and radioactive materials. These COCS categories are identified in the JEM (see Section 11 - Appendix D). Examples of mobile COCS categories are plumbers and pipefitters (C080) and general laborers (L050, L060).

Table 6-2. Target population size estimates for Job Exposure Matrix (JEM) exposure agent categories, by general categories and specific agents, LANL, 1998

AGENT	ZIA/JCI/Pan Am was employer	UC was employer	TOTAL - ZIA + UC
GENERAL CATEGORIES			
All exposures	7175	6433	13608
All metals	3655	5174	8829
All other agents	6861	5368	12229
All physical agents	5785	5904	11689
All radiation	4118	4917	9035
All solvents	1839	4599	6438
SPECIFIC AGENTS			
Americium	3316	4306	7622
Arsenic	378	1753	2131
Asbestos	6614	4184	10798
Benzene	563	2662	3225
Beryllium	3186	4196	7382
Cadmium	1839	3793	5632
Carbon tetrachloride	114	3133	3247
Chlorinated solvents	1030	4356	5386
Chromium	1013	3287	4300
Cobalt	378	1753	2131
Degreasers	1104	3364	4468
External radiation	3799	4895	8694
Fiberglass	2103	398	2501
Glycol ethers	113	2926	3039
Isocyanates	335	89	424

AGENT	ZIA/JCI/Pan Am was employer	UC was employer	TOTAL - ZIA + UC
Lasers	134	1226	1360
Lead	2727	5072	7799
Manganese	536	921	1457
Mercury	980	2676	3656
Metal working fluids	962	3242	4204
MOCA	0	86	86
Nickel	681	3285	3966
Noise	4547	4405	8952
Other aromatic solvents	1182	3337	4519
Other isotopes	3316	4306	7622
Other metals	805	3512	4317
Other solvents	1839	4532	6371
PBB / PCB	1762	2443	4205
Pesticides/herbicides	1605	1051	2656
Plutonium	3316	4306	7622
Polonium	3278	3315	6593
Radiofrequency/microwaves	1044	2779	3823
Rock dust/silica	2258	2275	4533
Uranium	2976	963	3939
UV radiation	3636	4411	8047
Vanadium	427	2708	3135
Vibration	2151	3370	5521
Welding fumes	1526	2605	4131

6.4 Tracking Pilot Project

The final number of former workers in a Phase II screening program is also dependent on our ability to locate them and their interest in participation. In order to assess this, we randomly selected 500 employees whose first or last job titles from the original JCI and UC/LANL epidemiology databases were as follows: 100 machinists (several search terms used including "Mach", "Tool", "Shop"), 100 operators, 100 technicians, 100 staff members (several search terms used including "SM", "Staff I", "Staff II", "Staff Mbr" and "Staff Member") and 50 asbestos workers. We also randomly selected 50 names from an industrial hygiene list of former workers with exposure to beryllium. This strategy allowed us to search for the workers who are the most challenging to locate since they were first hired between 20 and 50 years ago. We felt it was important to determine the difficulties presented in locating more remote former workers. In addition, the time constraints of the Needs Assessment required using the first operational databases, which were the epidemiology rosters, to identify former workers.

We obtained vital status information from the Social Security Death Index and the tracking service that we used to determine current addresses (discussed below). These sources revealed that 166 of the 500 were deceased. The tracking service was then used to provide updated address information based on the Social security numbers

(SSNs) of the remaining individuals. We used CSC Credit Services in Indianapolis, Indiana, a company that the LANL Epidemiology Program used successfully on several prior occasions. The information they provide is from the nationwide credit reporting database operated by Equifax Credit Information Services, Inc. This service was able to return names and addresses for 268 SSNs.

We wanted to contact the remaining individuals by phone prior to an initial mailing. Therefore we used a CD-ROM national phone directory and an Internet telephone directory (Bigfoot). With this strategy, we were able to identify 187 phone numbers. These were not complete matches in all cases since some individuals in the phone directory did not have street information. However, we matched on all information provided including first name and middle initial when present.

The names, addresses and phone numbers were sent to Innovative Medical Research (IMR), a local company that has the ability to contact individuals by phone on a national basis. The staff placing the calls are skilled in administering phone questionnaires. In this case, we determined whether the individual we were attempting to locate still resided at the address and phone number we had, made sure the person was a former LANL employee and verified the address. IMR was able to verify that the former worker still resided at the phone number called and confirm or correct the address for 145 individuals. IMR was unable to contact the other individuals for a variety of reasons including that the former worker no longer resided at the phone number we had, the phone number was disconnected or a fax machine, or there was no answer after 10 attempts.

Therefore, our pilot showed that of the initial 500 members from our oldest rosters (containing no workers hired since the late 1970s), we located an address or confirmed death in all but 66. We plan to contact the New Mexico drivers license bureau to try to get address information for these individuals.

Next, we are mailing an introductory packet to the individuals for whom an address was obtained. The packet contains the following (forms in Section 11- Appendix E):

- introductory letter from the program Principal Investigators
- informational pamphlet
- an introductory letter from Dr. Erickson, Director, ESH, LANL
- consent to fill out the questionnaire
- initial questionnaire
- postcard to mail back declining participation or requesting the questionnaire in Spanish, if desired

Responses to this mailing will provide information on both interest in a screening program and former worker concerns. The results of this mailing are analyzed and will be used to prepare the Phase II proposal (see Section 11 - Appendix E).

7 Assessment of Former Worker Concerns and Recommendations

Assessment of former worker concerns is a critical portion of the Needs Assessment. Information from employees was used for X_5 in equation 2.1. We also wanted to learn what workers felt would be most useful in a Phase II program and which type(s) of screening they preferred (e.g., exam, lab tests, medical record review). If such a program is found to be necessary, the information will be used in an iterative manner to provide a Phase II program that meets the needs of as many workers as possible.

We have used several strategies to assess the health and exposure concerns of former LANL workers. Initially, we started by disseminating information about the program to both former and current workers. Current workers were included to ensure that they will be aware of the project when they become former workers and because family members may have worked at LANL.

After LANL was selected as a site for one of the former worker medical surveillance programs, DOE sent a memorandum to the Albuquerque Operations Office. Subsequently, our LANL collaborators widely disseminated information describing the program. Notices (see Section 11 - Appendix F) were posted in the Los Alamos Reading Room, in downtown Los Alamos, along with a copy of the program proposal. The notice was placed on the ESH division homepage and a copy was given to Rick Blea, President of the New Mexico Building and Construction Trades Council, so that he could pass information on to the Unions with members at LANL. In addition, the notice was sent to all managers at LANL. An announcement describing the program was placed on the LANL website news bulletin (see Section 11 - Appendix F). Dr. Erikson, Director, ESH2 division, also sent a memo on the program to all LANL employees and copies are now given to all new hires (see Section 11 - Appendix F). We had 25-30 current and former workers or their family members, who called in after hearing of the program.

We presented the program to interested groups that included former workers. In 6/98 we attended a meeting of the Building Trades Council in Albuquerque. Business managers from 14 local unions were in attendance. Concerns raised included: locating "sub, sub contractors"; obtaining workers' compensation benefits; whether current workers with past exposure are receiving appropriate ongoing medical surveillance; multiple sclerosis cluster in 1957-1962 Los Alamos High graduates; and the current status of the brain and thyroid cancer studies.

In addition, our Laborers' Union local team member is facilitating the placement of a short write-up on the project in various Union newsletters.

We also formed a Steering Committee comprised of both current and former workers as well as community members. The initial meeting of the Steering Committee was 8/2/98

in Los Alamos, New Mexico. Steering Committee members include Helen Stanbro, a Los Alamos community member; Joe Lopez, a former JCI health and safety officer; Haskell Sheinberg, a former UC employee; Raul Brunner, a current UC employee in the Beryllium Shop; Maryann Kosty, RN, who previously worked at the local medical center and at LANL; and Rick Blea, President, New Mexico Building and Construction Trades Council and a former JCI employee. The mission of the Steering Committee is advisory. The Committee has provided input to the project on:

1) sources of exposure information at LANL;
2) methods of contacting former workers;
3) ways to effectively communicate with former workers, and;
4) arrangements for the medical surveillance program for Phase II.

They reviewed our pilot worker tracing materials and recommended several modifications and additional questions. They discussed possible benefits from participation in a Phase II program including free exams and medical recommendations. They also suggested a variety of forms for the Phase II encounters covering a range of costs, including some cost saving options. One such option suggested was that some former workers might prefer to send their medical records to project physicians for review in place of a physician visit.

The Steering Committee agreed at this meeting that several additional members should be recruited for the committee. Suggestions for additional members are a representative from the State Health Department, several representatives from the Pueblos that border Los Alamos, and a local physician, possibly a pulmonologist. Contact has been made with the health department and our union liaison will facilitate contact with former LANL workers who reside in the neighboring Pueblos.

We have also identified several other ways to increase awareness of former workers regarding this project. We plan to present the program at one of the regularly scheduled LANL Friday luncheons for workers. We also have access to the LIUNA Union Hall in Española, which will be a good setting to talk with JCI workers about the project since many of them live in Española and the surrounding communities. Finally, we have received permission from the University of California benefits office for LANL to use their mailing list of former UC workers to send our information pamphlets out to more former workers.

7.1 Focus Groups with Former Workers at LANL

One of the specific aims of the Phase I Project was to provide an initial determination of the most significant concerns and additional hazardous exposures for former Los Alamos National Laboratory (LANL) site workers. In order to ascertain the concerns of former workers, we conducted focus groups with former LANL workers in New Mexico. The plan was to include only six to eight workers in each group so that each individual would have the opportunity to participate in the discussions and to insure that all of the

main topics of interest were covered. Each group was scheduled to last for one and one-half to two hours and would include focused discussion topics and a survey to be completed at the end of the meeting.

7.1.1 Recruitment of Participants

Four focus groups were planned for Phase I. Three focus groups were to be recruited to be representative of former University of California (UC) workers, the largest employer at LANL. As a research and development facility, the LANL workforce has always been quite distinct. The UC workforce is divided into professional staff, technicians, and general support staff. The former UC professional staff are scientists, researchers, and administrators. Technicians work in all fields and areas of the Laboratory. A technician is someone who works in a scientific laboratory, or with computers, a "computer tec", or a machinist, a "mach/fab tec." There was also a large clerical and general support staff over the years at LANL. A fourth focus group with former craft workers from the trade unions was recruited to represent subcontractor employees. They were former employees of Zia, Pan Am, and/or JCI, companies that provided support to LANL in terms of building and construction trades and janitorial services.

Former University of California Workers

Three former UC focus groups were recruited in an effort to represent the diverse workforce described above. One focus group included male scientists, researchers and administrative level employees. The second group included machinists and mechanical technicians. The last group included retired female employees from any employment category (scientist, administrator, technicians, and general support staff). Volunteers for the scientist/administrator group and the women's group were recruited through an e-mail announcement that was sent out to members of the Los Alamos Retirement Group. There was a good response from the former male scientists/researchers and that group was filled quickly. Those retirees who responded to the announcement, but were unable to participate in the focus groups were asked to complete a mailed questionnaire that will be sent later this month. There was a low response to the e-mail from the machinist/mechanical technician group. Machinists were recruited via telephone through a list of former machinists at LANL.

Former Union Workers

Members of the building and construction trade unions worked for the main subcontractors at Los Alamos, namely the Zia Company, Pan Am World Services, or Johnson Controls International. These trades are represented by the New Mexico Building and Construction Trades Council and include plumbers and pipefitters, plasterers and cement masons, asbestos workers, carpenters, iron workers, bricklayers, teamsters, laborers, operating engineers and sheet metal workers. The

business agents for these unions were contacted and asked to provide names of former union members who had previously worked at LANL and who might wish to participate in the focus group. Many business agents were reluctant to provide names, but agreed to have several retired or former LANL workers come to the focus group in Española. When names were provided, several of these workers were called and asked to participate in the group. This meeting was held in Española, New Mexico at the Laborers' Union Hall.

7.1.2 Focus Group Subjects

Demographic Information

Thirty former workers participated in the focus groups. The ages of the participants ranged from 44 years to 83 years of age. Twenty-four of the thirty participants were male. The majority of the participants were white and non-Hispanic. The following tables (Tables 7-1 through 7-6) display the demographic information for the participants. A list of the longest job titles held by the participants is included to demonstrate the range of job categories, educational levels, and technical skills that were represented in the focus groups. Also presented is a table that shows the unions that were represented in the focus groups.

Table 7-1. Age

Age	N (%)
40-49	1 (3.3%)
50-59	3 (10%)
60-69	14 (46.6%)
70-79	8 (26.8%)
80-89	1 (3.3%)
NR*	3 (10%)

*NR = no response

Table 7-2. Gender

Gender	N (%)
Male	24 (80%)
Female	6 (20%)

Table 7-3. Race

Race	N (%)
White	23 (76.8%)
White & Native American	1 (3.3%)
Native American	1 (3.3%)
Other	1 (3.3%)
NR *	4 (13.3%)

*NR = no response

Table 7-4. Ethnicity

Ethnicity	N (%)
Hispanic	8 (26.7%)
Non-Hispanic	14 (46.7%)
Other	4 (13.3%)
NR *	4 (13.3%)

*NR = no response

Table 7-5. Unions Represented in Focus Groups

Union	N
NR* or no past union affiliation	11
Iron Workers	6
Plumbers/Pipefitters	5
Laborers	2
United Auto Workers	2
International Association of Machinists	1
International Brotherhood of Electrical Workers	1
Machinist	1
Sheet Metal	1

*NR = no response

Table 7-6. Job Titles of Participants

Job Titles (Held for the Longest Period of Time)	N
Iron Worker, Iron Worker, Foreman	6
Staff Member, Unspecified (2)	
Staff Member, Assistant Section Leader (1)	5
Staff Member, Chemist (1)	
Staff Member, Explosives Research (1)	
Plumber, Pipefitter	4
NR*	4
Deputy Group Leader (2)	3
Group Leader, Librarian (1)	
Machinist (2)	3
Machinist, Foreman (1)	
Supervisor, Technicians (1)	2
Technician (1)	

Job Titles (Held for the Longest Period of Time)	N
Custodian, Foreman	1
Property Manager	1
Welder	1

*NR = no response

7.1.3 Data Collection Instruments

Script for the Focus Groups

The investigators wished to cover several themes with the focus groups. The themes included:

(A) the health and exposure concerns of former workers;
(B) the medical surveillance program, what services should be offered, who should be included, and the most important benefits;
(C) barriers to participation in such a program;
(D) questions about health related to the workplace, who should answer workers' questions, and how health information gets to workers;
(E) how should the individual information be given to workers; and
(F) ways to locate and communicate with former LANL workers.

This script was used in each focus group. A copy of the script is included in Section 11- Appendix B.

Questionnaire

In order to obtain additional information and to encourage individuals to offer opinions that they may not offer in a group, a questionnaire was developed for use at the end of the discussion period. The questionnaire was used to collect the following information:

(A) a limited history of each worker's job/craft and work location at LANL,
(B) union information
(C) some information on health care utilization
(D) information on common medical conditions
(E) a table to rate the level of concern about exposure to agents used at LANL
(F) questions about health, and obtaining health information
(G) evaluation methods for a medical surveillance program
(H) open ended questions about health
(I) demographic information

This questionnaire was used in each focus group. A copy of the questionnaire is included in Section 11- Appendix B.

7.1.4 Procedures

Each focus group began with an introduction of Dr. Curbow, the group facilitator, and the focus group staff. A brief introduction to the Former Worker Project at LANL was given. Participants were told the following:

> This project is Phase I of a two-phase program sponsored by the Department of Energy. Phase I is the Needs Assessment. The purpose of Phase I is to determine if there is a need for the development of a medical surveillance or evaluation program for former Los Alamos National Laboratory (LANL) workers who may be at risk for health problems from exposures they had during their work at LANL. The project is being conducted in collaboration with Los Alamos National Laboratory, Laborers' Health and Safety Fund of North America, and the National Jewish Medical and Research Center in Denver. As part of the Phase I Needs Assessment, we are conducting four focus groups here in New Mexico with former workers to determine workers' health concerns related to their previous employment. If funded, Phase II of the project will involve the development and implementation of a medical surveillance program for selected groups of former LANL workers.

After the introductions, the procedures of the focus group were explained to the participants and three copies of the informed consent were given to each participant. The consent form was discussed, the purpose of the form and the three copies was explained and participants were asked to sign and return to the focus group staff two copies. Workers were informed that one copy would go to Johns Hopkins University, one copy was for the Los Alamos Institutional Review Board, and the third copy was for the participant to keep. A copy of the informed consent is included in Section 11-Appendix B.

As stated previously, the investigators wanted to determine which exposures, if any, former workers felt were the most significant work-related exposures and what the major health concerns of former workers are. In order to address these issues, two questions were developed to initiate discussion on these topics. The first question asked each worker to think about a concern related to his or her health because of something that he or she may have been exposed to while working at LANL. Each person in the group was given the opportunity to describe the exposure and/or health concern in detail. The responses were displayed on a board for the entire group. The second question requested that each participant pick the two most important health concerns. For efficiency, two to three lists were made on the board for each group. The lists were exposures, illnesses or conditions, and concerns. Group members were asked to offer suggestions for each list and these suggestions were added. After each participant was given the opportunity to respond, the group was asked to agree or disagree with all or part of each list. The results are included in the discussion below.

A multi-part question was designed to gather information from the workers about a medical surveillance program. Workers were asked to offer their comments on what a medical monitoring program should be like, what types of services should be provided, who should be offered the monitoring, and how such a program would benefit workers. Again, each participant was asked to comment on each part of the question and the ideas were placed on the board.

Two questions were designed to gather information from former workers on the best methods to disseminate information about workplace hazards or health outcomes to workers. These questions asked who should provide the information and in what forms that information should be given. The participants were also asked to offer their opinions on who should give workers the results of their health monitoring examinations or tests and in what format.

The last question requested information from the participants on the best and most efficient ways for the investigators to locate and communicate with former workers. Participants were asked if they wished to make any closing comments and to complete the questionnaire. All participants were given twenty-five dollars in cash for their time and to cover travel expenses to the focus groups.

7.1.5 Results

Focus Group Discussion

Questions 1 and 2 - Exposure and Health Concerns

Focus Group #1

The former union workers had primary exposure concerns related to working with asbestos, lead and radiation. Some of their specific concerns about asbestos involved working with asbestos in the past with only a paper mask. One worker spoke of removing asbestos dust by simply wetting it down. Another worker stated that he worked with rolls of asbestos five feet by one hundred feet and that he had white in his nose every day. One worker spoke of using a hammer to remove asbestos from a pipe.

Several workers spoke of pouring lead from a pot onto wet asbestos to make molds without respiratory protection. A worker said he worked for 30 years at the Lab welding lead. Several workers stated that protective measures came later and that there are now long procedures to get things done.

Many union workers were also concerned with possible radiation exposure because their jobs often involved working in "hot" areas. One worker stated that there was no warning about the severity of the "hot areas." Another worker spoke of being "contaminated."

Former workers spoke of feeling ill after cutting and welding galvanized (pipe). Another worker recalled an eye injury while working with galvanized. Almost all the union workers agreed that there was no protection from noise exposure during fabrication processes. Several workers stated that they had no health concerns because safety measures were in place when they worked at LANL.

Many union workers in this group had varied health complaints including arthritis of the hands, back, and knees, stomach pains, and skin problems. One worker spoke of spots on his lungs, another of skin cancer, and another of pus pockets on his stomach. Several workers had vision problems and some questioned whether these problems were due to eye injuries, such as, steel in the eye, or galvanized welding burns to the eyes. (See Tables 7-7 a and b and 7-8 for more details about exposure and health concerns from Focus Group I).

Focus Group #2

The scientist/researcher/professional focus group had concerns related to stress and anger about lack of appreciation for the work that was performed, heavy handed supervision, and the amount of paperwork and documentation that scientists were required to do. One former worker mentioned that he had some concerns related to radiation exposure and reproductive effects during his employment. Another worker spoke of the perceptions that people have concerning multiple sclerosis and work at LANL and cancer and work at LANL. One former worker expressed concern about an exposure he had and his inability to get dose estimates. He stated that it was difficult for individuals to find out about exposures. One worker stated that individuals were not always told of their exposures.

Two participants had wives who died of ovarian cancer, and one worker's wife also had multiple sclerosis. There was no mention if these woman worked at LANL, but one worker stated that his wife denied that her illnesses were related to LANL. It was mentioned during the discussion that Los Alamos has the highest rate of multiple sclerosis in the country.

The majority of the group felt that they had no exposure or health concerns related to their past employment because there were "good sets of standard operating procedures." Although there were "unavoidable risks due to unknowns and the mission", they felt that the health physics and safety people "did a remarkable job considering the unknowns." (See Tables 7-7 a and b and 7-8 for more details about exposure and health concerns from Focus Group II).

Focus Group #3

The machinists focus group members spoke about working with metals, radiation, and high explosives. A worker spoke of working with beryllium and graphite, but he felt that

the monitoring was adequate. One worker spoke of a cut that he sustained in the beryllium shop that wouldn't heal. Another worker mentioned a worker from the beryllium shop who may have died from beryllium disease.

A worker worked with "hot stuff", uranium and tritium, and the only problem that he could remember was a high beryllium count once. Several machinists spoke of working with depleted uranium. It burned when machined, and during machining, the chips would cover the machines. Another machinist also worked with depleted uranium, but he had routine health checks, a yearly urinalysis, and felt he had good monitoring.

One worker spoke of the problems of working with lithium. He mentioned that it was a substance that shouldn't be inhaled, and that it was also a fire hazard.

One machinist was concerned about machining high explosives because he had no idea what it would do when it was machined. He heard of individuals who worked with high explosives who developed cancer. The suspicion was that this may be related to the solvents that were used. The machinists also used a lot of solvents. One former worker stated that there were unknown hazards but they used the protection that was acceptable for the time. (See Tables 7-7 a and b and 7-8 for more details about exposure and health concerns from Focus Group III).

Focus Group #4

The final focus group was composed of women who had worked at LANL. One former worker stated that she worked at LANL in her teens and she was unaware and unconcerned at the time. Her concerns came later. A worker spoke of witnessing many above ground tests in Nevada and developing cataracts in both eyes by the age of twenty, although there was no family history of the disease.

A participant spoke of working in management, having a lot of stress, and developing autoimmune problems in the form of generalized muscle difficulties. Many of her employees had concerns. Some of the employees' concerns were general, but other employees felt that their radiation contact was insufficiently controlled. A worker in the group noted that she once had a high radiation count on her dosimeter after doing an inventory near an oven. Another worker had an injury in which she sustained multiple cuts and lacerations. This injury occurred in a radiation area. One worker was never exposed and had not heard of any concerns (See Tables 7-7a,b and 7-8 for details).

Summary of Concerns

Table 7-7a is a compilation of the major exposure concerns. It can be seen that radiation, asbestos, lead, and galvanized were the exposures mentioned most frequently by workers. Health concerns are listed in Table 7-7b. Arthritis and various types of cancer were the most frequently mentioned health concerns.

Table 7-7a. Question #1 Responses - Exposure Concerns

Exposures	Group I	Group II	Group III	Group IV	TOTALS
radiation	3	1		2	6
uranium (enriched and depleted)			3		3
tritium			3		3
contaminated at hot dump	1				1
high radiation count				1	1
injuries in radiation area (lacerations and cuts)				1	1
subtotal (times mentioned)					15
asbestos	4				4
mixing asbestos	1				1
pouring asbestos	2				2
subtotal (times mentioned)					7
poured lead and zinc	1				1
poured lead	2				2
weld and cut lead	1				1
cutting pipe	1				1
welding galvanized	1				1
cutting galvanized	1				1
subtotal (times mentioned)					7
stress		3			3
hazardous materials		1			1
high explosives			2		2
solvents			1		1
waste products				1	1
chromium		1			1
lithium			3		3

Exposures	Group I	Group II	Group III	Group IV	TOTALS
beryllium			3		3
high beryllium count			1		1

Table 7-7b. Question #1 Responses - Health Concerns

Health Concern	Group I	Group II	Group III	Group IV	Totals
arthritis	4				4
joint pains	1				1
subtotal (times mentioned)					5
cancer (all)			1		1
skin cancer	1				1
cancer (ovarian)		2			2
pancreatic cancer			1		1
subtotal (times mentioned)					5
stomach problems	1				1
pus on stomach	1				1
skin problems	1				1
MS		1			1
autoimmune disorders				1	1
cataracts				1	1
dental problems				1	1
fracture	1				1
heart attack	1	1			2
ill after cutting galvanized	1				1
loss of vision	1				1
reproductive effects		1			1
spots on lungs	1				1

Table 7-8 is a compilation of the list of exposure and health concerns developed by the focus group participants in response to question #2.

Table 7-8. Question #2 - List of Exposure and Health Concerns

Exposure	Group I	Group II	Group III	Group IV	Totals
Radiation (all types) Plutonium Tritium Uranium (depleted & enriched) Polonium	10	1	3	3	15
Asbestos	10				10
Lead	7				7
Stress		6		1	7
Galvanized	6				6
Noise	4			1	4
Beryllium			1		1
Explosives			1		1
Fumes (organic chemicals)				1	1
Graphite			1		1
Hazardous Materials (all types)		1			1
Lithium			1		1
Pregnancy exposures				1	1
Solvents			1		1
Health	**Group I**	**Group II**	**Group III**	**Group IV**	**Totals**
Arthritis	4				4
Cancers Pancreatic, Brain, Thyroid			1	3	4
Heart Attack/ Surgery/Hypertension	2	2			4
Stomach Problems	4				4
Diabetes	1				1
Hives, Allergic Reactions		1		1	2
Immune System Depression, Autoimmune Disorders		1		1	2
Cataracts				1	1
Fertility				1	1

Exposure	Group I	Group II	Group III	Group IV	Totals
Hair Loss				1	1
Hearing Loss				1	1
Lung Problems			1		1

Question #3 and #4 - Medical Surveillance Program; Participation and Barriers

Focus Group #1

Former union workers would like a medical surveillance program to provide information about their past exposures, such as radiation, and any adverse effects these exposures may have caused. Some workers are interested in knowing their radiation whole body counts and other workers want lead testing. Many workers want information on medical conditions, such as, arthritis. The former workers want this information from "someone who knows what they are doing," and will give them honest information. Some workers want these programs to be run by independent, outside, medical persons. Overall, the former workers want something done for those that need help right now.

When questioned about what types of services should be provided, many workers expressed their concerns about who is responsible to provide care for them once they are laid-off or retired. One worker questioned why there is no continued follow-up for exposures after retirement. Another worker would like mandatory payment of their health insurance after retirement. A former worker felt that reports of the findings of any program should be given to workers face-to-face. Some former workers want the results of their medical surveillance to be used to contribute to the health and safety of current workers.

Focus Group #2

One participant stated that a medical surveillance program must be scientifically sound with a specific design and population. It should take interacting variables into consideration and be peer reviewed. Other suggestions included having the individual's personal physician do the monitoring and add it to a database. A service or data center could be developed for physicians and psychologists so that these professionals would know about the Lab population's needs or problems.

One participant stated that many former workers are sensitized to how they answer questions regarding exposures, so questionnaires and surveys need to be tailored intelligently, and re-surveys considered so that the answers are not pre-determined. One participant thought that efforts should be made to separate "real" from "imagined" concerns, and "popular" concerns (e.g. cancer) versus "unpopular" concerns.

Several former workers suggested that the Lab might want to have managers trained to better recognize physical problems, such as, multiple sclerosis or alcoholism (although it was noted that this may enter into the area of client confidentiality issues).

This group felt that the barriers to participation in a medical surveillance program include issues related to an overly complicated or time consuming program, and a program that may be damaging to an individual's reputation. One participant offered that individuals are turned off by studies. Another barrier would be if a program costs a lot of money but does no good, or opens the Lab up to liability issues. One participant stated that the program needs a well-defined, defensible mission with customer buy-in.

It was noted during the discussion that cynicism is prevalent. Suggestions for overcoming this cynicism included defining if there is a problem that needs to be fixed; if there is not a need, don't try to do something anyway. It was also felt to be important to make sure there is a scientific basis for providing the service before it is offered. A focus group member proposed that a method to encourage participation would be to provide feedback on where the study is and where it is going.

Focus Group # 3

One worker stated that when he was employed, x-rays were done every year and then every 5 years for beryllium disease. He felt that if this was offered to former workers, it would be nice to continue to be monitored. A worker mentioned a whole body count for radioactivity, and another worker mentioned Pulmonary Function Tests (PFTs). One worker felt that the Personal Protective Equipment used and the monitoring that was done while he was employed were good. One participant thought that workers could be checked every so many years to see how things compare to their medical records on file at LANL.

One participant pointed out a potential problem. Former workers have relocated everywhere, and it is not practical to have a centralized location. The former workers felt the program should be confined to the area around Los Alamos. One worker said that retirees should be allowed to use the Wellness Center in Los Alamos. The barriers to participation identified by this group were distrust, scheduling and cost.

Focus Group #4

One former worker felt that everyone should be given the opportunity to participate in the program, and if they have suffered from any of the problems (listed in the previous table), including thyroid problems, they should be contacted with an exposure questionnaire. One participant mentioned that thyroid problems and multiple sclerosis are very prevalent. One worker suggested that it would be good to look at the cause of death. Another worker thought that a diagnosis would be needed to see if the death was related to Lab work.

One focus group member stated that stress is prevalent throughout the Lab, and it would be good to look at how to eliminate it. Another former worker stated that many jobs varied greatly and it often depended on what group a worker was in. When questioned about what groups are most at risk, a worker stated that it depends on whether you were referring to direct exposure or stress. When asked who was most at risk for chemical and radiation exposures, a participant said that the "techs" work with them the most but complain the least because they need the job. Another worker felt that the "techs" had a lot of stress from that. Barriers to participation in the program mentioned by the group included fear, privacy issues, denial, time, and many people do not see themselves as affected.

Question 5 and Question 6 - Providing workers with information about the health effects of exposures at the workplace and providing information to individual workers on medical surveillance results.

Focus Group #1

Most former union workers would like health monitoring information given to them face-to-face, some want an open meeting where all can hear the results. Many workers will accept a letter but not a form letter and the letter should be understandable. They would like the letter to state what will be done and who will do it. Other workers want to meet face-to-face after the information is sent in a letter. One worker wants information in a letter stating who is going to help or do something about his results. Someone made the statement that college people don't understand the working people. A former worker wants someone who understands the working man's ideas and what their jobs are about to give the health monitoring information back to workers.

Focus Group #2

This group felt the information should be short and to the point. Information should be written and not demeaning or over legalized. Communication should be different between groups at the Lab. Scientists respond to written communication but this is not true for all worker groups at the Lab, and the audience must be considered. Local newspapers and the public access cable may be ways to report on issues.

One participant raised the issue of defining the population who will be included in the program. While neighboring populations are not included, it was suggested that the investigators may want to include workers' families.

Focus Group #3

The former workers would be interested in information about the health hazards for materials that they worked on and updated tolerance levels. A worker stated that he wasn't sure who he would believe. One worker felt that the Lab should provide the information. Another worker felt that the information should be provided by competent individuals.

The participants had different opinions about how the information should be provided to the individual. One worker said it was nice when the physician gave the report to the patient for the beryllium x-rays. Other suggestions included person-to-person, letters for workers who live a long distance away (unless the information was bad news), and information given as it is in a hospital - "if something is wrong, they talk to you, if not, then nothing."

Focus Group #4

One worker stated that there was little information available on health effects for long term employees. Many workers did not have the information passed on to them at the lower levels. Today, more information is passed on to employees. Another worker brought up the subject of literacy issues and the ability to understand scientific data.

Former workers thought that health related questions should be answered by medical people, group leaders, or both. One worker suggested that for many people the only person that they talk to is their personal physician.

One suggestion was to have information available to former workers on a website. In this way, an individual who wanted information on a chemical, such as benzene, could go to that place on the website and get information on the chemical, and its side effects. It was pointed out that many older retirees do not have access to a computer and many do not have an interest in learning about computers. Another worker suggested placing information in a newsletter such as the University of California's newsletter that is sent to current and former workers. Another suggestion was to alert area doctors to certain problems and give them contact numbers where they can report findings to a central body.

This group felt that the ideal way to provide information to an individual would be through a doctor or knowledgeable person. Written material would be better than nothing. Another suggestion was to give the report to an individual's private physician.

Question 7 - Locating and Communicating with Former Workers

Focus Group #1

All the former workers agreed that the unions are the best place to locate and communicate with former union workers. Most workers agreed that if the information was given to the union it would reach the worker. It is also important to send information through the unions due to privacy concerns.

Focus Group #2

Most participants agreed that the Retirement Groups are the best ways to locate and communicate with former workers, as well as mailing lists for Lab publications, and UC retirement information. It was suggested that these would miss contractor employees.

Focus Group #3

Former workers can be found through retiree associations, the personnel office, and the University of California. Short term employees will be difficult to find.

Focus Group #4

Former workers can be located through the University of California Benefits Office, and the Lab has a list of all retirees. The best way to communicate with former workers are newsletters, former workers groups, Lab mailings, and UC benefits statements.

Closing Comments

Former workers were provided with the opportunity to make closing comments and to discuss issues that were not brought up in the discussion.

Focus Group #1

When asked, "what would you like us to do to help you?", one worker stated that he would like the study to "Find out what is wrong with us." He also wanted the project to provide understandable information about what health problems hazardous materials might cause.

Focus Group #2

Many administrative, clerical and support staff workers were not exposed to industrial activities, therefore, the investigators may want to consider different levels of service.

Focus Group #3

The participants in this group offered no closing comments.

Focus Group #4

These workers felt that a study like this would provide a great benefit to many people who are frustrated about their health problems. While it may not be possible to prove a connection with health problems, such as multiple sclerosis, it would help if there was a way to deal with these frustrations. They noted that many people don't want to bother their private physician with these problems. They often want to deny their problems, because they do not want to be put into a hospital. They thought that a program could help by having a place where people can call into that has no negative impacts, where they can discuss the information that has been given to them about their health, they can ask questions without the fear of repercussions, and no one would ridicule or talk down to them. It was felt that Johns Hopkins would be a good place, because many people do not trust the Lab to be completely open with them. One suggestion was a medical hot-line where individual can call in with questions.

Questionnaire Data

The demographic information collected from the questionnaire has been presented in the Focus Group Subjects section. Also presented in the Focus Group Subjects section was information on the unions represented in the focus groups and the job title held for the longest period of time by the respondents. The additional data that is presented in this section includes information on health care utilization by the respondents (Tables 7-9 a, b, c), self-reported health status (Table 7-10), where respondents obtain health care (Table7-11), concern about health because of work at LANL (Table 7-12), level of concern the respondents have for some common agents used at LANL, and which method of medical evaluation would be acceptable to focus group members.

Health Care and Health Status

Tables 7-9 a, b, and c show that ninety percent (90%) of the respondents have seen a physician within the last year. Seventy percent (70%) of the respondents had blood tests within the last year, but only thirty-seven (36.7%) percent of the respondents had a chest x-ray within the past year.

Table 7-9a. Last Doctor Visit

Time Period	N (%)
within past year	27 (90%)
over 1 year	1 (3.3%)
don't remember	1 (3.3%)
NR*	1 (3.3%)

*NR = no response

Table 7-9b. Last Chest X-ray

Time Period	N (%)
less than 1 year	11(36.7%)
between 1 & 2 yrs	8 (26.7%)
over 2 years	6 (20%)
don't remember	3 (10%)
NR*	2 (6.6%)

*NR = no response

Table 7-9c. Last Blood Tests

Time Period	N (%)
less than 1 year	21(70%)
between 1 and 2 years	4 (13.3%)
over 2 years	2 (6.7%)
don't remember	1 (3.3%)
NR*	2 (6.7%)

*NR = no response

Table 7-10 shows a wide range of perceived health status, but thirty percent of respondents rated their health as only fair or poor. Table 7-11 shows that seventy percent (70%) of the respondents obtain their health care from their own physician. The respondents were not asked if the visit was for an illness or a routine health examination, or if they had insurance coverage. Table 7-12 shows that only thirty percent (30%) of the respondents reported no concern at all about their health because of their work at Los Alamos.

Table 7-10. General Health of Respondents

Health	N (%)
excellent	5 (16.7%)
very good	6 (20%)
good	7 (23.3%)
fair	4 (13.3%)
poor	5 (16.7%)
NR*	3 (10%)

*NR = no response

Table 7-11. Where Respondents Obtain Health Care

Health Care	N (%)
your own doctor	21 (70%)
own doctor & ER	3 (10%)
NR*	2 (6.8%)
clinic	1 (3.3%)
union health services	1 (3.3%)
your own doctor & clinic	1 (3.3%)
your own doctor & union health services	1 (3.3%)

*NR = no response

Table 7-12. Level of Concern About Health Because of Work

Level of Concern	N (%)
not at all concerned	9 (30%)
a little concerned	8 (26.7%)
very concerned	10 (33.3%)
NR*	3 (10%)

*NR = no response

Specific Health Concerns

The results of the specific health concerns are presented in two different formats. Table 7-13 presents the results of the matrix as it appears in the survey with the number of responses for each category and level of concern displayed. While Table 7-14 combines the responses to agents when they were rated "a little" concerned or "very" concerned. Agents are then listed by descending order of concern. It can be seen in Table 7-14 that the majority of the respondents had concerns about noise (70%), asbestos (56.6%), and lead (53.3%). One-third to one-half of the respondents had concerns about welding fumes (43.3%), uranium (40%), fiberglass (40%), carbon tetrachloride (40%), plutonium (36.6%), degreasers (36.6%), and beryllium (33.3%). (see Section 11 - Appendix B for a copy of the questionnaire).

Table 7-13. Example questionnaire with responses

The following table contains a list of agents that you may have worked with during your employment at Los Alamos. Please examine the list. For each agent, please circle the number that best describes how concerned you are about your contact with it during your work at Los Alamos. Please use this scale to rate your level of concern:

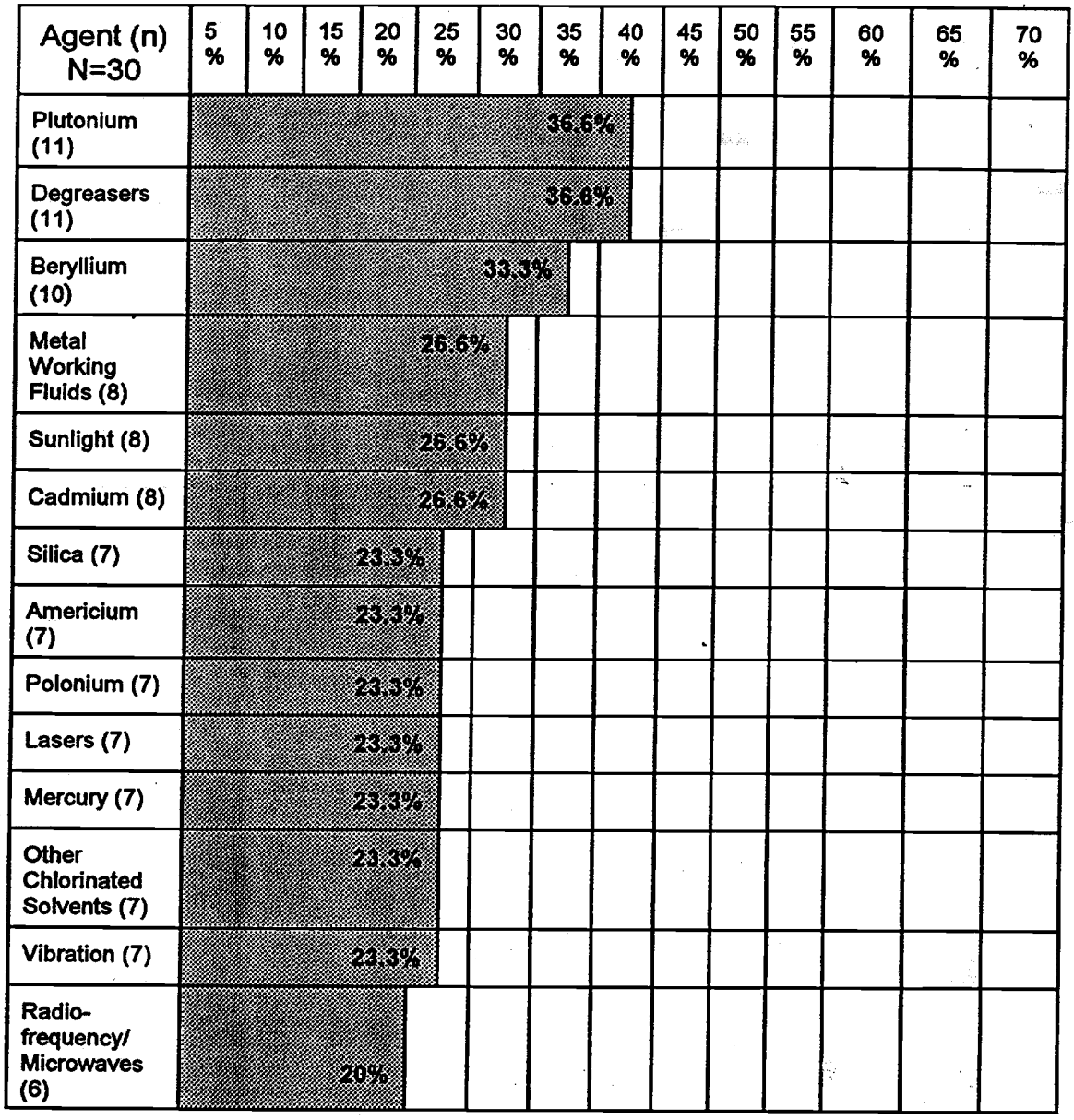
I am **not at all** concerned
I am **a little** concerned
I am **very** concerned
I **don't know** if I ever worked with this agent
I was **never** exposed to the agent
NR = no response

Metals	not at all	a little	very	don't know	never	NR
Arsenic	4	1	1	5	6	13
Beryllium (metal and compounds)	7	7	3	0	1	12
Cadmium	7	7	1	0	2	13
Chromium	7	4	0	0	3	16
Cobalt	6	2	1	1	3	17
Lead	8	7	9	0	2	4
Mercury	8	1	6	2	2	11

Nickel	7	1	4	0	4	14
Radioactive Materials	**not at all**	**a little**	**very**	**don't know**	**never**	**NR**
Americium	4	1	6	2	7	10
Plutonium	6	5	6	1	5	7
Polonium	5	1	6	2	6	10
Uranium	7	4	8	1	2	8
Solvents	**not at all**	**a little**	**very**	**don't know**	**never**	**NR**
Carbon Tetrachloride	9	8	4	0	3	6
Benzene	6	4	1	5	2	12
Chloroform	7	1	1	5	3	13
Other Chlorinated Solvents	8	3	4	4	1	10
Other Agents	**not at all**	**a little**	**very**	**don't know**	**never**	**NR**
Asbestos	7	4	13	1	2	3
Degreasers	7	7	4	2	0	10
Glycol Ethers	7	3	1	4	1	14
Fiberglass	9	3	9	0	2	7
Formaldehyde	6	2	0	3	4	15
Isocyanates	7	2	1	4	1	15
Metal Working Fluids	10	3	5	0	1	11
PBB/PCBs	4	1	2	3	4	16
Pesticides/Herbicides	5	4	1	4	4	12
Rock Dust/Silica	6	5	2	1	3	13
Styrene	8	2	3	0	2	15
Vinyl Chloride	6	4	0	4	2	14
Welding Fumes	7	3	10	0	2	8
Physical Agents	**not at all**	**a little**	**very**	**don't know**	**never**	**NR**
Lasers	9	6	1	1	3	10
Radiofrequency/Microwaves	9	6	0	2	1	12
Vibration	8	5	2	1	3	11
Noise (loud)	5	9	12	0	0	4
Sunlight/Outdoor work	8	3	5	0	2	12

Table 7-14. Agents Ranked By Level of Concern (Level of Concern = a little + very)

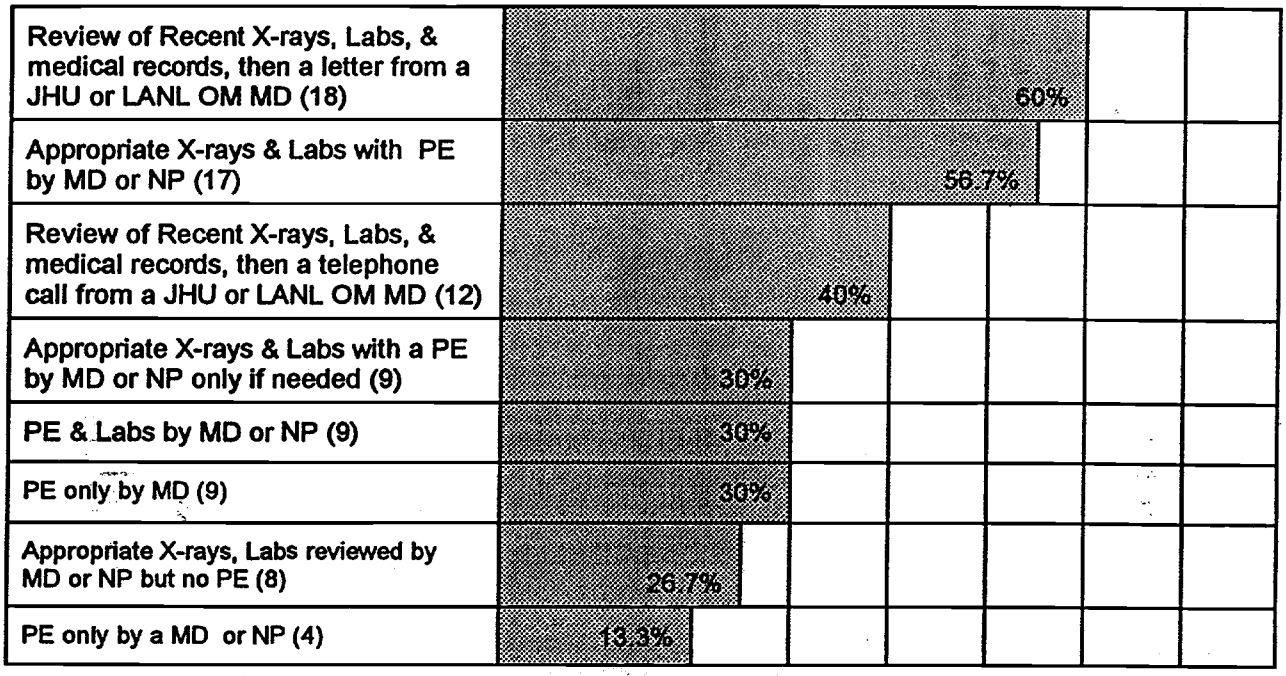
Agent (n) N=30	5 %	10 %	15 %	20 %	25 %	30 %	35 %	40 %	45 %	50 %	55 %	60 %	65 %	70 %
Noise (21)														70%
Asbestos (17)											56.6%			
Lead (16)										53.3%				
Welding Fumes (13)									43.3%					
Uranium (12)								40%						
Fiberglass (12)								40%						
Carbon Tetrachloride (12)								40%						



Respondents were asked in the survey to rate as acceptable or not acceptable a list of methods for medical evaluation in a medical surveillance program. Table 7-15. displays the percent of respondents who found each method acceptable listed in descending order. (See copy of the questionnaire in Section 11- Appendix B).

Table 7-15. Medical Evaluation Program - Percent Acceptable to Respondents

Method of evaluation (n) N = 30	10%	20%	30%	40%	50%	60%	70%	80 %
PE & Labs by MD (24)								80%



Summary of Major Findings
Conclusions from the Focus Groups

When asked to mention concerns about specific exposures, radiation exposures were mentioned most frequently. In fact, one-half of the former workers told stories about radiation exposures. The other major exposures included asbestos and lead with about one-quarter of the former workers mentioning these agents. The primary health concerns were arthritis and various types of cancer.

Three groups mentioned interest in informational materials about the agents that they were exposed to and the health outcomes related to those exposures. The health concerns were voiced most strongly by Focus Group #1. The members of this group gave poignant stories about their exposures and possible health outcomes.

There was an underlying theme in several groups reflecting a cynicism or distrust about the collection of information to be used to actually help workers.

The focus group participants identified many barriers to participation in a medical surveillance program. These barriers included distrust, inconvenient or time consuming schedules, overly complicated programs, the cost involved, fear, privacy issues, denial, and the fact that many individuals do not see themselves as affected. Several other interesting barriers to participation were programs that may be damaging to an individual, or programs that costs a lot but do nothing. Some former workers were concerned about programs that may open LANL up to liability. Finally, it was mentioned that people are turned off by studies.

The bottom-line is that any program will need worker buy-in to be successful. This may be difficult to accomplish. It will be imperative to include representation of different worker groups on the Steering Committee. The project collaborators will need to give careful consideration of how to establish and maintain credibility and trust.

Conclusions from the Survey

Most of the respondents seem to have at least some access to medical care because 90% stated that they had visited a physician within the past year. The majority seventy (70%) of respondents receive their medical care from their own physician. However, only a little over one-third of the respondents rated their health as excellent or very good. The majority (60%) of the respondents reported being a little or very concerned about their health because of work. The types of exposures causing the most concern were noise (70%), asbestos (56.6%), and lead (53.3%).

In terms of the medical evaluation program, workers found a physical examination and lab tests performed by a physician to be most acceptable (80%). In general, a nurse practitioner was not an acceptable health care provider with this group.

Several methodological issues became apparent in the course of completing and reviewing the surveys. In particular, the exposure matrix is difficult visually and conceptually. It is better to collect this information through an interview. It is possible that some workers may have low literacy skills but may be reluctant to convey this to researchers. Careful thought will need to be given to the best way of collecting exposure data across all groups in the larger study.

7.2 Mailing to Former Workers

The analysis of the data collected from the mailing is complete. A detailed report is included in Appendix E of this report. The following is a summary of these findings.

Statistically, the groups were similar with respect to their age, race and ethnic distribution. There were more women in the focus groups, and thus, the groups are statistically different in their gender distribution. There was no statistical difference between groups based on their health care utilization, but the groups are statistically different in regard to their level of concern about their health related to work. As was explained in the report, the difference between the groups may be due to sample selection, or the focus group discussions may have increased each individual's concerns about their health related to work.

The mailing respondents reported a higher general health status, and did not report as high a level of concern about their health related to their previous work at LANL as did the focus group participants. However, the health and exposure-related concerns expressed by this group were very similar to those of the focus groups.

8 Documentation of Need for Establishing a Medical Evaluation and Notification Program for the Targeted Former Workers

As outlined earlier (Section 2), our approach to the determination of need for a Phase II program involved a systematic method that integrated information from the preceding sections to arrive at a final score for each exposure category. In this process, we ranked the significance of the findings in each section as they relate to potential for medical screening benefit in former LANL workers. Equation 2.1, reviewed previously, summarizes the method used to assign final scores for exposure categories. The information used to arrive at scores for X_{1-3} and X_5 is described in the pertinent sections above. Information used to rank outcome severity (X_4) and intervention suitability factor is discussed in this section by specific exposure. Outcome severity utilized the published literature to determine the most serious possible adverse health effects from each specific exposure. As noted in section 2, greater weight was given to occupational diseases that can result in disability or death. All algorithm inputs will be periodically revisited as new information becomes available.

Selection of medical screening interventions required careful consideration since we could not assume that experience in currently exposed workers, in terms of the sensitivity and specificity of screening tests or the value of intervention, is generally applicable to workers whose exposures have ceased. This is due to the fact that exposure cessation is often the most important intervention in current workers, but has no role in former workers, assuming workers have not taken jobs after termination of employment with LANL that involve similar exposures.

To review, we considered an effective intervention to be available (i.e., I.S.F. = 1) if:

> I) screening tests with acceptable sensitivity and specificity (as defined by the US Task Force2) are available for the health outcome associated with the specific exposure under consideration; and
>
> ii) an intervention that decreases severity or rates of morbidity, or rates of mortality, is available

Table 8 -1 summarizes the numerical values assigned to each factor in the equation with the final intervention needs factor (I.N.F.) score, by agent.

Table 8-1. Summary of parameter values used in Equation 2.1, with Intervention Needs Factor scores by agent, LANL, 1998

AGENT	ZIA	UC	TOTAL	I.S.F.*	Significant exposure?	Documentation of health effect occurrence	Number of exposed workers	Outcome severity	Worker Concern[1]	Interv. Needs Factor
				ISF	X1	X2	X3	X4	X5	I.N.F.
Arsenic	378	1753	2131	0						
Asbestos	6614	4184	10798	1	3	3	3	3	3	15
Benzene	563	2662	3225	0						
Beryllium	3186	4196	7382	1	3	3	3	3	2	14
Cadmium	1839	3793	5632	0						
Chlorinated solvents										
Carbon tetrachloride	114	3133	3247	1	2	2	2	3	2	11
Others, not specified	1030	4356	5386	1	2	2	2	3	1	10
Degreasers	1104	3364	4468	1	2	2	2	3	2	11
Chromium	1013	3287	4300	0						
Cobalt	378	1753	2131	1	1	2	1	3	1	8
Fiberglass	2103	398	2501	0						
Glycol ethers	113	2926	3039	0						
Isocyanates	335	89	424	0						
Lasers	134	1226	1360	0						
Lead	2727	5072	7799	1	3	2	3	2	3	13
Manganese	536	921	1457	0						
Mercury	980	2676	3656	0						
Metal working fluids	962	3242	4204	0						
MOCA	0	86	86	1	3	1	1	3	0	8
Nickel	681	3285	3966	0						
Noise	4547	4405	8952	1	3	2	3	2	3	13
Other aromatic solvents	1182	3337	4519	0						
Other isotopes	3316	4306	7622	0						
Other metals	805	3512	4317	0						
Other solvents	1839	4532	6371	0						
PBB / PCB	1762	2443	4205	0						
Pesticides/herbicides	1605	1051	2656	0						
Ionizing Radiation										
Americium	3316	4306	7622	1	3	2	3	3	1	12
External	3799	4895	8694	1	3	2	3	3	0	11
Plutonium	3316	4306	7622	1	3	2	3	3	2	13
Polonium	3278	3315	6593	1	3	2	3	3	1	12
Uranium	2976	963	3939	1	3	2	2	3	2	12
Radiofreq. / microwaves	1044	2779	3823	0						
Rock dust/silica	2258	2275	4533	1	1	3	2	3	1	10
UV radiation	3636	4411	8047	1	1	2	3	3	2	11
Vanadium	427	2708	3135	0						
Vibration	2151	3370	5521	0						
Welding fumes	1526	2605	4131	0						

* I.S.F. = Intervention Suitability Factor
[1] 0 = agent not in questionnaire

The final scores that were possible based on this scoring system, and the actions that are recommended for different scores, is summarized below.

Score	Comment	Action
0	I.S.F. = 0	None at this time
5-10	I.S.F. = 1	May be considered for further action in Phase II
11-15	I.S.F. = 1	Recommend initial Phase II inclusion

We recommend that exposures with I.N.F. scores of 11-15, in the upper half of the I.N.F. range, be included in Phase II. This provides a balance of scientific, cost, and logistical considerations as discussed for each agent below.

A few points should be made about the assignments and calculations summarized in Table 8.1: 1) the exposure category of chlorinated solvents, including carbon tetrachloride, non-specified chlorinated solvents, and degreasers, has been combined because of similarity in exposures, health effects, and interventions; 2) ISF of 1 for cobalt is based on possible reduction in need for invasive diagnostic procedures in a worker who develops fibrosis if a history of cobalt exposure is known; 3) for benzene, screening for leukemia was not felt to meet both criteria for the I.S.F., since there is no accepted screening test for leukemia and the myelodysplastic and aplastic syndromes were not thought to be suitable for screening after exposure has already ceased; 4) effective interventions for most cancers are not thought to be available; and 5) for ultraviolet radiation, although other criteria were met, the inability to separate important non-occupational from occupational exposures for most workers has motivated us to consider it unsuitable for inclusion.

It is important to note that workers in categories with a final score below the initial cut-off could be included in later years of Phase II if new information is identified to change the final score. Such information could include worker concerns and results of our initial screening efforts. Our confidence in the scores of the categories we recommended for inclusion is obviously greater than for the lower scores since, due to the short period for the Needs Assessment, we may have failed to locate data indicating a need for medical screening for some exposures. Alternatively, Phase II may reveal that medical screening for some agents we have selected below will not be of enough benefit to continue that screening.

The data and rationale used in the equation to arrive at each final score are summarized below for specific exposure categories. These categories are those that we recommend screening for in the initial Phase II program.

8.1 Machinists

Machinists are not included as a separate category here, but rather will be screened for adverse health outcomes based on their specific exposures. Given the wide variety of their potential past exposures to occupational hazards, a machinist may, depending upon

his/her exposure history, receive focused screening for one or all of the specific exposures listed below. The range of potential exposures for machinists was documented both by the OM group in our discussions with them and in hard copy chart review of machinists in medical surveillance. In addition, during their focus group, machinists listed a wide variety of past exposures including ionizing radiation, solvents, beryllium and explosives.

8.2 Beryllium

As shown in Table 8-2, beryllium is included as one of the exposure categories recommended for Phase II based on a final score of 14. The following factors were considered in that assessment:

Table 8-2. Needs Factor calculation for beryllium

Factor	Rating	Rationale
Exposure	3	Probable evidence of significant past exposure based on ~3% of air samples > 2 $\mu g/m^3$, information from LANL staff and publications. Potential for continued exposure to workers in new beryllium complex at LANL.
Health outcome	3	Inherent SHE(O) based on a few cases of CBD diagnosed at LANL, also limited positive LPT testing (2+ of 87)
Target population size	3	Some degree of exposure estimated in 7,382
Outcome severity	3	CBD is a serious illness that can result in death from respiratory failure
Worker concern	2	33% of workers expressed concern
Intervention	1	Good screening test available (LPT), specific treatment available (prednisone), knowledge of past exposure useful to avoid misdiagnosis

Our Phase I Needs Assessment indicates that beryllium exposure was relatively well controlled at LANL. We could document only a very few cases of chronic beryllium disease. However, CBD can occur with only limited exposure and substantial numbers of workers with CBD have been diagnosed at other DOE sites. In addition, outcome severity is high and specific treatment options exist which make accurate diagnosis essential in CBD. Therefore, we conclude that former LANL workers must be screened initially. We realize that false positive screening tests may be a problem in low prevalence diseases. To address this and the fact that sensitization can occur even with lower exposures, we propose to include a stratified sample of former workers from all job types in BE exposed buildings in Phase II screening. This will allow us to target our surveillance and revise our approach as needed in later years of Phase II.

8.3 Asbestos

Former workers with past exposure to asbestos are recommended for screening in a Phase II program based on a final score of 15 (Table 8-3). The following factors were considered in that assessment:

Table 8-3. Needs Factor calculation for asbestos

Factor	Rating	Rationale
Exposure	3	Probable evidence of significant past exposure based on information from LANL staff of widespread use
Health outcome	3	Inherent SHE(O) based on diagnoses of asbestosis in the ICD-9 and workers' compensation databases, case registry of mesothelioma diagnoses; also considered as one possible etiologic factor for the restrictive spirometry results
Target population size	3	Some degree of exposure estimated in 10,798
Outcome severity	3	Death from respiratory failure or cancer
Worker concern	3	57% of workers expressed concern
Intervention	1	Knowledge of exposure may avoid misdiagnosis and eliminate need for lung biopsy; smoking cessation must be pursued in all workers with significant past exposure

Asbestos has ranking scores of 3 in all categories and thus is highly recommended for Phase II.

8.4 Noise

We recommend inclusion of former workers with past noise exposure for the Phase II program based on a final score of 13 (Table 8-4). The following factors were considered:

Table 8-4. Needs Factor calculation for noise

Factor	Rating	Rationale
Exposure	3	Probable evidence of significant past exposure based on past monitoring showing a noise level range above 85 dB(A) in the eight job titles listed in Table 4-5

Factor	Rating	Rationale
Health outcome	2	Non-inherent SHE(O) (definite hearing loss, but link to noise at work uncertain) based on STS present in 4072 (35%) of those with ≥ 2 audiograms and 7847 diagnosed with hearing loss in ICD-9 database
Target population size	3	Some degree of exposure estimated in 8952
Outcome severity	2	Can result in disabling hearing impairment
Worker concern	3	70% of workers expressed concern
Intervention	1	Good screening test (audiogram), specific treatment (hearing aide), impairment ratings

Noise exposed workers meet criteria for Phase II screening based on INF score. Our ability to focus on occupational noise induced hearing loss will be increased in Phase II when we will be able to link audiometry results with job titles. Furthermore, the audiometry screening test and hearing aide intervention are relatively simple and inexpensive which increases the cost/benefit ratio for this exposure category screening.

8.5 Lead

Former workers with past lead exposure are recommended for Phase II inclusion with a final score of 13. The following factors were considered in that assessment:

Table 8-5. Needs Factor calculation for lead

Factor	Rating	Rationale
Exposure	3	Probable evidence of significant past exposure based on historical use information from LANL staff (lead foundry)
Health outcome	2	Non-inherent SHE(O) based on chronic toxicity: peripheral neuropathy in ICD-9 database and renal abnormalities in chemistry database; inherent SHE(O) based on acute toxicity in ICD-9 database; many limitations to this assessment
Target population size	3	Some degree of exposure estimated in 7799
Outcome severity	2	Disability from target organ damage

Worker concern	3	53% of workers expressed concern
Intervention	1	Screening with blood lead and for elevated body burden of lead by K-shell x-ray fluorescence with ^{109}Cd source; consideration for chelation if health effects, elevated body burden, and no contra-indications (e.g., age, renal disease); counseling for future considerations (i.e., release of lead from bone with aging due to osteoporosis)

We are recommending this category based, to a great extent, on input from former workers. We have not found significant evidence of health impacts, however our detection ability is limited since lead related disease can be difficult to distinguish from non-occupational disease. Our determination of ISF for lead was difficult. Exposure screening tests do exist and can be used. Blood lead is not as useful in former workers as in currently exposed workers but we recommend including it since there is so much experience with it in the occupational setting. Bone lead measurement provides a better indicator of cumulative past exposure. We will have access to equipment for this in Phase II. We have given considerable thought to interventions beyond this individual exposure assessment. We have listed some options above although these are not as clear as, for example, noise. Any lead related interventions beyond screening will need to be individualized for each worker, depending on age and other medical problems.

8.6 Chlorinated Solvents

Former workers with past exposure to chlorinated solvents are recommended for Phase II inclusion with a final score of 10-11 depending on agent.

Table 8-6. Needs Factor calculation for chlorinated solvents

Factor	Rating	Rationale
Exposure	2	Possible evidence of significant past exposure based on historical information from LANL staff and publications
Health outcome	2	Non-inherent SHE(O) based on prior episode of LFT abnormalities in machinists and ongoing liver function test abnormalities (SGPT and GGT > twice normal) and renal abnormalities
Target population size	2	Some degree of exposure estimated in 3,247 to 5,386 depending on category
Outcome severity	3	Liver failure from chronic solvent exposure, although rare, can be fatal
Worker concern	2	36-40% of workers expressed concern, depending on agent

Intervention	1	Screening with liver function tests used frequently; serum bile acids and/or ultrasound in subset may improve predictive value; counseling on alcohol use and liver-healthy lifestyles (avoiding certain foods and medications)

Our additive factors for solvents result in a high score, however, this was another exposure category that required considerable thought to the ISF. Screening for hepatotoxins is not optimal. As discussed earlier, liver function tests are not specific when used for occupational screening. However, they are the most common screening test for exposure to hepatotoxins and have been used in occupational medical surveillance for years. There is some experience reported in the literature with serum bile acids (which are the liver equivalent of creatinine for kidney) and hepatic ultrasound. This is primarily in workers at extremely high risk for occupational liver disease, such as those exposed to vinyl chloride monomer. However, given the limitations of liver function tests, it is reasonable to utilize these tests in a subset of workers. These potentially improved screening techniques could be utilized more extensively in the later years of a Phase II program if shown to provide more clinically relevant information than liver function tests.

Therefore, we have decided to include chlorinated solvents in Phase II. However, we will try to minimize the false positive rate of LFTs through several strategies. We will try focus our screening on a population likely to have a higher prevalence of liver disease by selecting workers in exposed categories who had evidence of past LFT abnormalities. We will utilize more specific tests (serum bile acids and ultrasound) in a subset of workers with the highest exposures and repeatedly abnormal LFTs. We will also offer to review LFTs that workers may have had done in the past year by their primary care provider, thus reducing costs so that we can include the more specific but expensive tests.

8.7 Ionizing radiation

Former workers with past ionizing radiation exposure are recommended for Phase II inclusion with final scores of 12-13, depending on agent (Table 8-7).

Table 8-7. Needs Factor calculation for ionizing radiation

Factor	Rating	Rationale
Exposure	3	Probable evidence of significant past exposure based on past monitoring and information from LANL staff
Health outcome	2	Non-inherent SHE(O) based on one osteosarcoma in the plutonium medical surveillance group; several cases of leukemia in ICD-9 database; dose-response relations for whole body dose from external ionizing radiation and tritium were observed for brain and esophageal cancer and Hodgkin's disease.

Target population size	2	Some degree of exposure estimated in 3823-8694, depending on agent. Approximately 100 workers ever at LANL have had TEDE > 20 rem which is under consideration as threshold for entry into former radiation worker screening program (estimated 70 still alive and former workers at LANL)
Outcome severity	3	Death from cancer
Worker concern	2	Up to 40% of workers expressed concern, depending on agent
Intervention	1	Screening program similar to that already in place at Rocky Flats and planned for utilization at other DOE sites

Our additive factors for ionizing radiation result in a high score, however, this exposure category also required considerable thought for the ISF. Many of the ionizing radiation related malignancies, such as leukemia, do not have accepted screening tests. However, mammography is useful for breast cancer as is stool for occult blood for colon cancer. Finally, a screening program currently exists at Rocky Flats and will be expanded to other sites. Therefore, we have included ionizing radiation as our final Phase II recommendation for former workers at LANL.

In summary, we have identified 6 exposure categories for which previously exposed former workers are recommended for inclusion in a Phase II screening program: beryllium, asbestos, noise, lead, chlorinated solvents, ionizing radiation. The number of workers with each separate exposure is noted in the tables above. The total number of workers to be screened is less than the sum of the individual results due to multiple exposures in individual workers. Our Phase II proposal will outline the specifics of our planned approaches to screening for these groups.

9 Acknowledgments

Many individuals generously contributed advice and effort throughout the last year. Without their assistance, the quality of this project would have been greatly diminished. We would like to thank the LANL consultants and our Steering Committee and Scientific Advisory Board who were mentioned in the front of this document for their support and advice throughout this project. We also are very grateful to the following individuals for their contributions.

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Lourdes Salazar, Data Warehouse
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Jim Van Hecke, Human Resources
Helena Whyte, ESH-5

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Dennis Bachlet, Manager Labor Relations
Karen Canfield, Manager Human Resources
Sammie Hayes, Human Resources Specialist
John Mc Neel, Director, Environmental, Safety & Health
Dana Robeson, Business Systems Analyst

New Mexico Building and Construction Trades Council

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DOE Albuquerque

Mike Garcia, IH
Ron Reif, IH

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Appendix A Minutes
Scientific Advisory Board Meeting 5/21/98

Meeting Agenda
DOE Former Workers at Los Alamos National Laboratory
Scientific Advisory Board
Thursday May 21, 1998 2:00 - 4:00 P.M.
Johns Hopkins University
School of Hygiene and Public Health
Baltimore, Maryland

I Overview of the Project - 15 minutes
Patrick Breysse, PhD

II Role of the Scientific Advisory Board in the Project - 15 minutes
Patrick Breysse, PhD

Proposed Mission of the Scientific Advisory Board: to provide advice concerning the scientific issues and conduct of the project to the investigators, and to provide peer review of the Phase I work products and Phase II proposal.

III Proposed Study Plan - 1 hour
Brian Schwartz, MD, MS

1) Roster Development
2) Exposure and Health Risk Assessment
3) Outreach Plan
Maureen Cadorette, RN, MPH

IV Specific Issues for the Scientific Advisory Board - 15 minutes

1) How adequate is first job title and last job title as a surrogate for exposure risk?
2) There is an issue of security clearance at Los Alamos. Questionnaire data will be filtered through a security person who has a Q-clearance prior to review by project investigators. Does this pose a threat to the validity of exposure assessment?
3) Other

V Discussion - 15 minutes

DOE Pilot Program for Former Workers at Los Alamos National Laboratory
Minutes from the Scientific Advisory Board Meeting
Thursday May 21, 1998 2:00 - 4:00 P.M.
Johns Hopkins University
School of Hygiene and Public Health
Baltimore, Maryland

Meeting began at 2:05 P.M. in Hygiene Room 6015

Attendees:
Present in Baltimore:
Patrick Breysse, PhD
Brian Schwartz, MD, MS
Robert Spear, PhD
Hilde Mausner-Dorsch
Maureen Cadorette, RN, MPH
Via Conference from Denver:
Cecile Rose, MD
Via Conference Call from Los Alamos:
Laurie Wiggs, PhD
Jerry Williams, MD
Hugh Smith, MD
Joined Meeting Via Conference Call from Los Alamos at 2:30 P.M.:
Barbara Hargis, CIH
Helena Whyte
Joined Meeting at 3:05 P. M. in Baltimore:
Jonathan Samet, MD
Joined Meeting at 3:05 P. M. Via Conference Call from Denver:
Lee Newman, MD, MS

John Moran was unable to attend the meeting because he was involved with hearings and meetings related to DOE and external regulatory oversight in Washington, DC.

I Overview of the Project

Dr. Breysse discussed the background of the project and included the project goals, the components of Phase I and Phase II, the rationale for site selection, the history of the proposal, the current focus of the project, and the collaborative group. (See copies of overheads for details of the information presented)

In response to a question regarding the role of the labor unions at LANL, the following discussion took place. Members of the building and trades unions at LANL worked for the various subcontractors at LANL over the years and they comprise a large segment of the former worker population of interest to this project. These subcontractors include Zia Corporation (1945-1986), the PanAm Company (1986-1988) and Johnson Controls International, now Johnson Controls of Northern New Mexico (1986-present). Dr. Melius represents Laborers International

Former Worker Medical Surveillance Program at LANL

- Cooperative agreement with DOE
  - *Mandated in Defense Authorization Act of 1993*
- Two phase project
  - *Phase I - Needs assessment (1 year)*
  - *Phase II - Implementation (2-5 years if awarded)*
- Project goals from RFA
  - *identify groups of former LANL employees having significant risk for occupational disease*
  - *notify members of these groups*
  - *offer these workers medical screening that can lead to medical intervention*

LANL Site Selection Rationale

- *Large site, active since 1943*
- *Long history of IH activity and medical surveillance*
- *Large number of former workers - estimated 60,000 to 75,000 former workers*
- *Wide range of exposures, including beryllium*
- *Estimate between 1,000 to 5,000 former Be exposed workers*

Project Focus and Rationale

- *History of proposal*
- *Current focus*
  - *Beryllium*
    - *extensive site records (example - IH records computerized back to 1940's)*
    - *important focus of DOE*
    - *specific screening*
  - *Machinists*
    - *wide range of potential exposures (metals, solvents)*
  - *Other exposures*

Collaborative Group

- Johns Hopkins University
  - B. Schwartz and P. Breysse - Co PI's
  - V. Weaver - Medical Surveillance
  - B. Curbow - Risk communication / outreach
  - M. Cadorette - Project Coordinator
  - J. Samet - Epidemiology
- Laborers' Health and Safety Fund of North America
  - J. Mellus - Medical
  - TBA - IH technician

Collaborative Group (Continued)

- Los Alamos National Laboratory
  - L. Wiggs - Epidemiology
  - H. Smith - Medical
  - E. Johnson - Data management
  - J. Essington - Data management
  - Consultants
- National Jewish Medical and Research Center
  - L. Newman - Beryllium medical surveillance
  - L. Maier - Beryllium medical surveillance
  - L. Barker - Project manager

Union of North America, one of the largest unions at LANL. He is currently in the process of hiring a union technician who will work with this project as our liaison to the unions. It was estimated that labor unions comprise about 20-30 % of the subcontractor workforce at LANL.

II Role of the Scientific Advisory Board in the Project

Dr. Breysse discussed the composition of the Scientific Advisory Board (SAB) (See copies of overheads for details of the information presented).

1) John Moran was chosen for his labor and health and safety background as well as his familiarity with the Department of Energy (DOE).
2) Dr. Spear was chosen for his expertise in exposure assessment and because he is on the faculty of the University of California (UC). UC is the primary contractor at LANL.
3) Dr. Cecile Rose was chosen for her occupational medicine expertise.

At the semi-annual DOE meeting for the Medical Surveillance Pilot Projects in April, one of the other project investigators suggested that we have a worker on the advisory board. It was pointed out at the meeting that this project will have a steering committee composed of workers as well as other interested stakeholders. The composition of the SAB was opened for discussion at this time.

Dr. Rose stated that she is also on the SAB for the Nevada Test Site and this SAB is much bigger and broader. It has twelve members and includes several physicians, one who represents labor, a medical ethicist and 6 union current and former workers. The original plan for this project was to separate the discussion of the scientific aspects of the project from the more general discussion of the overall plans and goals for the project. The intent is to segregate peer review from the steering committee.

The conclusion was that it is reasonable to separate the two as long as there is another structure to address worker concerns. It was also suggested that John Moran give his opinion on the matter. The proposed mission was then discussed and agreed upon.

III Proposed Study Plan

1) Roster Development

Dr. Schwartz discussed the roster development for this project. (See Slides 1, 2, 3, 4 and Tables 1 and 3 for details of this presentation).

Following the initial presentation, there was a discussion concerning what data will be used to fill in the years in which there may be no personnel or payroll data available for the JCI roster (1978 - 1991). The plan at this time is to use the Occupational Medicine Database (LANL), the Radiation Monitoring Data (LANL), Labor Relations Database (JCI), microfiche files that are stored in the Archives at JCI, and possibly union records. The roster development is underway for Phase I. If necessary, the funds needed to complete the task will be requested in the Phase II budget.

2) Exposure and Health Risk Assessment

Dr. Schwartz discussed the three job exposure matrices that will be developed for the

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Proposed Study Plan

1. **Roster development**
   - A. Review of all existing data sources for utility
   - B. Identification of complete cohort
   - C. For linking individuals to exposure matrices
2. **Exposure and health risk assessment**
   - A. Review of all existing data sources for utility
   - B. Development of three matrices
3. **Outreach activities**
   - A. Capture worker concerns
   - B. Get workers involved

Existing Data Sources

(see Table 1 in handouts)

1. Epidemiology unit
2. Workers' compensation
3. Medical surveillance & occupational medicine
4. Industrial hygiene unit
5. Personnel department
6. Union-based data
7. Radiation health data
8. Miscellaneous sources

Master Roster

- All former Los Alamos National Laboratory (LANL) and Pan Am-Zia-JCI-JCNNM employees from 1943 to present
- Name, addresses, identification numbers, as much job history information as possible, vital status
- Importance of first job title, last job title

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Master Roster - Data Sources
(see Table 3)

1. LANL epidemiology database
2. Zia epidemiology database
3. LANL Data Warehouse (personnel)
4. JCNNM Human Resources and Payroll databases
5. Others - Union records, occupational medicine, radiation health databases

Job Exposure Matrices
(see Table 2)

1. **Beryllium-exposed workers**
   - job title x job area
   - FJT and LJT from Master Roster; COCS codes
2. **Machinists**
   - job area x agent
3. **All other agents**
   - job title x agent
   - FJT and LJT from Master Roster; COCS codes

COCS Codes
(see handout)

- Developed by Battelle for Pacific Northwest National Laboratories.
- Used by University of Washington for Phase I project at Hanford.
- We will code all FJT and LJT (from other sources) using COCS codes.
- COCS codes will form the basis for two of the exposure matrices.

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Beryllium
Quantitative exposure levels in matrix

	COCS codes						
Work Area	C040	M010	T110	L030	C080	C020	L040
TA3-SM-66	....	....	....	....	....	....	....
TA3-SM-39	....	....	....	....	....	....	....
TA3-SM-102	....	....	....	....	....	....	....
TA16	....	....	....	....	....	....	....
MORE	....	....	....	....	....	....	....

Machinists
Qualitative, semi-quantitative, or quantitative

	Work Area						
Agent	Sigma	T3S39	T3S10	Shop1	Shop2	Main	T3141
Lead	....	....	....	....	....	....	....
Mercury	....	....	....	....	....	....	....
Solvents	....	....	....	....	....	....	....
Asbestos	....	....	....	....	....	....	....
Noise	....	....	....	....	....	....	....
OTHERS	....	....	....	....	....	....	....

All Other Agents
Qualitative, semi-quantitative, or quantitative

	COCS codes						
Agent	C040	M010	T110	L030	C080	C020	L040
Lead	....	....	....	....	....	....	....
Mercury	....	....	....	....	....	....	....
Solvents	....	....	....	....	....	....	....
Asbestos	....	....	....	....	....	....	....
Noise	....	....	....	....	....	....	....
OTHERS	....	....	....	....	....	....	....

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Utility of Other Data Sources

- To confirm that cohort is fully enumerated.
  - occupational medicine; radiation health; union; worker lists
- To validate exposure assessment; evaluate presence of health effects in cells of matrix.
  - occupational medicine; not IH (OSHA 200 log [see handout]); not workers' compensation

Needs Assessment. (See Slides 5, 6, 7, 8, 9, Table 2, and the Lists of COCS codes for the details of this presentation).

The current task includes the collapsing 12,000 job titles (first job title, last job title, LANL and ZIA rosters) from the Epidemiology Database into approximately 1,000 to 1,500 job titles. These codes will then translated into COCS codes. In many instances, the recoding process involved grouping together job codes that were different based on the spelling of a word, such as assistant.

The concern was expressed about the data that has shown that a clerk or a secretary who was exposed to beryllium in work areas may be at risk for sensitization. Options for addressing this concern were offered such as, taking a random sample of people with potential exposures to beryllium, for example, a secretary in the machine shop, and offering them a Lymphocyte Proliferation Test. It may be possible to pull together anecdotally everyone who worked in a certain building based on information from former workers. It is also possible to add job titles that were not include in the Phase I Needs Assessment to the medical surveillance program in Phase II in order to get more complete coverage of personnel who were possibly exposed.

3) Outreach Plan

Ms. Cadorette discussed the plans for outreach to former workers, community and other stakeholders who are important to the project. This discussion was based on the DOE objectives as stated in the original RFA and the approaches for meeting these goals as outlined in the proposal by the investigators. Examples of the outreach activities to date and future outreach activities were presented. (See Slides 1 - 6 for further details of this presentation).

In the discussion that followed Dr. Newman stated that the risk communication documents developed by DOE Headquarters for current workers are excellent. These documents are written training materials for workers and may be useful in this project because most of the work has been done.

The question was raised whether questionnaires be mailed to former workers or administered via telephone. This is undecided at present.

A participant asked how recent our information on former workers was and if we would be able to locate these workers. The proposed pilot test of tracking methods was discussed that will use various sources including, the Department of Motor Vehicles, current Drivers License information, Credit Bureaus, and the Internet.

It was suggested that we consider the use of videotaped information versus printed information for dissemination to former workers. A video could be developed that was sensitive to the various languages and cultures found in the Los Alamos area.

Another areas of discussion centered on the new goal of completing the Needs Assessment by late summer. Some of the major points that should be considered in the study plan are: cohort definition, efforts to prevent exposure misclassification, such as random sampling from the lowest exposure groups to assure a low rate of exposure misclassification, and who is screened and are

DOE Former Worker Project at LANL

RFA

- Identify and locate "at risk" former workers
- Ascertain their health concerns
- Communicate risk information to former workers
- Provide medical surveillance

Project Approach

- Former workers identified and located based on JEM, roster, and pilot study
- Worker interviews, focus groups
- Develop methods to present work-related risk to former workers
- Standardized medical surveillance protocols

DOE Former Worker Project at LANL

RFA

- Ascertain health concerns of former workers related to their past DOE employment

Project Approach

- Worker interviews are integral to the development of the JEM and will be continued in Phase II
- Focus groups
- Workers on Steering Committee
- Outreach Activities

DOE Former Worker Project at LANL

RFA

- Communicate risk information to former workers regarding nature of health risk and actions that could be taken

Project Approach

- Risk communication expert to assist in the development of methods to present work-related risk to former workers and to summarize surveillance results

DOE Former Worker Project at LANL

RFA (continued)

Project Approach

- Incorporate Current DOE risk communication effort for beryllium where possible
- Include stakeholders and local health providers
- Bilingual for multicultural workforce

Outreach Plan for DOE Project

- Outreach Activities to Date
  - "All Employee Mailing" at LANL
  - Project notification on ES&H website
  - Article in the LANL news bulletin on LANL Home Page
  - Project notice and copy of grant in the Los Alamos Community Reading Room
  - Notice given to all new employees through Personnel
  - Meeting with the President of the Building Trades Council
  - Telephone inquires from 25 - 30 former workers
  - Internet address for DOE Former Worker Home Page

Outreach Plan for DOE Project

- Future Outreach Activities
  - Union liaison to be hired in New Mexico
  - Printed information mailed to all telephone contacts
  - Initial questionnaire development begun
  - Meeting with the entire Building Trades Council planned
  - Article about the project developed for BTC Newsletter
  - Future presentation at LANL for workers and community
  - Future meeting with JCNNM former workers and LANL retirement Groups

there opportunities to intervene. The issue of mixed exposures was discussed in some detail, where a single exposure may not warrant screening but the cumulative effects of mixed exposures may justify screening.

IV Specific Issues for the Scientific Advisory Board

1) How adequate is first job title (FJT) and last job title (LJT) as a surrogate for exposure risk?

As discussed in the Master Roster Development section, the Epidemiological Databases will establish the basic structure for the Master Roster. In their present form, the only job history is first job title and last job title. Several suggestions were offered for assessing the adequacy of FJT and LJT as measures of exposure risk, such as compare LJT to FJT to determine if there is a correlation, collapse FJT into LJT to see if they are the same or perform a pilot study to examine a sample of job categories and their relation to exposure.

It was agreed that a technician would probably remain a technician for his/her entire career, but they may work indifferent areas of the Laboratory. This may be especially true for the main subcontractor at LANL (Zia, Pan Am, JCI). It will make more sense in this population to consider exposures by trade or to consider those exposures that are associated with a trade.

2) There is an issue of security clearance at Los Alamos. Questionnaire data will be filtered through a security person who has a Q-clearance prior to review by project investigators. Does this pose a threat to the validity of exposure assessment?

The SAB members had no problems with security clearance review of questionnaire data.

3) General Discussion

There was discussion of the issue of exposures that involve special incidents. These exposures are probably not reflective of daily exposures. These workers may be exposed at higher levels and should be targeted for surveillance. There is a database for accidents and excursions available at the LANL. One area to consider is the explosive area where dynamic testing was done. The organizations WX and M are examples of areas where this type of testing was done.

It is imperative to convene the Steering Committee as soon as possible. Some suggestions for the composition of the steering committee include workers from LANL, the former workers who have contacted Dr. Wiggs, and local health care providers. The objectives of this committee are to gather worker input and buy in to the project, to offer advice from the worker to the investigators, and to address the needs of worker. The initiation of this committee will be given the highest priority and is on the agenda for the next trip to LANL in June.

Meeting was adjourned at 4:05 P.M.

Appendix B Focus Group Materials
Introduction
Script
Informed Consent
Questionnaire

Focus Groups with Former Workers at Los Alamos National Laboratory 9/30/98 and 10/1/98

Introduction to the Project

This project is part of a two-phase program sponsored by the Department of Energy. We are currently in Phase I of the program, the Needs Assessment phase. The purpose of Phase I is to determine if there is a need for the development of a medical surveillance or evaluation program for former Los Alamos National Laboratory (LANL) workers who may be at risk for health problems from exposures they had during their work at LANL. The project is being conducted in collaboration with Los Alamos National Laboratory, Laborers' Health and Safety Fund of North America, and National Jewish Medical and Research Center in Denver. As part of the Phase I Needs Assessment, we are conducting four focus groups here in New Mexico with former workers to determine workers' health concerns related to their previous employment. If funded, Phase II of the project will involve the development and implementation of a medical surveillance program for selected groups of former LANL workers.

Focus Groups with Former Workers at Los Alamos National Laboratory 9/30/98 and 10/1/98
Introduction: Staff, Project
Procedures of FGs
Informed Consent

1. I'd like to start off by asking each of you if you would take a few moments to think about a time when you had a concern about your health because of something you might have been exposed to while working at Los Alamos. Could you describe that concern to me?
   - Go around the room and ask each person to describe a concern. If none, ask them for an instance that someone else has described to them.
   - Put list on the board.
   - Probe: Can anyone think of any other concerns that you may have had or that someone else has mentioned to you?

2. Which of these do you see as the most important health concerns? Can each of you pick two and tell me?

3. It might be possible sometime in the future to set up a program to monitor the health of some Los Alamos workers who were exposed to specific agents on the job. IF it were possible to set up such a program, what do you think it should be like? (Keep in mind that funding for such a program would always be an issue, so we need to think realistically.)
   ***** Need to be very specific that this is a possible program******
   - Probe: What types of services should be provided?
   - Probe: Where should it be located?
   - Probe: Who would be most important to offer monitoring to?
   - Probe: How would such a program benefit you most?

4. What do you think would keep people from participating in such a program?
   - Probe: Would these same things keep you from participating?
   - Probe: How could these things be overcome?

5. I'd like to ask you about a different topic next. Workers sometimes report that they would like more information about the health effects of exposures at the workplace or about new findings that may become available. Do you have any questions like that right now?
   - Probe: Who do you think should be answering these questions? (Who do you trust?)
   - Probe: How should that information get out to workers?

6. If there were a health-monitoring program, information about individual workers would need to be given back to them (for example, information about test results). How do you think that information should be provided?
   - Probe: Who should give you that information?

7. What do you consider are the best or most efficient ways of locating former LANL workers?
   - What is the best way to communicate with them? (mailings, telephone, former worker groups)

8. Closing comments, survey.

FOCUS GROUP CONSENT FORM

Title of Project: Development of a Medical Surveillance Program for Former Los Alamos National Laboratory Workers (RPN NO: 96-04-23-01)

You are being asked to join a research study. We are asking you to join this study because you are a former worker at Los Alamos National Laboratory (LANL). We are studying workers whose past work may have placed them at increased risk for work-related diseases. If you agree to join this study, you will be asked to attend a focus group meeting with other LANL workers. This focus group will have two parts. During the first part, you will discuss past work exposures and concerns from your job at LANL. During the second part, you will complete a survey on similar topics. The entire session, including the survey, will last about two hours. All of the sessions will be audio tape recorded.

There are no physical risks or discomforts to you from this study. Your decision to join the study is totally voluntary. If you decide not to join the study, none of your LANL benefits will be affected. The information you provide will be kept private to the extent possible by law. To ensure this:

1) Only first names will be used during the sessions (you may use a name other than your own)
2) The audio tape recordings will be heard only by the transcriber and the research team. The recordings will be used only as a research tool to assist in the accurate documentation of participants' responses.
3) Your true name will not appear on any final written transcripts or survey.
4) You do not have to answer any questions that you do not want to answer

If you choose to participate, your travel costs will be reimbursed to you and you will be paid $20.00 for your participation in the study (however, we cannot do this if you are still employed in any way at LANL). In addition, your answers will help us to learn about any health concerns that LANL workers had. If you have any questions about the study or the questionnaire, you should call the Principal Investigator, Brian S. Schwartz, MD, MS at 410-955-4130. If you have any questions about your rights as a research subject, you may call the Joint Committee on Clinical Investigation at 410-955-3008.

Your signature below means that you understand the information given to you about the study and this consent form. If you sign the form it means that you agree to join the study.

PLEASE KEEP A COPY OF THIS CONSENT FORM AND RETURN THE OTHER WITH YOUR QUESTIONNAIRE.

NOT VALID WITHOUT THE COMMITTEE OR IRB STAMP OF CERTIFICATION

Approved By The Joint Committee On Clinical Investigation
SEP 21 1998

PROTOCOL WILL EXPIRE: 5/26/99

RPN NO. 96-04-23-01

FORM C (revised 01/96)

Subject's signature (including children, when applicable) Date

Signature of Parent or Guardian (when applicable) Date

Signature of Investigator or Approved Designee Date

Witness to Consent Procedures * Date

* Optional unless subject is illiterate, or unable to sign.

Los Alamos National Laboratory
IRB/HSR Approval for J. Williams MD
Informed Consent Valid
for Use Through 22 Jun 99

Questionnaire II for Use Through 22 Jan 99
Former Workers at Los Alamos National Laboratory

This questionnaire is designed to help us identify work-related health concerns that former workers from LANL may have. This information will help us decide if follow-up programs are needed to address these concerns. Please do not include any "classified" information in this questionnaire.

1. Today's Date: _____/_____/_____
   Month Day Year

2. About how many years in **total** (military and civilian) did you work at Los Alamos?

   (a) Military _____Years, from 19_____ to 19_____

   (b) Civilian _____Years, from 19_____ to 19_____.

3. What was the **first** job title (or type of job) that you held at Los Alamos and in which **technical area and/or building** did you work?

   (a) Job Title: _____

   (b) Technical Area: _____

   (c) Building: _____

4. What was the **last** job title (or type of job) that you held before leaving Los Alamos and in which **technical area and/or building** did you work?

   (a) Job Title: _____

   (b) Technical Area: _____

   (c) Building: _____

5. What was the title of the job (or type of job) that you held for the **longest period of time** at Los Alamos and in which **building** did you work most of that time?

   (a) Job Title: _____

   (b) Technical Area: _____

   (c) Building: _____

6. How many years did you work **in the job listed in question 5?**

   (a) _____Years, from 19_____ to 19_____.

(Please continue to the next page)

7. Are you now, or were you ever, a member of a Union?

(a) ☐ No.

(b) ☐ Yes, but in the past only. Which union/unions? _____

_____

(c) ☐ Yes, currently in a union. Which union? _____

The next group of questions will help us to gather some medical information.

8. When was the **last time** that you visited your medical doctor?

(a) ☐ within the past year

(b) ☐ over 1 year ago

(c) ☐ I do not remember when I last visited a medical doctor

9. When was your **last chest x-ray** performed?

(a) ☐ less than 1 year ago

(b) ☐ between 1 and 2 years ago

(c) ☐ over 2 years ago

(d) ☐ I do not remember when I had a chest x-ray performed

10. When was the **last time** that you had blood tests?

(a) ☐ less than 1 year ago

(b) ☐ between 1 and 2 years ago

(c) ☐ over 2 years ago

(d) ☐ I do not remember when I last had any blood tests

Why were the tests done? _____

(Please continue to the next page)

11. Please indicate if you are currently under a doctor's care for any of the following medical conditions:

(a) _____ Heart Disease/High Blood Pressure

(b) _____ Cancer

(c) _____ Diabetes Mellitus

(d) _____ Kidney Disease

(e) _____ Lung Disease

12. Where do you normally get your health care? Please check all that apply.

(a) _____ Your own doctor

(b) _____Clinic

(c) _____ Emergency Room

(d) _____ Specified Union Health Services

(e) _____ Public Health Services

(f) Other: _____

(Please continue to the next page)

13. The following table contains a list of agents that you may have worked with during your employment at Los Alamos. Please examine the list. For each agent, please circle the number that best describes how concerned you are about your contact with it during your work at Los Alamos. Please use this scale to rate your level of concern:

1 = I am **not at all** concerned
2 = I am **a little** concerned
3 = I am **very** concerned
4 = I **don't know** if I ever worked with this agent
5 = I was **never** exposed to the agent

Metals	not at all	a little	very	don't know	never
a) Arsenic	1	2	3	4	5
b) Beryllium (metal and compounds)	1	2	3	4	5
c) Cadmium	1	2	3	4	5
d) Chromium	1	2	3	4	5
e) Cobalt	1	2	3	4	5
f) Lead	1	2	3	4	5
g) Mercury	1	2	3	4	5
h) Nickel	1	2	3	4	5
Radioactive Materials	**not at all**	**a little**	**very**	**don't know**	**never**
i) Americium	1	2	3	4	5
j) Plutonium	1	2	3	4	5
k) Polonium	1	2	3	4	5
l) Uranium	1	2	3	4	5
Solvents	**not at all**	**a little**	**very**	**don't know**	**never**
m) Carbon Tetrachloride	1	2	3	4	5
n) Benzene	1	2	3	4	5
o) Chloroform	1	2	3	4	5
p) Other Chlorinated Solvents	1	2	3	4	5
Other Agents	**not at all**	**a little**	**very**	**don't know**	**never**
q) Asbestos	1	2	3	4	5
r) Degreasers	1	2	3	4	5
s) Glycol Ethers	1	2	3	4	5
t) Fiberglass	1	2	3	4	5
u) Formaldehyde	1	2	3	4	5
v) Isocyanates	1	2	3	4	5
w) Metal Working Fluids	1	2	3	4	5
x) PBB/PCBs	1	2	3	4	5
y) Pesticides/Herbicides	1	2	3	4	5
z) Rock Dust/Silica	1	2	3	4	5
aa) Styrene	1	2	3	4	5
bb) Vinyl Chloride	1	2	3	4	5
cc) Welding Fumes	1	2	3	4	5
Physical Agents	**not at all**	**a little**	**very**	**don't know**	**never**
dd) Lasers	1	2	3	4	5
ee) Radiofrequency/Microwaves	1	2	3	4	5
ff) Vibration	1	2	3	4	5
gg) Noise (loud)	1	2	3	4	5
hh) Sunlight/Outdoor work	1	2	3	4	5

(Please continue to the next page)

The next group of questions will help us to find out what concerns former workers may have about their health and/or their past work at the Laboratory.

14. In general, would you say your health is:

(a) ☐ excellent (b) ☐ very good (c) ☐ good

(d) ☐ fair (e) ☐ poor

15. People have different levels of concern about their health because of their work at Los Alamos. How concerned about your health are you?

(a) ☐ not at all concerned

(b) ☐ a little concerned

(c) ☐ very concerned

16. What questions about your health do you have?

_____

_____

_____

17. Who do you think should answer your own or other Los Alamos workers' questions about health?

_____

_____

_____

_____

18. How should these health questions be answered? Check all that apply.

(a) ☐ letter

(b) ☐ phone call

(c) ☐ video

(d) ☐ printed materials

(e) ☐ other: _____

(Please continue to the next page)

19. If you were told that you might be at-risk for a disease related to your previous work, and needed a medical evaluation for this, please indicate which method/methods of evaluation would be acceptable to you?

(a) physical examination by a physician, with no testing

(1) acceptable _____ (2) not acceptable _____

(b) physical examination by a physician **or** a nurse practitioner, with no testing

(1) acceptable _____ (2) not acceptable _____

(c) physical examination and lab testing by a physician

(1) acceptable _____ (2) not acceptable _____

(d) physical examination and lab testing by a physician **or** a nurse practitioner

(1) acceptable _____ (2) not acceptable _____

(e) appropriate x-rays or blood tests that are reviewed by a physician **or** nurse practitioner, but no physical examination

(1) acceptable _____ (2) not acceptable _____

(f) appropriate x-rays or blood tests with a physical examination by a physician **or** nurse practitioner, only if needed

(1) acceptable _____ (2) not acceptable _____

(g) appropriate x-rays or blood tests with a physical examination by a physician **or** nurse practitioner

(1) acceptable _____ (2) not acceptable _____

(h) review of recent x-rays, blood tests, and medical records, then a telephone call from a John Hopkins or LANL Occupational Health physician

(1) acceptable _____ (2) not acceptable _____

(i) review of recent x-rays, blood tests, and medical records, then a letter from a John Hopkins or LANL Occupational Health physician

(1) acceptable _____ (2) not acceptable _____

(Please continue to the next page)

20. In general, if you found any of these methods of medical evaluation unacceptable to you, please explain.

_____

_____

_____

_____

21. Is there anything else you feel that we should have asked?

_____

_____

_____

This last group of questions will allow us to obtain some individual information about you for use in our report.

22. What is your age as of today? _____

23. What is your gender? (1) ☐ Male (2) ☐ Female

24. What is your race? (1) ☐ White (2) ☐ Black (3) ☐ Asian (4) ☐ Native American (5) ☐ Other

25. What is your ethnicity? (1) ☐ Hispanic (2) ☐ Non-Hispanic (3) ☐ Other

Thank you for your help with this project.
If you have any questions in the future about this project, please call
Brian Schwartz, MD MS 410-955-4130
Patrick Breysse, PhD, CIH 410-955-3602
Laurie Wiggs, PhD 505-667-8234
e-mail address: LANLFWMS@jhsph.edu

Appendix C Exposure Assessment - Data Dictionaries
Industrial Hygiene Sampling Databases
Workcard Database

The Environmental, Safety and Health-5 (ESH-5) Group maintains 12 databases for storing data on field activities, health and safety issues, and chemical and physical agent exposures at Los Alamos. Table I presents a list of these 12 databases.

Table I
Listing of the 12 Databases Maintained by ESH-5

Database Name
Industrial Hygiene Sampling Database
Industrial Hygiene Workcard Form database
Non-Ionizing Radiation
Carcinogens Use
Automated Chemical Inventory System
Respiratory Protection
Concerns/ Deficiencies Tracking System
Hood Surveys
Confined Space Entry Permits
Injury/ Illnesses
Asbestos Containing Materials
Asbestos Sampling Data

Of these 12 databases, the Industrial Hygiene Sampling database, Industrial Hygiene Workcard Form database, and Non-Ionizing Radiation database were reviewed in detail and database dictionaries describing their structure and data entry fields were developed. The workcard and sampling databases were reviewed in detail because they are the primary electronic sources of quantitative chemical exposure data maintained at LANL. All industrial hygiene sample results in the sampling database are linked to the workcard database via a workcard number. This number is unique to each workcard corresponding sample result record in the databases. The non-ionizing radiation database was reviewed in detail because it contains the results of all evaluations for potential exposure to non-ionizing radiation at the lab. The following is a short description of the ESH-5 databases.

A. Industrial Hygiene Sampling Database (IHSD):

The IHSD is used to store and maintain industrial hygiene exposure monitoring data. This database includes the sampling date, workcard number of sampling job performed, the substance sampled for, laboratory analytical results, and calculated exposure results. A query of this database revealed that approximately 330 distinct chemical, biological, and physical agents have been sampled for at LANL since the early 1990's. All sampling activities performed after 1990, with the exception of those involving beryllium, are

entered into the database. All beryllium air samples and most swipe samples known to exist at LANL have been entered into the database dating back to October 17, 1949. A dictionary describing each of the 14 tables and their data entry fields is this Appendix.

B. Industrial Hygiene Workcard Form (IHWF) Database:

Industrial hygiene work activities are tracked at LANL using the workcard system. All job tasks are summarized and catalogued using a workcard data sheet with a unique identification number. The IHWF database is used to store and maintain workcards in electronic form, including the name of the person submitting the workcard, a description of activities performed, location performed at, and date task was performed. As with sampling data, all workcards generated after 1990, with the exception of those involving beryllium work, have been entered into the database. All workcards that mention the word beryllium or are part of a report involving beryllium air sampling have been entered retrospectively as an ongoing effort to support this project. LANL is currently working to retroactively enter all beryllium swipe sample data. The earliest workcard for beryllium tasks dates to 1949. The IHWF database is composed of 20 tables, each with multiple fields. A database dictionary that describes each of these 20 tables and their fields is presented in this Appendix.

C. Non-Ionizing Radiation (NIR) Database:

The NIR database is an electronic repository for data collected on NIR sources at LANL. Information in the database includes the location, manufacturer, and owner (at LANL) of NIR sources, the dates and results of NIR source evaluations, equipment used to perform surveys, and potential NIR exposures. All NIR exposure evaluations that have been performed to date are entered in this database. The earliest survey date in the database is 30-August-92 and the last entry is 25-December-95. There are 1,294 evaluations of NIR sources at LANL entered into the database. A dictionary for the 11 tables that compose this database has been developed and is included in this Appendix, however it is incomplete.

D. Carcinogens Use Database:

The carcinogens use database is used to track persons and TA's where carcinogens are used. This database is of limited use for this medical surveillance project because it only contains records back to 1990. The database tracks frequency of use and not quantity of use. Thus, from the database it can not be determined if a worker used a large quantity of a carcinogen on an isolated occasion or frequently worked with minute quantities.

E. Automated Chemical Inventory System (ACIS) Database:

The ACIS Database tracks all chemicals used on site at LANL, including compressed gases. This database is of limited for this medical surveillance project. The ACIS database only tracks chemical inventories as far back as the early 1990's and does not store exposure data. Also, the chemical user and work area data stored in the database may be misleading because chemical deliveries are often received and signed for at locations other than where they will be used and by a receiving clerk, not the end user.

F. Respiratory Protection Database:

This database stores data pertaining to LANL workers whom are fitted to wear respirators. The fact that a worker is fitted with a respirator does not imply exposure to any hazardous agent and there is no potential exposure data stored in this database.

G. Concerns/ Deficiencies Tracking System (CDTS) Database:

The CDTS Database is used to track employee concerns and deficiencies in work and health conditions. These concerns/ deficiencies are primarily requests for inspections, industrial hygiene monitoring, or safety controls (installation of railings, etc.). There is no exposure data stored in this database and it does not provide information applicable to long term medical surveillance.

H. Hoods Surveys Database:

The hoods survey database was created in 1989 and contains the results of ventilation surveys performed at LANL dating back to 1982. Hood uses are tracked (carcinogen, non-carcinogen) in this database, but no user information is provided to supplement it. Thus, it is unknown how many persons work at a carcinogen hood or what the levels of exposure were. The hoods database is of limited utility to this medical surveillance project because it only provides information on the location where carcinogens were potentially used and not who users were or potential exposure information.

I. Confined Space Entry (CSE) Permits Database:

The CSE Permits database stores electronic copies of permits required before entry into a confined space dating back to 1993. In addition, data on atmospheric conditions in the confined space is available (%LEL, % Oxygen, etc.). This database does not contain exposure data and only dates back to 1993, diminishing its utility in this project.

J. Injury/ Illnesses Database:

Description of database. This database compiles data that are analogous to those collected by the OSHA 200 log. The database includes a field entitled "Nature of Injury/Illness" that assigns the injury or illness to one of 37 different categories. Nine of these categories were examined (e.g., 130 - chemical burn; 180 - illness, 7a, skin disease; 225 - illness, 7e, disorders due to physical agents; 270 - illness, 7d, poisoning; 280 - illness, 7b, dust disease of the lungs; 292 - ionizing radiation effects (acute injury); 410 - illness, 7c, respiratory conditions due to toxic agents; 420 - illness, 7g, all other occupational illnesses; 995 - other injury not otherwise listed; 999 - indeterminate injury/illness). The remaining codes are for such injuries as amputation (code 100), avulsion/tear (115), concussion (140), electrical shock (200), fracture (210), hearing loss (230), heat stroke (240), hernia (250), infection (255), laceration (265), sprain (310), strain (320), or multiple injuries (400). Hearing loss is discussed in Section 5 of the Needs Assessment.

Results. The number of cases for each of these categories for the years 1993 to 1998 is summarized below. Written descriptions for each case were available and were reviewed. While the database included several occupational disease categories, the number of annual occupational disease cases in the nine categories examined were very low. Furthermore, review of the case details revealed that these occupational disease cases were always short latency, acute effects of chemical exposures. The majority of cases in this database were for code 252 - illness, 7f, disorders associated with repeated trauma.

Code	Description	1993	1994	1995	1996	1997	1998	Total
130	chemical burns	3	7	2	0	3	1	16
180	occupational dermatoses	6	1	3	5	3	0	18
225	illness due to physical agents	1	0	0	0	0	0	1
270	poisoning	0	0	0	1	0	0	1
280	pneumoconioses	0	0	0	0	0	0	0
292	acute radiation injury	0	0	0	2	0	0	2
410	toxic respiratory diseases	3	0	1	2	0	0	6
420	other occupational illnesses	1	0	0	1	2	0	4
995	other injury NOS	1	0	8	2	3	0	14
999	indeterminate illness	0	1	1	0	0	0	2
Total		15	9	15	13	11	1	64

K. Asbestos Containing Materials (ACM) Database:

From 1992 to 1997, the Johnson Controls Inc. (JCI) Asbestos Survey Team performed qualitative assessments of ACM at LANL. ACM present at LANL includes pipe or thermal system insulation (TSI), floor coverings (tile and linoleum), chalkboards, shingles, roofing materials, transite wallboard, and gaskets. Information gathered during these surveys include the type of ACM, location (building with occasional room numbers), number of employees potentially exposed to the ACM, the relative degree of health hazard it poses to LANL employees, and if any modifications have been made to the ACM. Results of these surveys are retained in 98 three-ring binders that are managed by Larry Ortiz. Review of these evaluations revealed that ACM is present throughout the lab and its location is documented; however exposure information is not available.

L. Asbestos Sampling Database:

The ESH-5 group also manages databases for tracking employee exposures to asbestos during remediation projects. These databases are potentially valuable to the medical surveillance project, however they have not been reviewed for data content because of logistic complications. Asbestos sampling data is stored in electronic form on three different computers. LANL employee Larry Ortiz has data input from 1990-1995 in a database on his personal computer (PC) and Mike Trujillo has a second database on his PC where data from 1996 to present is stored. A third set of data, of unknown origin, input from 1991 – 1997 is stored on the LANL EM84 computer server. The databases managed on the PC's are limited to data input only. Data entered on Larry Ortiz's computer can not be extracted electronically because the computer software used for the database crashed and disabled the sampling report option of the software. This data must be manually input into a new database before statistical analysis can be performed. Mike Trujillo's database only prints sampling reports and can not be exported into spreadsheet software, thus it must also be manually input into a spreadsheet program. More hardcopy data from 1985-1989 is reported to be stored in the archives at TA-21, however attempts to locate it have been unsuccessful. The contents of these databases are potentially important for the purpose of the medical surveillance program and warrant consideration for in depth review and inclusion in phase II tasks.

I. Industrial Hygiene Sampling (Chemicals and Noise) Database:

The industrial hygiene (IH) sampling database tracks chemical and noise exposure sampling performed by the LANL Environmental, Safety and Health Group-5 (ESH-5). Information in this database includes location sampled and date, comment field, workcard number, Z# of person who performed sampling, Z# of employee(s) sampled, substance sampled for, laboratory analytical results, and calculated exposure results.

Database Location: TA-59, Building OH-2 (hard copy), EM 84 server (electronic)

Database Manager: Ms. Josie Encinias (505) 665-4782

Database Access: Using Oracle browser software.

Database Creation Date: 1989

Earliest Record in Database: October 17, 1949 for beryllium samples; Efforts are ongoing to enter all old data for substances other than beryllium into the system.

Location of records prior to earliest entry date in the database: Old records are located at TA-59, Building OH-2 and the LANL archives.

There are a total of 14 tables (groupings of fields) in the IH sampling database. Of these 14 tables, 9 are look-up tables, which contain descriptions of coded data entered into the database. The remaining 5 tables are data tables. The purpose of a look-up table is to separate alpha and numerical fields so that mathematical analysis of numerical data can be performed using the Oracle browser. The IH sampling database is accessed using an Oracle browser, which is case and grammar sensitive. For example, a query for 1,1,2-Trichlorobenzene and 1,1,2 Trichlorobenzene will return different results. The fields in each of the 14 tables of the IH sampling database are described in Table I. Hard copies of all look-up tables in the IH database and an example of a LANL workcard are available for review.

Key-

Fields: C - Calendar date (ex. Feb 20, 1998); 789 - Numeric; A - Alpha-numeric (ex. mg/m^3)

Table I: A descriptive summary of the 14 tables in the IH sampling database

Sample Data Sheet Data Table		
Field Name	Type	Description of Contents
IHWF ID	789	Industrial Hygiene Workcard Form Identification Number. Not all data entered in the IH database has an IHWF ID number because workcards were not created until the early 1990's.
Sample ID	A	This number is the same as the IHWF ID number.
SDS Type	A	Sampling Data Sheet type: S (substance) or N (noise).
Sample Date	C	The date on which the sample was collected.
Date Entered	C	The date on which workcard information was entered into the IH database.
Date Entered User	A	The Z# (a unique employee identifier) of the person who entered the workcard data into the IH database.
Date Updated	C	The date a record in the IH database was updated. If no update has been made, the date is defaulted to the Date Entered.
Date Updated User	A	The Z# of the person who updated the workcard data in the IH database.
Sample Data Method	789	A numeric code (1,2,3, or 4) assigned to the sample method used. See the L Sample Method table for an explanation of the codes.
Sample Org Owner	A	Name of organization for whom sampling was performed (LANL, JCI, etc.).
Sample Map	A	Is a map attached to the workcard? Y or N.

Convert Units Data Table		
Field Name	Type	Description of Contents
From Units	A	On all IHWF, units are expressed using an alpha code (ex. B = mg/m^3). To convert units of B to another coded unit, a Multiplication Factor is needed.
To Units	A	The units for which the sampling results need to be converted to (ex. C = mg/m^3).

Mult Factor	789	A multiplication factor for changing the reported units of exposure.

Sample Other Data Table		
Field Name	Type	Description of Contents
IHWF ID	789	Industrial Hygiene Workcard Form Identification Number. Not all data entered in the IH database has an IHWF ID number because workcards were not created until the early 1990's.
Sample ID	A	This number is the same as the IHWF ID number in the database.
OHSnumber	A	A unique number assigned to all LANL Material Safety Data Sheets on site by a commercial vendor (MDL, Inc.).
SN Sample Seq	A	Sequence number that differentiates one sample from the next within a workcard.
SN IM Type	A	Instrument or Model number of equipment used.
Z Number	A	A unique numerical identifier assigned to all LANL workers (University of California and Contractors). Only one Z# is ever assigned to a person in their lifetime.
OP Code	A	A numerical code to identify the operation evaluated for exposure.
SN Loc	A	A brief description of where the sample was collected.
Sample Code	A	An alpha code for the type of sample collected (personal, area, blank, etc). These codes appear on the LANL ESH-5 Multi-Substance Sampling Data Sheet and are described in the L Sample table.
SN Substance	A	The substance sampled for.
CAS	A	Chemical Abstract Services number, a unique chemical identification number.
Media Code	A	A letter code for the media on which the sample was collected (agar, charcoal, etc.). These letter codes are described in the L Filter Media table.
SN Direct Result	A	The measurement quantity from a real-time instrument.
SN Direct Unit	A	An alpha coded unit of measurement associated with the real-time instrument. Units are described in the L Sample

		Units table.
SN Calc Result	A	The calculated result for the sample collected.
SN Calc Unit	A	The unit of measurement associated with the calculated result. Units are described in the L Sample Units table.
SN Calc TWA	A	The calculated time-weighted average (TWA) exposure for the sample collected.
SN Calc TWA Unit	A	An alpha coded unit of measurement associated with the calculated TWA result. Units are described in the L Sample Units table.
SN Detection Limit	A	The limit of detection of the analytical method used.
SN Detection Unit	A	The alpha coded unit associated with the detection limit of the analytical method. Units are described in the L Sample Units table.
STD Conc	A	The regulatory exposure limit for the substance sampled. For example, the OSHA PEL for Lead.
STD Code	A	An alpha code for the type of regulatory limit to which results will be compared to (PEL, TLV, 15 minute STEL, etc.). STD Codes are described in the L STD Guideline table.
SN STD Unit	A	The unit of measurement for the regulatory standard of concern. Units are described in the L Sample Units table.
Date Entered	C	The date on which sampling data was entered into the IH database.
Date Entered User	A	Z# of person who entered workcard data into IH sampling database.
Date Updated	C	The date a record in the IH database was updated. If no update has been made, the date is defaulted to the Date Entered.
Date Updated User	A	Z# of person who updated workcard data in IH sampling database.
Expgrp FMU No	789	The facility management unit (FMU) number.
PPE Code	789	A code for the type of Personal Protective Equipment (PPE), if any, worn while sampling was performed. It is unknown if a lookup table describing the PPE codes exists.
Det Sym	A	If a less than or greater than symbol is the reported result a

		numeric code for the symbol is entered in this field. These codes are described in the L Sample Symbols table.
TWA Sym	A	If a TWA exposure was calculated using analytical results reported to be above or below the capabilities of the analytical instrument, a less than or greater than symbol must be included in the result and a numeric code for this symbol is entered in this field. These codes are described in the L Sample Symbols table.
Calc Sym	A	If analytical results reported to be above or below the capabilities of the analytical instrument were used in a calculation, a less than or greater than symbol must be included in the result and a numeric code is entered in this field. These codes are described in the L Sample Symbols table.
Indv Samp Date	C	The date on which an individual sample was collected. One workcard may be used for samples collected on multiple days.
Sample Method	789	The standard sampling method followed to evaluate exposure. Each type of method is coded in this field and described in the L Sample Method table.
Flow Rate Pre	789	The pre-calibration flow rate of the sampling pump.
Flow Rate Post	789	The post-calibration flow rate of the sampling pump.
Sample Time On	C	The time at which sampling began.
Sample Time Off	C	The time at which sampling was stopped.
Sample Time Tot	789	The total time sampled.
Sample Flow Rate	789	The calibrated air sampling flow rate.
Sample Filterwt Pre	789	The pre-weight of the filter on which sample was collected.
Sample Filterwt Post	789	The post-weight of the filter on which sample was collected.
Samplepump Chk Info	A	If the pump flow rate was checked during the sampling period, it is indicated here.
Sampled Volume	789	The total volume of air sampled.
Sample Filterwt Tot	789	The total filter weight (post-weight minus pre-weight) of a collected sample.

Sample Noise Data Table		
Field Name	Type	Description of Contents
IHWF ID	A	Industrial Hygiene Workcard Form Identification Number. Not all data entered in the IH database has an IHWF ID number because workcards were not created until the early 1990's.
Sample ID	A	This number is the same as the IHWF ID number.
SN Sample Seq	A	Sequence number that differentiates one sample from the next within a workcard.
SN IM Type	A	Instrument or model number of equipment used to conduct survey.
Z Number	A	A unique numerical identifier assigned to all LANL workers (University Of California and Contractors); only one Z# is ever assigned to a person in their lifetime.
OP Code	A	Numerical code to identify the operation sampled.
SN Loc	A	A brief description of the location where the sample was collected.
SN Time	A	Unknown. It is most likely the time when the sample was collected or the duration of time sampled.
SN Lmax dBA	789	The maximum sound pressure level measured, in decibels and weighted using A scale.
SN Lpk	789	The peak sound pressure level measured.
SN Lavg	789	The average sound pressure level measured.
SN Dose	789	The dose calculated for the measured exposure.
SN Back dBA	789	A-weighted background noise measurement.
SN Back dBC	789	C-weighted background noise measurement
SN Actual dBA	789	A-weighted noise measurements collected.
SN Actual dBC	789	C-weighted noise measurements collected.
Noise Code	A	An alpha code for the type of noise pattern measured. These codes are described in the L Noise table.
SN Freq 62 5	789	Sound pressure level measured at the 62.5 Hz octave band.

SN Freq 125	789	Sound pressure level measured at the 125 Hz octave band.
SN Freq 250	789	Sound pressure level measured at the 250 Hz octave band.
SN Freq 500	789	Sound pressure level measured at the 500 Hz octave band.
SN Freq 1000	789	Sound pressure level measured at the 1000 Hz octave band.
SN Freq 2000	789	Sound pressure level measured at the 2000 Hz octave band.
SN Freq 4000	789	Sound pressure level measured at the 4000 Hz octave band.
SN Freq 8000	789	Sound pressure level measured at the 8000 Hz octave band.
SN Freq dBA	789	The sound pressure level measured using the A-weighting scale.
SN Freq dBC	789	The sound pressure level measured using the C-weighting scale.
SN Octave Band	A	Either an "N" or an "O" is entered in this field. An "N" means no octave band measurements were made and an "O" means measurements were made at the octave bands.
Date Entered	C	The date on which sampling data was entered into the IH database.
Date Entered User	A	Z# of person who entered the workcard data into IH sampling database.
Date Updated	C	The date a record in the IH database was updated. If no update has been made it is defaulted to the Date Entered.
Date Updated User	A	Z# of person who updated the workcard data in IH sampling database.
Individual Sample Date	C	The date on which an individual sample was collected. One workcard may be used for samples collected on multiple days.

Swipe Dist. Data Table		
Field Name	Type	Description of Contents
Numb of Swipes	789	Currently, this table is not populated. However, it appears it will eventually contain data on all swipe samples taken at LANL.

L Sample Method Look-up Table		

Field Name	Type	Description of Contents
Sample Data Method	789	A numeric code (1,2,3, or 4) assigned to the sample method used. These codes are described in the Sample Method Desc field.
Sample Method Desc	A	A description of the numeric Sampling Data Method code. For example, 1 = NIOSH standard method.
Sample Method Longdesc	A	An explanation of the Sample Method Description acronym. For example, NIOSH = National Institute for Occupational Safety and Health.
Sample Method Create Date	C	The date on which the Sample Method Create Date field was created.
Sample Method Create User	A	Name of person who created record.
Sample Method Update Date	C	The date on which any updates were made to the L Sample Method table. Currently, this is defaulted to the Sample Method Create Date.
Sample Method Update User	A	Name of person who updated record.

L Sample Symbol Look-up Table		
Field Name	Type	Description of Contents
Sample Symbol ID	789	A numeric code (1 - 12) assigned to each symbol associated with the detected results.
Sample Symbol	A	An alpha description of the numeric sample symbol code. For example, 6 is < and 11 is %. These symbols are described in the Sample Symbol Desc field.
Sample Symbol Desc	A	A description of the alpha sample symbol. For example, < is "less than", % is "percent".
Sample Symbol Create Date	C	The date on which the Sample Symbol Create Date field was created.
Sample Symbol Create User	A	Name of person who created record.
Sample Symbol Update Date	C	The date on which any updates were made to the Sample Symbol Create Date. Currently, this is defaulted to the Sample Symbol Create Date.
Sample Symbol		

Update User	A	Name of person who created the record.

L Filter Media Look-up Table		
Field Name	Type	Description of Contents
Media Code	A	An alpha code for sample collection media. For example, C, I, T, etc. These codes are described in the Media Desc field.
Media Desc	A	The sample collection media code, for example, C = charcoal, I = impinger, and T = tenax.

L Sample Org Look-Up Table		
Field Name	Type	Description of Contents
Sample Org ID	A	An acronym for the name of the laboratory and primary contractors.
Sample Description	A	A description of the Laboratory or Contractor acronym. For example, JCI is Johnson Control, Inc.
Sample Org Create Date	C	The date on which the Sample Org Create Date field was created.
Sample Org Create User	A	Name of person who created record.
Sample Org Update Date	C	The date on which any updates were made to the Sample Org Create Date field. Currently, this is defaulted to the Sample Method Create Date.
Sample Org Update User	A	Name of person who created record.

L Sample Units Look-up Table		
Field Name	Type	Description of Contents
SU Code	A	An alpha code for the unit of measurement associated with the results of the sampling performed. These alpha codes are described in the SU Desc field.
SU Desc	A	A description of the alpha code. For example, A corresponds to units of ppm and W to nanogram per cubic meter

L Standard Guideline Look-up Table		

Field Name	Type	Description of Contents
STD Code	A	An alpha code for the type of regulatory standard to which results were compared. These codes are described in the STD Desc field.
STD Desc	A	A description of the alpha code for the regulatory standard. For example, A corresponds to an OSHA-TWA and D to a STEL.

L Sample Substance Look-up Table		
Field Name	Type	Description of Contents
List Name	A	A list of substance names that would be listed on the ESH-5 Multi-Substance Sampling Data Sheet under the column SUBSTANCE. This includes both abbreviated and spelled out names (ex. Al and Aluminum are listed).
DB Default Name	A	This is a list of default substance names for the IH database which correspond to the substance names lists in the List Name field. For example, if a workcard listed samples for "aerobic and anaerobic fungi", the default database name for these organisms is "yeast and molds".
Substance Class	A	A one word class name for the substance listed (organic, etc.).
Substance Group	A	A more specific classification for the listed substance. For example, chlorine is listed as inorganic in the Substance Class field, and as a halogen in the Substance Group field.
Create Date	A	Dates on which the sample was collected.
Create User	C	Name of person who created record.
Update Date	A	The date on which any update was made to the L Sample Substance table. Currently, this is defaulted to the Create Date.
Update User	C	Name of person who created record.

L Sample Look-up Table		
Field Name	Type	Description of Contents
Sample Code	A	An alpha code for the type of sample collected. These codes are described in the Sample Desc field.
		A description of the alpha coded type of sample collected.

Sample Desc	A	For example, B is for bulk sample and BZ for breathing zone sample.

L Noise Look-up Table		
Field Name	Type	Description of Contents
Noise Code	A	An alpha code for the type of noise pattern measured. These codes are described in the Noise Desc field.
Noise Desc	A	A description of the type of noise coded for using alpha characters. For example, IT means intermittent and IMP means impulse noise.

II. Industrial Hygiene Workcard Database:

LANL uses an industrial hygiene workcard form (IHWF) system to track the work activities of Environmental, Safety and Health Group-5 (ESH-5) field workers. The industrial hygiene workcard database tracks IHWF generated by ESH-5 personnel. Information in this database includes workcard number, Z# of person generating workcard, description of activity performed, and location and date of activity performed.

Database Location: TA-59, Building OH-2 (hard copy), EM 84 server (electronic)

Database Manager: Ms. Josie Encinias (505) 665-4782

Database Access: Using Oracle browser software.

Database Creation Date: 1989

Earliest Record in Database: 1949; Efforts are ongoing to enter all old data into the system

Location of records prior to earliest entry date in the database: All old records are located at TA-59, Building OH-2 and the LANL archives.

There are a total of 20 tables (groupings of fields) in the IHWF database. Of these 20 tables, 7 are look-up tables that contain descriptions of coded data entered into the database. The remaining 11 tables are data tables. The purpose of a look-up table is to separate alpha and numeric fields so that mathematical analysis of numerical data can be performed using the oracle browser. The IHWF database is accessed using an Oracle browser, which is case and grammar sensitive. For example, a query for Machinists and machinists will return different results. Table I summarizes the 20 tables in the IHWF database and describes the contents of the fields in each table. Hard copies of all lookup tables in the IHWF database and an example of a LANL workcard are available for review.

Key-

Fields: C - Calendar date (ex. April 14, 1998); 789 - Numeric; A - Alpha-numeric (ex. mg/m^3)

Table I: A description of the 20 data and look-up tables in the IHWF database

Industrial Hygiene Workcard Form (IHWF) Data Table		
Field Name	Type	Description of Contents
IHWF ID	789	Industrial Hygiene Workcard Form Identification Number. Not all data entered in the IH database has an IHWF ID number because workcards were not created until the early 1990's.
IHWF Date	C	The date on the IHWF.
IHWF Op Type	789	Numerical code for a type of operation.
IHWF Request Date	C	The date a work activity was requested from ESH-5.
IHWF Complete Date	C	The date a work activity was completed by ESH-5.
IHWF Op Desc	A	A description of the work performed by ESH-5 personnel.
IHWF Person Hours	789	The number of hours worked on the activity reported on the IHWF.
IHWF Status	A	The status of the IHWF- open or complete.
IHWF Program Code	789	A numeric code (0-45) that describes the work activity performed. See the L Program Area Look-up table for an explanation of the codes.
IHWF Comment	A	Any written comments on the workcard.
Created On	C	The date a record in the IHWF database was created.
Created By	A	Z# of person who created IHWF record in the database.
UPD When	C	The date a record in the IHWF database was updated. If no update has been made, the date is defaulted to the Created On date.
UPD Who	A	Z# of person who updated IHWF data in the database.

Location Assignment Data Table		
Field Name	Type	Description of Contents
IHWF ID	789	Industrial Hygiene Workcard Form Identification Number. Not all data entered in the IH database has an IHWF ID number because workcards were not created until the early

		1990's.
Process ID	A	Same as IHWF ID (field is not fully populated).
TA	A	The LANL technical area where the activity reported on the IHWF was performed.
Bldg.	A	The building within the LANL TA where the activity was performed.
Room	A	The room within the building in the LANL TA where the activity was performed.
LA Comment	A	Location assignment.
Process Code	A	An alpha code for the process performed by ESH-5 personnel. Process Codes are described in the L Process Type Look-up table.
Created On	C	The date a record in the IHWF database was created.
Created By	C	Z# of person who created IHWF record in the database.
UPD When	C	The date a record in the IHWF database was updated. If no update has been made, the date is defaulted to the Created On date.
UPD Who	C	Z# of person who updated IHWF data in the database.
FMU No	A	Facility Management Unit Number.

Personnel Assignment Data Table		
Field Name	**Type**	**Description of Contents**
Name	A	Name of person who generated the IHWF.
IHWF ID	789	Industrial Hygiene Workcard Form Identification Number. Not all data entered in the IH database has an IHWF ID number because workcards were not created until the early 1990's.
Process ID	A	Same as IHWF ID (field is not fully populated).
Z Number	A	A unique numerical identifier assigned to all LANL workers (University of California and Contractors). Only one Z# is ever assigned to a person in their lifetime.
PID	789	A numeric personal identification number assigned to each Z# in the database to allow for privacy protection. The L PID Look-up table contains a list of Z#'s and corresponding PID

		numbers.
Process Code	A	An alpha code for the process performed by ESH-5 personnel. Process Codes are described in the L Process Type Look-up table.
Role Code	A	An alpha code describing the role that the generator of an IHWF played in the activity reported. See the L Role Type Look-up table for a description of the codes.
Initials	A	Initials of the person who signed-off on the IHWF.
Phone	A	Phone number of person listed as the contact on the IHWF.
Created On	C	The date a record in the IHWF database was created.
Created By	A	Z# of person who created IHWF record in the database.
UPD When	C	The date a record in the IHWF database was updated. If no update has been made, the date is defaulted to the Created On date.
UPD Who	A	Z# of person who updated IHWF data in the database.

WF Attachment Data Table		
Field Name	Type	Description of Contents
IHWF ID	789	Industrial Hygiene Workcard Form Identification Number. Not all data entered in the IH database has an IHWF ID number because workcards were not created until the early 1990's.
ATT Code	A	An alpha code assigned to the type of attachment(s) submitted with an IHWF. See the L Attachment Look-Up table for a description of the ATT Code.
ATT Qty	789	The number of attachments submitted with an IHWF.
ATT Comment	A	A comment field for any notes written on the back of the IHWF.
Created On	C	The date a record in the IHWF database was created.
Created By	A	Z# of person who created IHWF record in the database.
UPD When	C	The date a record in the IHWF database was updated. If no update has been made, the date is defaulted to the Created On date.

UPD Who	A	Z# of person who updated IHWF data in the database.

WF Memo Data Table		
Field Name	Type	Description of Contents
Memo IHWF ID	789	An identification number for memorandums associated with workcard activities.
Memo ID	A	A memo to explain work performed or in response to work performed.
Created On	C	The date a record in the IHWF database was created.
Created By	A	Z# of person who created IHWF record in the database.
Updated When	C	The date a record in the IHWF database was updated. If no update has been made, the date is defaulted to the Created On date.
Updated Who	A	Z# of person who updated IHWF data in the database.

WF Activity Data Table		
Field Name	Type	Description of Contents
IHWF ID	789	Industrial Hygiene Workcard Form Identification Number. Not all data entered in the IH database has an IHWF ID number because workcards were not created until the early 1990's.
ACT Code	789	A numeric code corresponding to the activity. See the L Activity Look-up table for a description of the ACT Code.
Created On	C	The date a record in the IHWF database was created.
Created By	A	Z# of person who created IHWF record in the database.
Updated When	C	The date a record in the IHWF database was updated. If no update has been made, the date is defaulted to the Created On date.
Updated Who	A	Z# of person who updated IHWF data in the database.

Contact Data Table		
Field Name	Type	Contents of Description

C Last Name	A	Last name of person listed as primary contact on the IHWF.
C First Name	A	First name of person listed as primary contact on the IHWF.
C IHWF ID	789	IHWF identification number.
C Phone	A	Phone number for contact listed on IHWF.

New Locations Data Table		
Field Name	Type	Description of Contents
TA	A	If a TA is not in the lab wide system, it is assigned a new number from this field to allow it to be entered into the database.
Bldg.	A	If a building is not in the lab wide system, it is assigned a new number from this field to allow it to be entered into the database.
Room	A	If a room in a building is not in the lab wide system, it is assigned a new number from this field to allow it to be entered into the database.

Conversion Data Table		
Field Name	Type	Description of Contents
Old Activity	A	The activity previously listed on the IHWF
New Activity	789	The current numeric code replacing the old activity.
Conversion	789	A field for conversion of data from Dbase to Oracle.

Organization Assignment Data Table		
Field Name	Type	Description of Contents
IHWF ID	789	Industrial Hygiene Workcard Form Identification Number. Not all data entered in the IH database has an IHWF ID number because workcards were not created until the early 1990's.
Process ID	A	Same as IHWF ID (field is not fully populated).
WRK Cst Div	A	The division to which work performed will be charged to.
WRK Cst Grp	A	The group to which work performed will be charged to.

Process Code	A	An alpha code for the process performed by ESH-5 personnel. Process Codes are described in the L Process Type Look-up table.
WRK Cst Name	A	Unknown- Name of the person who is billing for the work they performed?
Created On	C	The date a record in the IHWF database was created.
Created By	A	Z# of person who created IHWF record in the database.
Updated When	C	The date a record in the IHWF database was updated. If no update has been made, the date is defaulted to the Created On date.
Updated Who	A	Z# of person who updated IHWF data in the database.

CSWS Personnel Data Table		
Field Name	Type	Description of Contents
Z Number	A	A unique numerical identifier assigned to all LANL workers (University of California and Contractors). Only one Z# is ever assigned to a person in their lifetime.
SSN	A	An employee's social security number. The CSWS Personnel data table, along with the Personnel Assignment, Organization Assignment, Job Code, and CSWS Organization tables are tied into human resources databases.
Role Code	A	An alpha code describing the role that the generator of an IHWF played in the activity reported. See the L Role Type Look-up table for a description of the codes.
Last Name	A	Employees' last name.
First Name	A	Employees' first name.
Middle Name	A	Employees' middle name.
PID	789	A numeric personal identification number assigned to each Z# in the database to allow for privacy protection. The L PID Look-up table contains a list of Z#'s and corresponding PID numbers.
Check Name	A	The employees' name as it appears on their paycheck.
Initials	A	Employees' initials.

Org Owner	A	Organization for which the employee works, this can be LANL, JCI, etc.
Email Address	A	Email address of employee.

CSWS Organization Data Table		
Field Name	Type	Description of Contents
WRK Cst Code	A	The cost code to which the work performed will be charged to.
WRK Cst Grp	A	The group to which work performed will be charged to.
WRK Cst Div	A	The division to which work performed will be charged to.
WRK Cst Type	A	Type of record for the cost code; C= cost center that pays for employee; W= cost center that employee works for; blank= cost center is both C and W.
WRK Cst Long NM	A	Descriptive name of group, e.g. Industrial Hygiene and Safety
WRK Cst Name	A	Organization name of the group, e.g. ESH-5
WRK Cst Date Added	C	Date the record was created.
WRK Cst AD	A	Cost code for the Associate Director responsible for that group.
WRK Cst Active	A	If the cost code is active or inactive.

Job Code Data Table		
Field Name	Type	Description of Contents
Job Code	A	A persons 5 digit job code. These codes are from a human resources database. There are 1,783 job codes listed in this field.
Job Title	A	The job title corresponding to the job code.
Job Series	A	The job series of the job title; there are multiple series for some job titles.
Job Level	A	The job level of the job series.
Job LN MGR CD	A	Code for rank in management scheme. 0= Lab Director, 1= Division Leader, 2= Not Used, 3= Group Leader, 4=

		Everybody else.
Sob Stat	A	The status of a person's job, Active (A) or Inactive (I).
Job LNG NM	A	Descriptive version of Job_Title
Job EEO Cat	A	The equal employment opportunity category of a job.
Job EEO Subcat	A	The equal employment opportunity subcategory of a job.
Job Fam Cd	A	A way to group jobs into families; never really used.
Job Subfam	A	A subfamily for grouped jobs, this field is unpopulated.
Job Paybasis	A	An employee's payroll basis. Exempt = salary, Non-exempt = Overtime allowed.
Job Supercd	A	A code for Supervisory (S) or non-supervisory (N) job positions.
Job Mgr Lev	A	Managerial level of a job; field is not used.
Job Specpgm	A	Code for special programs associated with a job. Ex. Undergraduate or graduate students, women in science, fellows, etc.
Job EEO Mgrlev	A	Job codes based on CFR for EEO reporting.

L PID Look-up Table		
Field Name	Type	Description of Contents
Z Number	A	A unique numerical identifier assigned to all LANL workers (University of California and Contractors). Only one Z# is ever assigned to a person in their lifetime.
PID	789	A numeric personal identification number assigned to each Z# in the database to allow for privacy protection. A list of Z#'s and corresponding PID numbers is found in this field.

L Activity Look-up Table		
Field Name	Type	Description of Contents
ACT Code	789	A numeric code corresponding to the activity. See the L Activity Look-up table for a description of the ACT Code.
ACT Desc	A	A description of the numeric ACT Code. For example, if an ACT Code = 6, work is done as the result of an "employee complaint."

ACT Status	A	This field is populated with either the letter "H" or "C"; it is unclear how this designation corresponds to active or inactive codes.
Created On	C	The date a record in the IHWF database was created.
Created By	A	Z# of person who created IHWF record in the database.
UPD When	C	The date a record in the IHWF database was updated. If no update has been made, the date is defaulted to the Created On date.
UPD Who	A	Z# of person who updated IHWF data in the database.
Parent Code		The old code for a current activity. The parent code tells which code originally applied to that activity.

L Attachment Look-up Table		
Field Name	Type	Description of Contents
ATT Code	A	An alpha code assigned to the type of attachment(s), which are submitted with an IHWF.
ATT Desc	A	A description of the alpha ATT Code. For example, EP = Excavation Permit is attached to the IHWF, while HS = a Hood Survey is attached.
ATT Status	A	Unknown.
Created On	C	The date a record in the IHWF database was created.
Created By	A	Z# of person who created IHWF record in the database.
UPD When	C	The date a record in the IHWF database was updated. If no update has been made, the date is defaulted to the Created On date.
UPD Who	A	Z# of person who updated IHWF data in the database.

L Process Type Look-Up Table		
Field Name	Type	Description of Contents
Process Code	A	An alpha code for the process performed by ESH-5 personnel. Process Codes are described in the Process Desc field.
Process Desc	A	A description of the process code. For example, HA =

		Health Hazard Assessment.
Created On	C	The date a record in the IHWF database was created.
Created By	A	Z# of person who created IHWF record in the database.
UPD When	C	The date a record in the IHWF database was updated. If no update has been made, the date is defaulted to the Created On date.
UPD Who	A	Z# of person who updated IHWF data in the database.

L Program Area Look-up Table		
Field Name	Type	Description of Contents
Prog Code	789	A numeric code (0-45) assigned work activities performed. Prog Codes are described in the Prog Desc field.
Prog Desc	A	A description of the Prog Code found on the IHWF under the heading "Program Area." For example, Prog Code 9 = Ergonomics and 19 = Respiratory Protection.
Prog Status	A	This field is populated with either the letter "H" or "C"; it is unclear how this designation corresponds to active or inactive codes.
Created On	C	The date a record in the IHWF database was created.
Created By	A	Z# of person who created IHWF record in the database.
UPD When	C	The date a record in the IHWF database was updated. If no update has been made, the date is defaulted to the Created On date.
UPD Who	A	Z# of person who updated IHWF data in the database.

L Role Type Look-up Table		
Field Name	Type	Description of Contents
Role Code	A	An alpha code describing the role that the generator of an IHWF played in the activity reported. See the Role Desc field for a description of the codes.
Role Desc	A	There are five Role Codes, each describing the role the ESH-5 personnel played in the activity reported on the IHWF. For example, if the Role Code = IN, the person was an investigator.

Created On	C	The date a record in the IHWF database was created.
Created By	A	Z# of person who created IHWF record in the database.
UPD When	C	The date a record in the IHWF database was updated. If no update has been made, the date is defaulted to the Created On date.
UPD Who	A	Z# of person who updated IHWF data in the database.

L Quarter Look-up Table		
Field Name	Type	Description of Contents
QTR	789	Calendar year quarter. The purpose of this field is unknown.
Begin Date	A	Begin date of the quarter (ex. January 1, 1998).
End Date	A	End date of quarter (ex. March 31, 1998).
Created On	C	The date a record in the IHWF database was created.
Created By	A	Z# of person who created IHWF record in the database.
UPD When	C	The date a record in the IHWF database was updated. If no update has been made, the date is defaulted to the Created On date.
UPD Who	A	Z# of person who updated IHWF data in the database.

III. Non-Ionizing Radiation Database:

The non-ionizing radiation database contains information on sources of non-ionizing radiation (NIR) at LANL and results of Environmental, Safety and Health (ESH-5) evaluations of the NIR sources. The NIR database has 5 functions:

a. NIR Sources- Maintain, analyze, and report information concerning NIR sources.

b. Report- Analyze and report about NIR sources and potential exposures.

c. Document- Record details about new and existing NIR sources as required by DOE regulations and LANL standards.

d. Evaluate- Perform NIR source evaluations to document current information.

e. Survey- Prepare survey materials, conduct investigations on new and existing NIR sources, and prepare an investigation report.

Contents of the NIR database include data on the location, manufacturer, and owner of a specific NIR source; evaluation dates and results; records of evaluation instruments used; and potential NIR exposures. All evaluations were conducted from 1992 to1995 and the results of the surveys have been entered into the database.

Database Location: TA-59, Building OH-2 (hard copy), EM 84 server (electronic)

Database Manager: Ms. Josie Encinias (505) 665-4782; Jeff Hollander

Database Access: Using Oracle browser software.

Database Creation Date: 1993

Earliest Record in Database: August 30, 1992

Location of records prior to earliest entry date in the database: All records are entered.

There are a total of 11 tables (groupings of fields) in the NIR database. The NIR database is accessed using an Oracle browser, which is case and grammar sensitive. A summary of the 11 tables in the NIR database and descriptions of their contents is provided in Table I.

Key-

Fields: C - Calendar date (ex. Feb 20, 1998); 789 - Numeric; A - Alpha-numeric (ex. mg/m^3)

Table I: A descriptive summary of the 11 tables in the NIR database

CG Form Help		
Field Name	Type	Description of Contents
HLP APPLN		Unknown
HLP INDEX		Unknown
HLP MODTAB NAME		Unknown
HLP GENERATED		Unknown
HLP SEQ		Unknown
HLP TEXT		Unknown
HLP TYPE		Unknown

NIR Evaluations		
Field Name	Type	Description of Contents
EVAL UID	789	The unique identifier of the NIR evaluation.
EVAL DATE	C	The Date of the NIR evaluation (mm/dd/yy).
EVAL IHWF ID	789	The unique identifier of the industrial hygiene workcard.
EVAL SRCE UID	789	The unique identifier of the NIR source.
EVAL SRCE YEAR	A	Unknown

NIR Samples		
Field Name	Type	Description of Contents
SAMP UID	789	The unique identifier of an NIR sample.
SAMP TYPE	A	The type of NIR sample being collected.
SAMP CMNT	A	Any comment about the NIR sample collected.
SAMP SURVEY INST NO	A	The instrument identification number used to collect the NIR sample.
SAMP SURVEY INST	A	The instrument used to collect the NIR sample.
SAMP OPER COND	A	A comment about the operation of the NIR source during sampling.
SAMP EVAL UID	789	Unknown

CHK Evals		
Field Name	Type	Description of Contents
EVAL UID	789	The Unique identifier of the NIR evaluation.

TMP Exp		
Field Name	Type	Description of Contents

SRC UID	789	The unique identifier of the NIR source.
SRCE YEAR	A	Unknown

CG Ref Codes		
Field Name	Type	Description of Contents
RV LOW VALUE	A	Unknown
RV HIGH VALUE	A	Unknown
RV ABBREVIATION	A	Unknown
RV DOMAIN	A	Unknown
RV MEANING	A	Unknown
RV TYPE	A	Unknown

NIR Missing Info		
Field Name	Type	Description of Contents
MISS SRCE UID	789	Unknown
MISS FREQ	A	Unknown
MISS OUTPUT	A	Unknown
MISS USEAGE	A	Unknown
MISS EXPOSURES	A	Unknown
MISS STATIONARY FLAG	A	Unknown

NIR Conversion Factors		
Field Name	Type	Description of Contents
CV FROM UNIT	A	Measurement unit to be converted from.
CV TO UNIT	A	Measurement unit to be converted to.
CV FACTOR	789	Conversion factor to change from one unit to another.
CV COMMENT	A	Any comment pertinent to the conversion of units.

NIR Potential Exposures		
Field Name	Type	Description of Contents
PEXP EVAL UID	789	The unique identifier of the NIR evaluation.
PEXP PID	789	The unique identity of the person potentially exposed.

NIR Sample Measurements		
Field Name	Type	Description of Contents
MEAS SEQ NO	789	The sample sequence number of the sample measurement.
MEAS LOC CMNT	A	A comment about the location of the sample measurement.
MEAS READING	789	The recorded sample measurement reading.
MEAS READING UNITS	A	The associated reading units for the sample measurement.
MEAS TYPICAL OR MAX FLAG	A	Is the personnel exposure typical or maximum?
MEAS SAMP UID	789	The unique identifier of an NIR sample.

NIR Sources		
Field Name	Type	Description of Contents
SRCE PROPERTY NO	A	The LANL property number of the NIR source.
SRCE PROPERTY NO	A	The LANL property number of the NIR source.
SRCE TECH AREA	A	The technical area where the NIR source is located.
SRCE BLDG NO	A	The building where the NIR source is located.
SRCE ROOM NO	A	The room where the NIR source is located.
SRCE LOCATION OTHER	A	Any additional information describing the location of the NIR source.
SRCE REQ SECURITY	A	The security requirements needed to visit the NIR source.
SRCE ESCORT FLAG	A	Is a LANL escort required to visit the NIR source?
SRCE EQUIPMENT NAME	A	The name of the NIR source equipment.
SRCE EQUIPMENT MODEL	A	The model of the NIR source equipment.
SRCE EQUIPMENT MANF	A	The manufacturer of the NIR source equipment.
SRCE MANF ADDR LINE 1	A	The first line of the manufacturer's address.
SRCE MANF ADDR LINE 2	A	The second line of the manufacturer's address.
SRCE MANF CITY	A	The city where the NIR source manufacturer is located.
SRCE MANF STATE	A	The state where the NIR source manufacturer is located.
SRCE MANF ZIP CODE	A	The zip code of the NIR source manufacturer.
SRCE MANF PHONE	A	The phone number of the NIR source manufacturer (999) 999-9999.
SRCE STATIONARY FLAG	A	Is the NIR source stationary?
SRCE MAX RATED OUTPUT	789	The maximum rated output of the NIR source.
SRCE MAX RATED OUT UNITS	A	The units associated with the maximum rated output of the NIR source.
SRCE CONT PULSED FLAG	A	Is the source continuous or pulsed?
SRCE PULSE DURATION	789	The pulse duration of the NIR source.
SRCE PULSE DURATION UNITS	A	The units associated with the pulse rate of the NIR source.

SRCE PULSE RATE	789	The pulse rate of the NIR source.
SRCE USE OR APPL	A	Describe how the NIR source is used or applied.
SRCE FREQ	789	The frequency of the NIR source.
SRCE PULSE RATE UNITS	A	The units associated with the pulse rate of the NIR source.
SRCE FREQ UNITS	A	The units associated with the NIR source frequency.
SRCE OPER HRS	789	The typical operating hours of the NIR source.
SRCE OPER HRS UNITS	A	The units associated with the operating hours of the NIR source.
SRCE OPER CMNT	A	Any comment on how the NIR source is operated.
SRCE RESP WRK CST NAME	A	The customer name of the organization.
SRCE USING WRK CST NAME	A	The customer name of the organization.
SRCE PID	789	The unique identification of the person.
SRCE CMNT	A	Any pertinent comment about the NIR source.
SRCE MAGNET FLAG	A	Is it a magnetic source? Y or N
SRCE RATING VALUE	789	Unknown
SRCE RE SURVEY YN	A	Unknown
SRCE RATING STATUS	A	Unknown
SRCE RATING DATE	C	Unknown
SRCE YEAR	A	Unknown
SRCE RATING TYPE	A	Unknown
SRCE RATING TLV	789	Unknown
SRCE LATEST	A	Unknown

Appendix D Common Occupational Classification System (COCS) and Job Exposure Matrix (JEM)

Common Occupational Classification System (COCS) Used for the Development of the Job Exposure Matrix During the Phase I Needs Assessment at Los Alamos National Laboratory

Code	Definition
A000	**Unknown Job Title**
C000	**Crafts/Skilled Operators**
C010	Carpenters/Construction Workers
C020	Electricians/Electrical Workers
C040	Machinists
C050	Masons/Bricklayers/Cement Workers
C070	Painters
C080	Plumbers and Pipefitters
C090	Structural/Metal/Foundry Workers/Blacksmiths
C100	Vehicle and Mobile Equipment Mechanics/Other Mechanists
C110	Welders/Cutters/Braziers/Solderers/Burners
C120	Other Crafts
C130	Asbestos/Insulation Workers
C140	Explosive/Detonation Workers
C150	Maintenance/Salvage Workers/Facilities
C160	Printers
E000	**Engineers**
E010	Chemical Engineers
E020	Civil Engineers
E040	Electrical Engineers
E050	Environmental Engineers/Sanitary Engineers
E060	Industrial Engineers
E070	Mechanical Engineers
E080	Nuclear Engineers
E120	Safety Engineers
E130	Other Engineers
E140	Construction Engineers
G000	**General Administrative, Secretarial, and Clerical Support Staff**
G003	Student, support staff
L000	**Laborers and General Services Workers**
L010	Firefighters
L020	Food Service Workers
L030	Janitors and Cleaners
L040	Laundry Workers
L050	Handlers helpers, and Laborers (general)
L060	Handlers Helpers, and Laborers (specialized)
L070	Light Vehicle Drivers
L080	Security Guards
L090	Other Laborers and General Security Guardservice Workers
L100	Warehouse Workers, Partsman

Common Occupational Classification System (COCS) Used for the Development of the Job Exposure Matrix During the Phase I Needs Assessment at Los Alamos National Laboratory

Code	Definition
M000	**General managers, Executives, First Line Supervisors, and Program/Project Managers**
N000	**Nevada Test Site Workers, Field Party**
P000	**Professional Administrative and Related Occupations**
P010	Accountants and Auditors
P020	Architects/Draftsman
P030	Buyers, Procurement and Contracting Specialists
P050	Compliance Inspectors
P070	Cost Estimators and Planners and Schedulers
P080	Health Physicists
P090	Industrial Hygienists/Safety
P100	Lawyers
P120	Physicians
P130	Physicians Assistants, Nurses and Other Medical Support Occupations
P150	Trainers
P180	Military Personnel
R000	**Operators**
R010	Chemical System Operators
R012	Chemical Systems Technicians
R030	Material Moving Equipment Operators
R040	Nuclear Plant Operators
R042	Nuclear Plant Technicians
R070	Utilities Operators
R072	Utilities Technicians
R080	Other Operators
R090	Furnace/Boiler Operators
R092	Furnace/Boiler Technicians
R100	Explosives Operators
R110	Accelerator, Particle Beam, LAMPF Operator
R112	Accelerator, Particle Beam, LAMPF Technician
R120	Compressed Gas Facility Operator
R122	Compressed Gas Facility Technician

Common Occupational Classification System (COCS) Used for the Development of the Job Exposure Matrix During the Phase I Needs Assessment at Los Alamos National Laboratory

Code	Definition
S000	**Scientists**
S010	Chemists
S012	Chemical Technician
S013	Chem Tech, Student
S020	Environmental Scientist
S030	Geologists
S032	Geology Technician
S040	Life Scientists
S042	Life Science Technicians
S050	Materials/Metallurgy Scientists
S052	Materials/Metallurgy Technicians
S060	Mathematicians
S070	Physicists
S072	Physics Technician
S090	Other Scientists
S100	Computer Scientists
T000	**Technicians**
T010	Computer Operator/Coders
T013	Computer Technician, Student
T020	Drafters/ Draftsman (Tech)
T030	Engineering Technicians
T040	Environmental Sciences Technicians
T040.4	Water Treatment and Management Activities/Solid Waste
T040.6	Transportation Activities
T050	Health Physics Technicians
T060	Industrial Safety and Health Technicians
T070	Instrument and Control Technicians
T080	Laboratory Technicians
T090	Media Technicians includes Photography, Video, Radio
T100	Surveying and Mapping Technicians
T110	Other Technicians
T113	Technician, Student
T120	Mechanical Technician (Mech Tech)
T123	Mech Tech, Summer/Student
Y000	**Staff Member**
Y003	Research Assistant, Associate, Graduate Research Associate, Student
Z000	**Employees, Students, Faculty, Visitors**
Z000	Employees (unspecified, part-time, short-term, unclassified)
Z003	Students, unspecified
Z004	Faculty, unspecified
Z005	Guest, Visitor

Agents	JOB CODES																	
	G000, G003 (Support Staff)						M000 (Management)						Z000, Z003, Z004, Z005 (Employees, faculty, students, visitors)					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manganese	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nickel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solvents																		
Chlorinated Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbon Tetrachloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Aromatic Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glycol Ethers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Radioactive materials																		
Americium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
External Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plutonium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polonium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uranium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Isotopes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical Agents																		
Lasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Radiofrequency/ Microwaves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultraviolet Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vibration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degreasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fiberglass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PBB/PCB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pesticides/Herbicides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Dust/Silica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Agents	JOB CODES																	
	Y000, Y003 (Staff Member)						N000 (Nevada Test Site)						E000 (Engineers)					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Chromium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Cobalt	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Lead	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	0	0	0
Manganese	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Nickel	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Vanadium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Solvents																		
Chlorinated Solvents	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Carbon Tetrachloride	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Other Aromatic Solvents	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Glycol Ethers	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Radioactive materials																		
Americium	1	1	1	1	1	1	0	1	1	1	1	1	0	0	0	0	0	0
External Radiation	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
Plutonium	1	1	1	1	1	1	0	1	1	1	1	1	0	0	0	0	0	0
Polonium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Uranium	1	1	1	1	1	1	0	1	1	1	1	1	0	0	0	0	0	0
Other Isotopes	1	1	1	1	1	1	0	1	1	1	1	1	0	0	0	0	0	0
Physical Agents																		
Lasers	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Noise	1	1	1	1	1	1	0	1	1	1	1	1	0	0	0	0	0	0
Radiofrequency/ Microwaves	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Ultraviolet Radiation	1	1	1	1	1	1	0	1	1	1	1	1	0	0	0	0	0	0
Vibration	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Other Agents																		
Acrylonitrile	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Degreasers	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Fiberglass	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Isocyanates	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
PBB/PCB	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Pesticides/Herbicides	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Rock Dust/Silica	1	1	1	1	1	1	0	1	1	1	1	1	0	0	0	0	0	0
Vinyl Chloride	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	1	1	1	1	1	1	0	1	1	1	1	1	0	0	0	0	0	0

Agents	JOB CODES																	
	E010, E050, E060, E070						E020, E140						E040					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manganese	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nickel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solvents																		
Chlorinated Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbon Tetrachloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Aromatic Solvents	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Glycol Ethers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Radioactive materials																		
Americium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
External Radiation	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Plutonium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Polonium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Uranium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Other Isotopes	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Physical Agents																		
Lasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Radiofrequency/ Microwaves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultraviolet Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vibration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Degreasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fiberglass	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PBB/PCB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pesticides/Herbicides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Dust/Silica	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Agents	JOB CODES																	
	E080						E120, E130						S000, S060, S090, S100, (Scientists)					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manganese	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nickel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solvents																		
Chlorinated Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbon Tetrachloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Aromatic Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glycol Ethers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Radioactive materials																		
Americium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
External Radiation	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Plutonium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Polonium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Uranium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Other Isotopes	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Physical Agents																		
Lasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Radiofrequency/ Microwaves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultraviolet Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vibration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degreasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fiberglass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PBB/PCB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pesticides/Herbicides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Dust/Silica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Agents	JOB CODES																	
	S010, S012, S013						S030, S032						S040, S042					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Chromium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Cobalt	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Lead	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Manganese	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Nickel	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Vanadium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Solvents																		
Chlorinated Solvents	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Carbon Tetrachloride	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Other Aromatic Solvents	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Glycol Ethers	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Radioactive materials																		
Americium	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
External Radiation	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Plutonium	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Polonium	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Uranium	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Other Isotopes	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Physical Agents																		
Lasers	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1
Noise	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Radiofrequency/ Microwaves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultraviolet Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vibration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Degreasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fiberglass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PBB/PCB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pesticides/Herbicides	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Rock Dust/ Silica	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Agents	JOB CODES																	
	S050, S052						S070, S072						P000, P010, P020, P030 P070, P100, P150					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Chromium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Cobalt	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Lead	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Manganese	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	0	0	0
Nickel	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Vanadium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Solvents																		
Chlorinated Solvents	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Carbon Tetrachloride	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Aromatic Solvents	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Glycol Ethers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Radioactive materials																		
Americium	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
External Radiation	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Plutonium	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Polonium	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Uranium	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Other Isotopes	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Physical Agents																		
Lasers	0	0	0	1	1	1	0	0	0	1	1	1	0	0	0	0	0	0
Noise	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Radiofrequency/ Microwaves	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Ultraviolet Radiation	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Vibration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Degreasers	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Fiberglass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PBB/PCB	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Pesticides/Herbicides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Dust/ Silica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0

Agents	JOB CODES																	
	P050						P080						P090					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Cadmium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Manganese	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Nickel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Solvents																		
Chlorinated Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbon Tetrachloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Aromatic Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glycol Ethers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Radioactive materials																		
Americium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
External Radiation	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Plutonium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Polonium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Uranium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Other Isotopes	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Physical Agents																		
Lasers	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Noise	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Radiofrequency/ Microwaves	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
Ultraviolet Radiation	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Vibration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Degreasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fiberglass	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
PBB/PCB	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Pesticides/Herbicides	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Rock Dust/ Silica	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

Agents	JOB CODES																	
	P120, P130						P180						T000, T110, T113 (Technicians)					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Cadmium	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Chromium	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead	0	0	0	0	0	0	1	1	0	0	0	0	1	1	1	1	1	1
Manganese	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Nickel	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Other Metals	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Solvents																		
Chlorinated Solvents	0	0	0	0	0	0	1	1	0	0	0	0	1	1	1	1	1	1
Carbon Tetrachloride	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Aromatic Solvents	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Glycol Ethers	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Other Solvents	0	0	0	0	0	0	1	1	0	0	0	0	1	1	1	1	1	1
Radioactive materials																		
Americium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
External Radiation	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Plutonium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Polonium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Uranium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Other Isotopes	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Physical Agents																		
Lasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise	0	0	0	0	0	0	1	1	0	0	0	0	1	1	1	1	1	1
Radiofrequency/ Microwaves	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Ultraviolet Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vibration	0	0	0	0	0	0	1	1	0	0	0	0	1	1	1	1	1	1
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	0	0	0	0	0	0	1	1	0	0	0	0	1	1	1	1	0	0
Degreasers	0	0	0	0	0	0	1	1	0	0	0	0	1	1	1	1	1	1
Fiberglass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	0	0	0	0	0	0	1	1	0	0	0	0	1	1	1	1	1	1
PBB/PCB	0	0	0	0	0	0	1	1	0	0	0	0	1	1	1	1	1	1
Pesticides/Herbicides	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Rock Dust/ Silica	0	0	0	0	0	0	1	1	0	0	0	0	1	1	1	1	1	1
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	0	0	0	0	0	0	1	1	0	0	0	0	1	1	1	1	1	1

Agents	JOB CODES																	
	T010, T013, T020, T090, T100						T030						T040					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manganese	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nickel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solvents																		
Chlorinated Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbon Tetrachloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Aromatic Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glycol Ethers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Radioactive materials																		
Americium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
External Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plutonium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polonium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uranium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Isotopes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical Agents																		
Lasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Radiofrequency/ Microwaves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultraviolet Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vibration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degreasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fiberglass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PBB/PCB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pesticides/Herbicides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Dust/ Silica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Agents	JOB CODES																	
	T040.4, T040.6						T050						T060					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Cadmium	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Manganese	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Nickel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Solvents																		
Chlorinated Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbon Tetrachloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
Other Aromatic Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glycol Ethers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Radioactive materials																		
Americium	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
External Radiation	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Plutonium	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Polonium	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Uranium	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Other Isotopes	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Physical Agents																		
Lasers	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Noise	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Radiofrequency/ Microwaves	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
Ultraviolet Radiation	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Vibration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Degreasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fiberglass	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
PBB/PCB	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Pesticides/Herbicides	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Rock Dust/ Silica	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

Agents	JOB CODES																	
	T070						T080						T120, T123					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Cadmium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Chromium	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1
Manganese	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Nickel	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Solvents																		
Chlorinated Solvents	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Carbon Tetrachloride	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Benzene	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Other Aromatic Solvents	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Glycol Ethers	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Other Solvents	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Radioactive materials																		
Americium	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
External Radiation	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Plutonium	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Polonium	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Uranium	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Other Isotopes	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Physical Agents																		
Lasers	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Noise	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Radiofrequency/ Microwaves	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Ultraviolet Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vibration	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	1	1	1	1	0	0	1	1	1	1	0	0	1	1	1	1	0	0
Degreasers	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Fiberglass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
PBB/PCB	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pesticides/Herbicides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Dust/ Silica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

Agents	JOB CODES																	
	C000, C120 (Crafts/Skilled Operator)						C010**						C020**					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Cadmium	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Manganese	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nickel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solvents																		
Chlorinated Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbon Tetrachloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Aromatic Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glycol Ethers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Radioactive materials																		
Americium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
External Radiation	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Plutonium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polonium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uranium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Isotopes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical Agents																		
Lasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Radiofrequency/ microwaves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Ultraviolet Radiation	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
Vibration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Degreasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fiberglass	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PBB/PCB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pesticides/Herbicides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Dust / Silica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

** Mobile Code, however in the opinion of those familiar with operations by these craft workers, external ionizing radiation exposure was unlikely. As a result, external ionizing radiation was not universally assigned to this job code.

Agents	JOB CODES																	
	C040						C050						C070					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Chromium	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Cobalt	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Lead	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Manganese	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Nickel	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Vanadium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Solvents																		
Chlorinated Solvents	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1
Carbon Tetrachloride	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Aromatic Solvents	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1
Glycol Ethers	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1
Radioactive materials																		
Americium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
External Radiation	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Plutonium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Polonium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uranium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Other Isotopes	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Physical Agents																		
Lasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Radiofrequency/ Microwaves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultraviolet Radiation	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Vibration	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Degreasers	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Fiberglass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Metal Working Fluids	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
PBB/PCB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pesticides/Herbicides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Dust / Silica	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Agents	JOB CODES																	
	C080**						C090						C100					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Beryllium	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Cadmium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Chromium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Cobalt	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Lead	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Manganese	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Mercury	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Nickel	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Vanadium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Other Metals	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Solvents																		
Chlorinated Solvents	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Carbon Tetrachloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Other Aromatic Solvents	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Glycol Ethers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Radioactive materials																		
Americium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
External Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plutonium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polonium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uranium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Other Isotopes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical Agents																		
Lasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Radiofrequency/ Microwaves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultraviolet Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vibration	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Degreasers	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Fiberglass	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
PBB/PCB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pesticides/Herbicides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Dust/ Silica	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1

** Mobile Code, however in the opinion of those familiar with operations by these craft workers, external ionizing radiation exposure was unlikely. As a result, external ionizing radiation was not universally assigned to this job code.

Agents	JOB CODES																	
	C110*						C120						C130*					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Cadmium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Chromium	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Manganese	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nickel	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Solvents																		
Chlorinated Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbon Tetrachloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Aromatic Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glycol Ethers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Radioactive materials																		
Americium	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
External Radiation	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Plutonium	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Polonium	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Uranium	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Other Isotopes	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Physical Agents																		
Lasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Radiofrequency/ microwaves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultraviolet Radiation	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Vibration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Degreasers	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Fiberglass	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PBB/PCB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pesticides/Herbicides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Dust/ Silica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0

* Mobile Craft – These workers were given exposure to asbestos and all radioactive materials listed in the JEM.

Agents	JOB CODES																	
	C140						C150*						C160					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Cadmium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Chromium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead	1	1	1	1	1	0	1	1	1	1	1	1	0	0	0	0	0	0
Manganese	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Mercury	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Nickel	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Solvents																		
Chlorinated Solvents	1	1	1	1	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Carbon Tetrachloride	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Aromatic Solvents	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Glycol Ethers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Radioactive materials																		
Americium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
External Radiation	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Plutonium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Polonium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Uranium	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Other Isotopes	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Physical Agents																		
Lasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Radiofrequency/ Microwaves	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Ultraviolet Radiation	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Vibration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Degreasers	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Fiberglass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isocyanates	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PBB/PCB	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
Pesticides/Herbicides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Dust/ Silica	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
MOCA	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

* Mobile Craft – These workers were given exposure to asbestos and all radioactive materials listed in the JEM.

Agents	JOB CODES																	
	R000 (Operators)						R010, R012						R030					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manganese	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nickel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solvents																		
Chlorinated Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbon Tetrachloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Aromatic Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glycol Ethers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Radioactive materials																		
Americium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
External Radiation	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Plutonium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Polonium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Uranium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Other Isotopes	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Physical Agents																		
Lasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Radiofrequency/ Microwaves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultraviolet Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vibration	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degreasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fiberglass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PBB/PCB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pesticides/Herbicides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Dust/ Silica	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Agents	JOB CODES																	
	R070						R080						R090, R092					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Manganese	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nickel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solvents																		
Chlorinated Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbon Tetrachloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Aromatic Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glycol Ethers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Radioactive materials																		
Americium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
External Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plutonium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polonium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uranium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Isotopes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical Agents																		
Lasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Radiofrequency/ Microwaves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultraviolet Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vibration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Degreasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fiberglass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PBB/PCB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pesticides/Herbicides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Dust/ Silica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Agents	JOB CODES																	
	R040, R042						R100						R110, R112					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manganese	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nickel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solvents																		
Chlorinated Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbon Tetrachloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Aromatic Solvents	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Glycol Ethers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Radioactive materials																		
Americium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
External Radiation	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Plutonium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polonium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uranium	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Other Isotopes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical Agents																		
Lasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Radiofrequency/ microwaves	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Ultraviolet Radiation	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Vibration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degreasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fiberglass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PBB/PCB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pesticides/Herbicides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Dust/ Silica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Agents	JOB CODES																	
	R120, R122						L000 (Laborers, General Service)						L010					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manganese	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nickel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solvents																		
Chlorinated Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbon Tetrachloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Aromatic Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glycol Ethers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Radioactive materials																		
Americium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
External Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plutonium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polonium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uranium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Isotopes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical Agents																		
Lasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Radiofrequency/ Microwaves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultraviolet Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vibration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degreasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fiberglass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PBB/PCB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pesticides/Herbicides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Dust/ Silica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Agents	JOB CODES																	
	L020, L070						L030*						L040					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manganese	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nickel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solvents																		
Chlorinated Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbon Tetrachloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Aromatic Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glycol Ethers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Radioactive materials																		
Americium	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0
External Radiation	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0
Plutonium	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0
Polonium	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0
Uranium	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0
Other Isotopes	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0
Physical Agents																		
Lasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Radiofrequency/ Microwaves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultraviolet Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vibration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
Degreasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fiberglass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PBB/PCB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pesticides/Herbicides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Dust/ Silica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

* Mobile Craft – These workers were given exposure to asbestos and all radioactive materials listed in the JEM.

Agents	JOB CODES																	
	L050, L060*						L080, L090						L100					
METALS	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990	1940	1950	1960	1970	1980	1990
Arsenic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beryllium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Manganese	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nickel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solvents																		
Chlorinated Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbon Tetrachloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Aromatic Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glycol Ethers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Radioactive materials																		
Americium	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
External Radiation	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Plutonium	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Polonium	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Uranium	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Other Isotopes	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Physical Agents																		
Lasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Radiofrequency/ Microwaves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultraviolet Radiation	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Vibration	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Other Agents																		
Acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asbestos	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Degreasers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fiberglass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isocyanates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Working Fluids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PBB/PCB	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Pesticides/Herbicides	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Rock Dust/ Silica	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Vinyl Chloride	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welding Fumes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

* Mobile Craft – These workers were given exposure to asbestos and all radioactive materials listed in the JEM.

Appendix E Mailing Packet to Former Los Alamos National Laboratory Workers
Report on Mailing to Former Workers

Dear [specific name merged],

We invite you to take part in a new program to examine the health and work exposures of former Los Alamos National Laboratory (LANL) workers. The Department of Energy (DOE) has provided funds to the Johns Hopkins University (JHU) School of Hygiene and Public Health for this project. It is divided into two parts. In Phase I, which lasts for one year, we will do a needs assessment. We will review records and interview workers to find out about the exposures that former workers had while working at LANL, the number of exposed workers, and their health concerns. Based on this information, we will decide if medical screening to detect any health effects from past LANL exposures would benefit former workers. If such screening could help, we will ask DOE for funding for Phase II of this project. If a Phase II project is needed, it would last for 1-4 years and provide medical exams for selected groups of former workers.

The program team is led by faculty and staff from the Johns Hopkins University School of Hygiene and Public Health. The study team also includes investigators from the Health and Safety Fund of the Laborers' International Union of North America, LANL, and the National Jewish Medical and Research Center. Team members were selected for their occupational health experience. A Steering Committee that includes former workers will provide guidance to the team.

In this packet you will find the following materials:

1. **Information pamphlet**

The information pamphlet gives details on the project in a question and answer form.

2. **Postcard**

This should be returned to us if you prefer the questionnaire in Spanish or need more time to fill it out. Since part of this mailing is to find out if we have the correct address for you, we would like the postcard returned if we reached you and you don't have time to finish the questionnaire by the return date.

3. **Authorization for Disclosure Notice**

This is a letter from Dennis Erickson, PhD, Division Director, Environment, Safety and Health, LANL. It informs you about the project and gives you a LANL person to contact if you aren't sure whether any of your answers to the questionnaire might be "classified".

4. **Consent form**

The consent form gives us your permission to join the questionnaire part of the project. Please sign the consent form and return it with your questionnaire. Although it may seem strange to sign a consent form, it is needed since this program is new and considered to be "research" by DOE and JHU.

5. **Questionnaire**

The questionnaire tells us a little about you and your exposures and concerns from your past work at LANL. It should take just a few minutes to fill out. Please make sure you answer only with "unclassified" information as mentioned in Dr. Erickson's letter. If you have information that may be classified, we can provide a Q cleared person to talk with you further.

If you have any questions about the project or the questionnaire, the information pamphlet contains contact addresses and numbers on the last page.

Since we need this information for the Phase II application, we ask that you return it to us by _____. Thank you very much for taking the time to help us with this important program.

Sincerely,

Brian Schwartz, MD, MS
Co-Principal Investigator

Patrick Breysse, PhD
Co-Principal Investigator

Los Alamos National Laboratory (LANL)

Former Workers Medical Screening Program

Phase I - Needs Assessment

Thank you for your interest in this project.

Conducted by

Johns Hopkins University School of Hygiene and Public Health

Los Alamos National Laboratory

Laborers' Health & Safety Fund of North America

National Jewish Medical and Research Center

August, 1998

What is the Former Workers Program at Los Alamos?

The Former Workers Medical Surveillance Program was created by Congress in the Defense Authorization Act of 1993. This Act directed the Secretary of Energy to develop medical evaluation programs for former workers at risk for health problems from exposures they had during work at Department of Energy (DOE) sites. Los Alamos is one of 9 DOE sites that have former worker programs. These programs will help DOE decide how to include former worker medical screening into regular site activities such as medical surveillance for current workers.

The DOE has provided funds to the Johns Hopkins University (JHU) School of Hygiene and Public Health for this program. The program is divided into two parts, Phase I and Phase II. We are currently in Phase I which is a one year needs assessment to find out if former workers may be at a higher risk for illness from past work exposures at DOE sites. If the answer is yes, the program team will decide if medical screening examinations could prevent or lower the risk. If needed, Phase II will provide medical screening examinations to selected groups of former workers over the next 1-4 years.

The goal of Phase I is to find out if former LANL workers may have an increased risk for illness from past work exposures. The goals of Phase II, if needed, are to:

1. notify these workers of the higher risk;
2. offer them medical exams that can improve or prevent worsening of their health; and
3. work closely with LANL health and safety programs for current workers so that high risk workers will continue to be followed when they leave LANL.

Who is on the LANL Medical Screening Program team?

The program team is led by faculty and staff from the Johns Hopkins University School of Hygiene and Public Health in Baltimore, MD. They are doctors, industrial hygienists, nurses, and other occupational health specialists. They will be assisted by investigators with health and safety skills from the Health and Safety Fund of the Laborers' International Union of North America, LANL, and the National Jewish Medical and Research Center in Denver, Colorado. The project will receive important direction from a Steering Committee of former and current workers, community members, and local health officials. An Advisory Committee of occupational health experts will provide advice. The National Institute of Occupational Safety and Health will also be involved through their review of the needs assessment report.

How will this program benefit me?

The information that you give to us will help develop a list of the exposures that former workers may have experienced over the past 50 years at LANL. We will also learn about any concerns you may have. This will help identify health risks for you and your former co-workers since some work-related diseases can appear years after exposure stops. This project will also help to identify risks for current and future workers. The information we gather will be used by the program team, including former workers on the Steering Committee, to decide if a medical screening program is needed. If you are in a group of workers who need exams, you will have a chance to find out more about your health and get answers to questions you might have about past exposures from your LANL employment.

Which sites have the other Former Workers programs?

In 1996, six sites were funded:

- Hanford, Washington
- Nevada Test Site
- Oak Ridge, Tennessee
- Paducah, Kentucky
- Portsmouth, Ohio
- Rocky Flats, Colorado

These sites have finished their Phase I Needs

Assessments and most are entering Phase II.

In 1997, two sites were funded along with LANL:

- Idaho National Engineering and Environmental Laboratory
- Savannah River, Georgia

Which exposures and work groups will be reviewed first in the LANL program?

While we will consider other former workers, Phase I at LANL will start with two groups of former workers: machinists and workers who had exposure to beryllium. Workers who were employed by the University of California and the contractors (ZIA, PanAm, JCI) are included. Other groups of former workers, such as those with past exposure to asbestos, noise, degreasing agents, and lead, will be included as time and resources allow. During Phase I, we will review existing exposure and health information and suggest ways to identify former workers who may be at higher risk. We will meet with former workers to learn about their past exposures and work practices and current concerns. Questionnaires will be sent to former workers to gather this information as well. All this information will be used to find out if further follow-up is needed. If needed, we will apply for funds to perform medical screening exams for selected groups of former workers in Phase II.

How did you find me?

You may be receiving this packet because you contacted us after reading the notices we placed in the LANL reading rooms, on the Internet and in Union newsletters. You also may have heard of our project through other former workers. If we found you, it was through DOE or Union records that we searched for this project.

If I choose to participate, what will I have to do?

First, you simply sign the consent form and fill out the questionnaire. If you agree to allow us to contact you in the future, just check yes to that on the questionnaire. This would involve answering more questions on health and past exposures. We will select a small group of former workers for these additional questions. This can be done over the phone, by questionnaire or in person. Phase II, if needed and funded, would involve medical screening but we are not asking you to agree to that now.

Are there any risks to me from participating in this program?

No, this program has no risks to you. You may refuse to participate in this project. If you choose to participate, there is no financial cost to you and you may withdraw at any time. These decisions will not harm any LANL benefits you receive. All information will be kept confidential and secure as noted below.

How will my privacy be protected?

Health researchers will need access to personnel records for this program. Information that could be used to identify individuals, such as name and social security number, will remain confidential and be protected from public disclosure to the fullest extent of the law. This information is protected in four ways: (1) the Federal Privacy Act of 1974 limits the release of sensitive information, including personal identifiers, from federally held records; (2) certain State privacy laws may limit the release of this information held by contractors; (3) researchers under contract to the Federal Government, including DOE, are bound by the terms of their contracts to safeguard this information; and (4) DOE, NIOSH, and other Federal Agencies require that researchers follow the requirements of an Institutional Review Board to protect the health, safety, and records of individuals in research studies.

Will I violate any secrecy agreements if I participate?

The questionnaire in this packet has been reviewed and approved by LANL personnel in Security. Please do not answer any questions that you are concerned about. If you have information that may be classified and need further information please contact: The Classifications Office at 505-667-5011.

assessment?

Results for the Phase I Needs Assessment will be reported to former workers and other interested individuals and organizations. The results may also be distributed as health bulletins throughout DOE, as news releases to the media, and as publications in scientific and public health journals.

Who can I contact if I have additional questions?

The program principal investigators are:

Dr. Brian Schwartz, Director
Division of Occupational and Environmental Health
Johns Hopkins University
School of Hygiene and Public Health
615 N. Wolfe Street., Room 7041
Baltimore MD 21205
410-955-4130, fax 410-955-1811

Dr. Patrick Breysse, Associate Professor
Division of Environmental Health Engineering
Johns Hopkins University
School of Hygiene and Public Health
615 N. Wolfe Street, Room W6010
Baltimore, MD 21205
410-955-3608, fax 410-955-9334

The project e-mail address is:
LANLFWMS@jhsph.edu

The LANL co-investigator contact is:

Laurie Wiggs, PhD
Epidemiology Team Leader
ESH-2, MS D421
LANL
Los Alamos, NM 87545
505-667-8234, fax 505-665-5643

The Laborers' International Union of North America contact is:

Matthew Pacheco
Laborers' International Union of North America,
Local #16
1030 San Pedro N. E.
Albuquerque, NM 87110 505-265-7933

The Los Alamos Area Office contact is:

Rudy Valdez
Safety & Health Team Leader
Los Alamos Area Office
528 35th Street
Los Alamos, NM 87544 505-667-0580

The DOE Albuquerque Operations Office contact is:

Mike Garcia
Industrial Hygiene Team Leader
DOE Albuquerque Operations Office
PO Box 5400
Albuquerque, NM 87185-5400 505-845-6397

The DOE Headquarters contact is:

John Peeters, PhD
Office of Occupational Medicine and Medical Surveillance (EH-61)
US DOE
19901 Germantown Road
Germantown, MD 20874-1290 301-903-5902

Los Alamos National Laboratory

Environment, Safety, and Health Division
P.O. Box 1663, Mail Stop K491
Los Alamos, New Mexico 87545
(505) 667-4218 / FAX: (505) 665-3811

Date: October 28, 1998
Symbol:ESH-DO:98-290

Dear Former Los Alamos Worker:

NOTICE TO PAST EMPLOYEES – AUTHORIZATION FOR DISCLOSURE

This notice provides opportunity to participate in a pilot study funded by the U.S. Department of Energy (DOE). The purpose of the pilot (Phase I) is to evaluate types of exposures that former workers may have had while working at Los Alamos National Laboratory, the numbers of workers potentially exposed, and the health concerns those workers may have. Participation is open to former Laboratory workers employed by the University of California and its contractors.

The study is being conducted by investigators from the School of Hygiene and Public Health at the Johns Hopkins University (JHU) in Baltimore, Maryland; the Los Alamos National Laboratory (LANL); the National Jewish Medical and Research Center (NJM&RC) in Denver, Colorado; and the Laborers' National Health and Safety Fund of North America (LNHSFNA). Information gathered by the investigators will aid in the development of a historical profile for Los Alamos. The information will also be used to determine if a need exists to offer medical examinations or screening (medical surveillance) to selected former workers from Los Alamos in a Phase II program. If a Phase II study is funded, you may be contacted again to answer additional questions or perhaps participate in some type of medical surveillance.

We encourage your full cooperation with project personnel in this important endeavor and appreciate your time and assistance in completing the Phase I study. However, your participation in the Phase I pilot study is entirely voluntary and does not commit you to further participation, including the possible Phase II study. You may choose to withdraw your participation at any time.

If you choose to participate, you need to heed the following instructions. Researchers from the investigation organizations (JHU, LANL, NJM&RC, and LNHSFNA) may request information from you pertaining to your work experiences at Los Alamos. The investigators may request information through a questionnaire administered by telephone or in-person. Note that at the time of termination of employment at Los Alamos, you signed a Security Termination Statement (Form 5631.29) that prohibits you from disclosing to any individual ***any Restricted Data, Formerly Restricted Data, or other classified information*** of which you have gained knowledge, except as authorized by

law, by regulations of the Department of Energy, or in writing by DOE officials empowered to grant permission for such disclosure. You, therefore, are free to provide ***unclassified information only*** to project personnel. If you feel that you have information relevant to this project that may be classified, the project will provide a Q-cleared person for your interview.

Your questions concerning this notice or verification of an investigator should be directed to ***Maureen Cadorette (the John Hopkins University) at 410-955-4587 or Dr. Laurie Wiggs (LANL) at 505-667-8234.***

Questions concerning the classification of information should be directed to the ***LANL Classification Group at 505-667-5011*** before responding to a telephone or in-person questionnaire or interview.

Thank you for your consideration.

Sincerely,

Dr. Dennis J. Erickson, Director
Environment, Safety, and Health Division

DJE/LW/dis

Cy: CIC-10/A150
ESH-DO file

Respondent's Mailing Label

Brian Schwartz, MD, MS
Division of Occupational and Environmental Health
Johns Hopkins University
School of Hygiene and Public Health
615 N. Wolfe Street, Room 7041
Baltimore, MD 21205

Brian Schwartz, MD, MS
Division of Occupational and Environmental Health
Johns Hopkins University
School of Hygiene and Public Health
615 N. Wolfe Street, Room 7041
Baltimore, MD 21205

FOLD ALONG PERFORATIONS FOR EASY REMOVAL.

Title of Project: Development of a Medical Surveillance Program for Former Los Alamos National Laboratory Workers (RPN No. 96-04-23-01)

You are being asked to join a research study. We are asking you to join this study because you are a former worker at Los Alamos National Laboratory (LANL). We are studying workers whose past work may have placed them at increased risk for work-related diseases. If you agree to join this study, we will ask you to fill out the attached questionnaire. This should take only 20 minutes of your time.

There are no physical risks or discomforts to you if you fill out the questionnaire. Your answers will help us to learn about any health concerns that LANL workers had. You do not have to answer any questions that you do not want to answer. Your decision to fill out the questionnaire is voluntary. If you decide not to fill out the questionnaire, none of your LANL benefits will be affected in any way. The information you provide will be kept private to the extent possible by law.

If you have any questions about the study or the questionnaire, you should call the Principal Investigator, Dr. Brian Schwartz at Area code 410-955-4130. If you have any questions about your rights as a research subject, you may call the Joint Committee on Clinical Investigation at Area code 410-955-3008.

Your signature below means that you understand the information given to you about the study and this consent form. If you sign the form it means that you agree to join the study.

PLEASE KEEP A COPY OF THIS CONSENT FORM AND RETURN THE OTHER WITH YOUR QUESTIONNAIRE.

NOT VALID WITHOUT THE COMMITTEE OR IRB STAMP OF CERTIFICATION

Approved By The Joint Committee On Clinical Investigation
AUG 8 1996

PROTOCOL WILL EXPIRE: 5/26/99

RPN NO. 96-04-23-01

Form C (Revised 01/98)

Los Alamos National Laboratory
IRB/HSR Approval
Informed Consent Valid
for Use Through 22 JAN - 99

Subject's signature (including children, when applicable) Date

Signature of Parent or Guardian (when applicable) Date

Signature of Investigator or Approved Designee 10/6/98 Date

Witness to Consent Procedures * Date

* Optional unless subject is illiterate, or unable to sign.

IRB/HSR Approval [signature]
Informed Consent Valid
for Use Through 22 JAN - 99

Questionnaire I
Former Workers at Los Alamos National Laboratory

This questionnaire is designed to help with this project in two ways:

- It will help us identify work-related health concerns that former workers from LANL may have. This information will help us decide if follow-up programs are needed to address these concerns.
- It will provide information that will help us contact you in the future if we need your help with getting more information on your past exposures and your health.

Instructions: (1) Please read and sign the enclosed consent form and return it with your completed questionnaire.
(2) Please complete the questionnaire and return it as soon as possible in the enclosed stamped envelope. Thank you for your help on this important project. Please return by 12/1/98

1. Today's Date: _____/_____/_____
   Month Day Year

2. Please print your name:

   _____
   First Middle Last

3. Please list any other names that you may have used in the past:

   _____

4. Please fill in your date of birth: _____/_____/_____
   Month Day Year

5. What is your age as of today? _____

6. Please fill in your Social Security Number: _____-_____-_____

7. Please list your Z-number if known: _____

8. Please correct any mistakes in your mailing address and home telephone number:

   _____
   Street Apt number

   _____
   City State Zip Code

   _____
   Area code Telephone number

(Please continue to the next page)

9. Have you ever worked for Project "Y", at the Manhattan Engineering District, the Los Alamos Scientific Laboratory or Los Alamos National Laboratory?

_____**No. Thank you for your time. Please return this questionnaire with the consent form in the enclosed envelope.**
_____**Yes, please continue.**

10. About how many years in **total** (military and civilian) did you work at Los Alamos?

Military _____Years, from 19_____ to 19_____

Civilian _____Years, from 19_____ to 19_____.

11. What was the **first** job title (or type of job) that you held at Los Alamos and in which **building** did you work?

_____ Building _____

12. What was the **last** job title (or type of job) that you held before leaving Los Alamos and in which **building** did you work?

_____ Building _____

13. What was the title of the job (or type of job) that you held for the **longest period of time** at Los Alamos and in which **building did you work most of that time**?

_____ Building _____

14. How many years did you work **in the job listed in question 13**? _____Years, from 19_____ to 19_____

15. Are you now or were you ever a member of a Union?
_____No.

_____Yes. Which union or unions? _____

_____

16. What is your race? _____White _____Black _____Asian
_____Native American _____Other

17. What is your ethnicity? _____Hispanic _____Non-Hispanic _____Other

18. What is your sex? _____Male _____Female

(Please continue to the next page)

The next group of questions will help us to gather some medical information.

19. When was the **last time** that you visited your medical doctor?

_____

20. When was your **last chest x-ray** performed? _____

21. When was the **last time** that you had blood tests? _____

    Why was the test done? _____

The next group of questions will help us to find out what concerns former workers may have about their health and/or their past work at the Laboratory.

22. In general, would you say your health is:

    _____Excellent _____Very Good _____Good _____Fair _____ Poor

23. People have different levels of concern about their health because of their work at Los Alamos. How concerned about your health are you?

    - ☐ not at all concerned
    - ☐ a little concerned
    - ☐ very concerned

24. What particular concerns about your health do you have?

_____

_____

25. Please list any concerns that you have heard from other Los Alamos workers.

_____

_____

26. What questions about your health do you have?

_____

_____

_____

(Please continue to the next page)

27. Who do you think should answer your or other Los Alamos workers' questions about health?

_____

_____

28. How should these health questions be answered (for example, in a letter, in a phone call, in a video, some other way)?

_____

_____

29. May we contact you in the future to ask other questions about your exposures and concerns (if any)?

_____No.

_____Yes. If yes, what is the best time and phone number?

Morning ____ Afternoon_____ Evening _____

Day of the week _____

Phone number (if different from the number you listed on the first page)

_____
Area code Telephone number

30. Is there anything else you feel we should have asked?

_____

_____

_____

Thank you for your help with this project.

Forma de Consentimiento al cuestionario de investigación.

Título del proyecto: Desarrollo de un programa de Monitoreo Médico para los antiguos Trabajadores del Laboratorio Nacional Los Alamos. (RPN no. 96 -04- 23- 01)

Se le está pidiendo unirse a un estudio de investigación. Le estamos pidiendo unirse a este estudio porque usted trabajó en el pasado en el Laboratorio Nacional Los Alamos (LANL). Estamos haciendo un estudio acerca de los trabajadores que tengan un mayor riesgo de contraer una enfermedad debido a alguno de los trabajos que hayan realizado en el pasado. Si usted está de acuerdo en unirse a este estudio, le pedimos que llene el cuestionario que está adjunto. Esto le llevará alrededor de 20 minutos de su tiempo.

No hay riesgo físico ni incomodidad para usted al llenar el cuestionario. Sus respuestas nos ayudarán a conocer las preocupaciones acerca de la salud que tienen los trabajadores de LANL.
No tiene que contestar alguna pregunta que usted no quiera contestar. Su decisión de llenar el cuestionario es voluntaria. Si usted decide no llenar el cuestionario, ninguno de sus beneficios en LANL serán afectados de ninguna manera. La información que usted nos proporcione se mantendrá privada dentro de lo posible por ley.

Si tiene usted alguna pregunta acerca del estudio o del cuestionario, puede llamar al investigador principal, Dr. Brian Schwartz, al telefono area (410) 955 -41-30. Si tiene alguna pregunta acerca de sus derechos como sujeto de investigación, puede usted llamar al comité de Investigación Clínica al teléfono area (410) 955- 30-08.

Su firma abajo quiere decir que entendió la información dada a usted acerca del estudio y acerca de esta forma de consentimiento. Si usted firma esta hoja quiere decir que está de acuerdo a unirse al estudio.

POR FAVOR GUARDE UNA COPIA DE ESTA FORMA DE CONSENTIMIENTO Y REGRESE LA OTRA CON SU CUESTIONARIO.

ESTA HOJA NO ES VALIDA SIN EL SELLO DE CERTIFICACION DEL COMITE O DEL IRB

Firma **Fecha**
(Incluyendo niños, cuando sea aplicable)

Firma del padre o Guardián **Fecha**
(Cuando sea aplicable)

Firma del Investigador **Fecha**
(O de la persona designada por él)

Testigo *

*** Opcional a menos que el sujeto sea analfabeta o no pueda firmar**

ESTE PROTOCOLO EXPIRA: 5/26/99

Los Alamos National Laboratory
IRB/HSR Approval Jerry Williams MD by M Mueller
Informed Consent Valid
for Use Through 01/22/99

IRB/HSR Approval Jerry Williams MD
Informed Consent Valid by M Miller
for Use Through 01/22/2000

Cuestionario I

Trabajadores que en el pasado laboraron en el Laboratorio Nacional Los Alamos

Este cuestionario está diseñado para ayudarnos en este proyecto en dos formas:

I. Nos ayudará a identificar posibles problemas de salud relacionados con el trabajo realizado en LANL de los antiguos trabajadores. Esta información nos ayudará a decidir si algún programa de seguimiento es necesario para atender a estas preocupaciones.
II. Proporcionará información que nos ayudará a contactarlo a usted en un futuro en caso de que necesitemos de su ayuda para recabar mas información acerca de su trabajo y su salud en el pasado.

Instrucciones: (1) Por favor lea y firme la forma de consentimiento adjunta y regrésela con su cuestionario completo.
(2) Por favor complete el cuestionario y regréselo tan pronto como le sea posible en el sobre con estampilla adjunto. Gracias por su ayuda en este proyecto tan importante. Por favor regreselo antes del 12 / 1 / 98

---

1. Fecha de hoy _____ _____ _____
   Mes Día Año
2. Por favor escriba su nombre: _____
3. Por favor escriba otros nombres que usted haya usado en el pasado: _____
   _____
4. Por favor escriba su fecha de nacimiento: ____ _____ _____
5. Que edad tiene usted ahora? _____
6. Por favor escriba el numero de su seguro social: _____
7. Por favor escriba su numero de la lista Z, si lo sabe _____
8. Por favor corrija cualquier equivocacion en su dirección, zona postal o número de teléfono de su casa

_____
Calle Apartamento

_____
Ciudad Estado Zona Postal

_____
(Area) Número de Teléfono

(Por favor continúe en la siguiente hoja)

9. ¿ Trabajó usted alguna vez para el proyecto "Y", el distrito de Ingeniería de Manhattan, los Laboratorios Científicos de Los Alamos o el Laboratorio Nacional Los Alamos?

_____ No. Gracias por su tiempo. Por favor regrese este cuestionario con la forma de consentimiento en el sobre que viene adjunto.
_____ Si. Por favor continúe.

10. ¿Alrededor de cuantos años **en total**, (como militar o civil) trabajó usted en Los Alamos?

Militar _____ años, de 19_____ a 19 _____

Civil _____ años, de 19_____ a 19 _____

11. ¿ Cual fué el primer puesto de trabajo (o tipo de trabajo) que usted desempeñó en Los Alamos y en cual edificio trabajó?

Puesto_____ Edificio_____

12. ¿ Cual fue el último puesto de trabajo (o tipo de trabajo) que usted desempeñó antes de dejar Los Alamos y en cual edificio trabajó?

Puesto_____ Edificio_____

13. ¿ Cual fue el puesto de trabajo (o tipo de trabajo) que usted desempeñó **por mas tiempo** en los Alamos y en cual edificio trabajó **la mayoría de ese tiempo?**

Puesto_____ Edificio_____

14. ¿ Cuantos años trabajó usted en el empleo mencionado en la pregunta 13?

_____ años, de 19_____ a 19_____.

15. ¿Es usted o ha sido alguna vez miembro de la unión (el sindicato)?

_____ No
_____ Si. Cual unión o uniones? _____
_____.

16. ¿Cual es su raza? _____Blanca _____Negra _____Asiática

_____ Nativo Americano? _____ Otra

17. ¿ A qué grupo étnico pertenece usted? _____ Hispano _____ No hispano _____ Otro

18. ¿ Cual es su sexo? _____ Masculino _____ Femenino

(Por favor continúe en la siguiente página)

El siguiente grupo de preguntas nos ayudará a recabar alguna información médica

19. ¿ Cuando fué la **última vez** que visitó a su médico?

_____

20. ¿ Cuando fué la **última vez** que le tomaron placas de rayos X de torax?

_____

21. ¿ Cuando fué la **última vez** que le hicieron un análisis de sangre?

_____

¿ Por qué le hicieron el análisis? _____

El siguiente grupo de preguntas nos ayudará a encontrar qué es lo que les preocupa a los antiguos trabajadores acerca de su salud y/o respecto al trabajo desempeñado en LANL.

22. En general usted puede decir que su salud es:

_____ Excelente _____ Muy Buena _____ Buena _____ Regular _____ Mala

23. Las personas tienen diferentes niveles de preocupación referente a su salud por el trabajo en Los Alamos. ¿ Qué tan preocupado está usted acerca de su salud?

____ No me preocupa

____ Me preocupa poco

____ Me preocupa mucho

24. ¿ Que inquietudes en particular tiene usted sobre su salud?

_____

25. Por favor escriba cualquier preocupación que usted haya escuchado de otros trabajadores de Los Alamos.

_____

26. ¿ Que preguntas tiene acerca de su salud?

_____

_____

_____

27. ¿ Qién cree usted que debería contestarle a usted o a otros trabajadores de Los Alamos preguntas acerca de salud? _____

_____

(Por favor pase a la siguiente página)

28. ¿ De qué modo podríamos contestar estas preguntas acerca de su salud? (Por ejemplo, en una carta, en una llamada por teléfono, en video, o de alguna otra manera)_____

_____

29. ¿ Podríamos comunicarnos con usted en un futuro para hacerle otras preguntas acerca de lo que estuvo expuesto? (si lo hay) .

____ No

____ Si. Si su respuesta es si, ¿ cual es la mejor hora para llamarlo y su número de teléfono?

En la mañana_____ A medio día_____ En la tarde_____.

Día de la semana _____.

Número de teléfono (si es diferente al que está en la primera página)

_____

Area Numero de teléfono

30. ¿ Hay algo más que usted crea que deberíamos haberle preguntado?

_____

_____

_____.

Gracias por su ayuda con este proyecto.

Research Questionnaire Consent Form

Project's title: Development of a Medical Surveillance program for former workers of the Los Alamos National Laboratory. (RPN no. 96-04-23-01)

You are being asked to join a research study. We are asking you to join this study because you are a former worker of the Los Alamos National Laboratory (LANL). We are conducting a study of the workers that, because of their past work, have an increased risk of work related disease. If you agree to join this study, we ask you to fill out the attached questionnaire. This will take you around 20 minutes of your time.

There is no physical risk or discomfort to you when you fill the questionnaire. Your answers will help us learn about the concerns that the workers of LANL have about their health. You don't have to answer any question you don't want to answer. Your decision of answering the questionnaire is voluntary. If you decide not to fill the questionnaire, none of your LANL benefits will be affected in any way. The information you provide will be kept private within the limits of law.

If you have any questions about the study or the questionnaire, you can call the Principal Investigator, Dr. Brian Schwartz , at the following number: area (410) 955-4130. If you have any questions concerning your rights as a research subject, you can call the Clinical Investigation Committee at (410) 955-3008.

Your signature below means you understood the information given to you about the study and this consent form. If you sign this form it means you agree to join the study

PLEASE KEEP A COPY OF THIS CONSENT FORM AND RETURN THE OTHER WITH YOUR QUESTIONNAIRE.

THIS FORM IS NOT VALID
WITHOUT THE COMMITTEE
OR IRB CERTIFICATION STAMP

Name and Signature (Including children, when applicable) Date

Signature of the parent or guardian (when applicable) Date

Investigator's signature (or designated person) Date

Witness *

* Optional unless the person is illiterate or unable to sign.

This protocol expires: 5 / 26 / 99

Los Alamos National Laboratory
IRB/HSR Approval Jessy Williams MD
Informed Consent Valid by M Sullen
for Use Through 01/22/2000

IRB/HSR Approval Jerry Williams
Informed Consent Valid by M Miller
for Use Through 01/22/2000

Questionnaire I

Former Workers of the Los Alamos National Laboratory.

This questionnaire is designed to help us with this project in two ways:

* It will help us identify work-related health concerns that former workers of LANL may have. This information will help us decide if a follow-up program is needed to take into consideration this concern.

* This will provide us with information that will help us contact you in the future, in case we need your help to gather more information about your work and health in the past.

Instructions (1) please read and sign the attached consent form and return it with your completed questionnaire.
(2) Please complete the questionnaire and return it as soon as possible in the attached envelope with stamp. Thank you for you help in this important project.
Please return it by 12/1/98.

---

1. Today's date _____ _____ _____
Month Day Year

2. Please write your name:

_____
Name last name

3. Please write other names that you might have used in the past:

_____

4. Please write your date of birth _____ _____ _____
Month Day Year

5. How old are you now? _____

6. Please write your Social Security number _____

7. Please write your number of the Z list, if you know it _____

8. Please correct any mistake in your address, zip code and home phone number:

_____
street apartment number

_____
City State Zip Code

_____
Area Phone Number

(Please continue on the next page)

9. Did you ever work for project "Y," in the engineering district of Manhattan, the Los Alamos Scientific Laboratories or the Los Alamos National Lab?

___No. Thank you for your time, please return this questionnaire with the consent form in the attached envelope.
___Yes. Please continue

10. About how many years in total (as military or civilian) did you work in Los Alamos?

Military _____ years from 19_____ to 19_____

Civilian _____ years from 19_____ to 19_____

11. Which was the first job title (or job type) that you performed in Los Alamos and in which building did you work?
Job title:_____ building _____

12. Which was the **last** job title (or job type) that you performed before leaving los Alamos and in which building did you work?
Job title: _____ building _____

13. Which was the job title (or job type) that you performed for **the longest time** in Los Alamos and in which building?
Job title :_____ building _____

14. How many years did you work in the job of question number 13?

_____years from 19____ to 19_____.

15. Are you now or have you been a Union member?
_____ No
_____ Yes. Which union or unions? _____

16. What is your race ? _____White _____Black _____Asian

_____Native American _____ Other

17. Which is your ethnicity? _____ Hispanic _____non Hispanic

_____ Other

18. Which is your sex? _____Male _____Female

(Please continue on the next page)

The following group of questions will help us collect some medical information.

19. When was the last time you visited your doctor?

_____

20. When was the last time you had chest X rays performed?

_____

21. When was the last time that you had a blood analysis? _____

Why were these analyses performed? _____

The following group of questions will help us find the concerns workers may have about their health and/or the work performed previously in the Laboratory.

22. In general, you can say that your health is:

_____Excellent _____Very Good _____ Good _____Average _____ Bad

23. People have different levels of concern about their health because of their work in Los Alamos. How concerned are you about your health?

_____ Not worried
_____ Worried a little
_____ Very worried

24. What particular concerns do you have regarding your health?

_____

_____

25. Please write any concern you have heard from other workers at Los Alamos

_____

_____

26. What questions do you have about your health?

_____

_____

_____

27. Who do you think should answer you or other Los Alamos workers questions about health?

_____

(Please continue on the next page)

28. How could we answer these questions about your health? (for instance, in a letter, in a phone call, on video, or some other way?_____

_____

29. Could we contact you in the future to ask you other questions regarding past exposures and concerns? (if any)

____NO

____Yes. If yes, which is the best time to call you and your phone number?

_____ In the morning _____ at noon _____ in the evening

day of the week _____

Phone number (if different from the one listed on the first page)

_____

area telephone number

30. Is there something else that you think we should have asked you?

_____

_____

_____.

Thank you for your help with this project.

Mailing to Former Workers

Selection of Participants

As stated in Section 6.4, 500 former employees were randomly selected from the original JCI and UC/LANL epidemiology databases based on their first or last job titles including: machinists, operators, technicians, or staff members and 50 asbestos workers. Also randomly selected were 50 names from an industrial hygiene list of former workers with exposure to beryllium. As previously stated, this strategy allowed us to search for the workers who are the most challenging to locate since they were first hired between 20 and 50 years ago, and to determine the difficulties presented in locating more remote former workers.

Section 6.4 of this report has a detailed description of the pilot study and the steps that were taken to locate the final mailing list for this project. The names and addresses for 282 former workers were obtained in this manner. Seventeen additional former workers who were unable to join the focus groups were asked to complete questionnaires as part of this mailing.

Data Collection Instrument

The introductory packet mailed to the 299 individuals for whom an address was obtained included the following items (forms are included in this Appendix):

(A) introductory letter from the program Principal Investigators
(B) informational pamphlet
(C) an introductory letter from Dr. Erickson, Director, ESH, LANL
(D) consent to fill out the questionnaire
(E) initial questionnaire
(F) postcard to mail back declining participation or requesting the questionnaire in Spanish, if desired

The questionnaire used for the mailing was designed to collect the following information:

(A) a limited work history including first job title, last job title and longest job title held during employment at LANL
(B) a limited work location history based on first job title, last job title and longest job title held during employment at LANL
(C) union information
(D) some information on health care utilization
(E) demographic information
(F) corrected mailing address, other names used in the past, future contact information
(G) self-reported health status and level of concern about health related to work at LANL

(H) open ended questions about health concerns, health questions, who should answer workers questions about health, how should questions be answered, and an opportunity to tell the investigators what should have been asked

The questionnaire used for this mailing differed from the questionnaire used in the focus groups in several ways. First, this questionnaire did not contain a table to rate the level of concern about exposure to agents used at LANL. We attempted to illicit this information through open ended questions. Second, we did not include a list of evaluation methods for medical surveillance programs in this questionnaire. Again, open ended questions were used to obtain information instead of a list of choices. Both methods were used to test their utility in this former worker population. As seen in the results section, similar information was gained through both methods.

7.2.3 Results

The introductory packet was mailed to 299 individuals. The results of this mailing are presented below. There were one hundred and thirty-one responses to the mailing for an overall tracking rate of forty-four percent (44%= 131/299*100). This rate indicates the percentage of former workers who were sent information packets and responded in one of the following ways. Sixty-four respondents answered 'yes" to working at Los Alamos during its fifty-five year history, and completed the questionnaire. Twenty-three respondents answered 'no" to working at Los Alamos, and returned the questionnaire without completing it, as instructed. Three individuals returned the postcard stating that they never worked at Los Alamos. Forty-one respondents returned the postcard stating that they did work at Los Alamos, but were not interested in joining the study. Twenty-five information packets were returned due to insufficient addresses.

There were two hundred and seventy-four persons with good address and the response rate calculations were based on that number. The participation rate was twenty-three percent (23%= 64/274*100). The refusal rate for participation in the project based on this exercise is sixty-seven percent (67%= 41+143= 184/274*100). This refusal rate includes a fifteen percent (15%= 41/274*100) active refusal rate and a fifty-two percent (52% =143/274*100) passive refusal rate. The passive refusal rate includes the non-respondents because it is not possible to know whether they would choose to participate or not. No further attempts were made to contact the non-respondents. Twenty-six respondents or nine percent (9.5%= 26/274*100) were removed from the refusal rate calculations, because it is possible that some of these individuals did work at Los Alamos at some time during its fifty-five year history. Based on telephone calls and e-mail inquiries from recipients of the mailing, it appears that some former workers may have misunderstood Question # 9 and responded that they were not former LANL workers, because they did not work on Project "Y." One former worker pointed out that the question should have asked if a person worked for Project "Y" **or** the Manhattan Engineering District **or** Los Alamos Scientific Laboratory **or** Los Alamos National Laboratory. It is possible that this confusion caused former workers to answer "no" to the question when they really were former LANL workers.

Responses from the Mailing

Type of Response	Number
Questionnaires - completed	64
Postcards- worked at LANL but declined participation	41
Postcards - never worked at LANL	3
Questionnaires - returned - denied work at LANL	23
Total Returned	131
Returned Undelivered	25
Total Mailing	299

Demographic Information

Sixty-four former LANL workers completed and returned the questionnaire. The respondents range in age from forty-seven to eighty-eight years. Fifty-nine percent (59%) of respondents are over seventy years of age. Ninety-four percent (94%) of the respondents are male, ninety-seven percent (97%) are white, and sixty-two percent (62%) are non-Hispanic. These demographics are displayed in tables 1 through 4. Table 5 shows the unions represented by the respondents. Table 6 lists the longest job title held by the respondents during their tenure at Los Alamos.

Table1. Age of Respondents

Age	N (%)
40-49	2 (3.1%)
50-59	3 (4.7%)
60-69	21 (33%)
70-79	30 (47%)
80-89	8 (12.5%)

Table 2. Gender of Respondents

Gender	N (%)
Male	60 (94%)
Female	4 (6%)

Table 3. Race of Respondents

Race	N (%)
White	62 (97%)
Native American	1 (1.6%)
Other	1 (1.6%)

Table 4. Ethnicity of Respondents

Ethnicity	N (%)
Hispanic	6 (9.4%)
Non-Hispanic	40 (62%)
Other	12 (19%)
No Response	6 (9.4%)

Table 5. Unions Represented in Mailing to Former Workers

Name Of Union	N
No Response/No union affiliation	52
Int. Assoc of Machinists	3
Machinists	2
Am Fed of Gov Employees	1
IAH&F Insulators, Asbestos Workers	1
IBEW	1
Int. Mine, Mill, & Smelter Workers	1
Operating Engineers	1
Railroad Operators	1
UAW	1

Table 6. Job Titles of Respondents

Job Titles (Held for the Longest Period of Time)	N
Staff Member, unspecified	11
Machinist	4
No Response	3
Engineer	2
Group Leader	2
Post Doctorate	2
Physicist	2
Asbestos Worker	1
Associate Group Leader	1
Data Process Manager, Ass.	1
Building Engineer	1
Construction Manager	1
Consultant	1
Deputy Group Leader	1

Job Titles (Held for the Longest Period of Time)	N
Engineer, Design & Construction	1
Engineer, Weapons Development	1
Instrument Maker	1
Mach/Mech/Welder	1
Machinist, Instrument Maker	1
Machinist, Tool & Model Maker	1
Military Police	1
Nurse	1
Pattern & Model Maker	1
Range Master/ Counting Technician	1
Record Clerk	1
Research Physicist	1
Research Scientist	1
Security Inspector	1
Staff Member, Chemist	1
Staff Member, Metallurgy Engineer	1
Staff Member, Metallurgist	1
Staff Member, R&D, HE Explosives	1
Staff Member, T-Division	1
Staff Member, Theoretical Physics	1
Staff Member, Weapons Engineering	1
Staff Member, P-4 Group	1
Statistician	1
Operator, Tab Machine	1
Technician	1
Technician, Chemical	1
Technician, Electronic	1
Technician, Mechanical Fabrication	1

Job Titles (Held for the Longest Period of Time)	N
Technician, Physics Laboratory	1
Tool Maker, Industrial	1
Toolroom Attendant	1

Health Care and Health Status

Tables 7 through 9 show that fifty-five respondents (86%) have seen a physician within the last year. Fifty respondents (78%) have had blood tests for various reasons within the last year. Thirty-five respondents (55.5%) stated that these blood tests were performed as part of an annual, routine or yearly physical. Only eighteen respondents (28%) had a chest x-ray within one year, and 36 respondents (56%) reported that their last chest x-ray was over two years ago (n = 28), or they don't recall when their last chest x-ray was done (n = 7), or they never had a chest x-ray (n = 1).

These results are similar to those of the focus groups, in that, ninety percent (90%) of the focus group respondents stated that they had seen a physician within one year or less. In a Chi-square test for homogeneity, the null hypothesis (H_o: the groups are similar) could not be rejected, demonstrating that the groups are similar in respect to their self-reported physician visits ($X^2 = .9945$; df = 2; $p \approx 0.50$). Thirty-seven percent (37%) of focus group respondents reported having had a chest x-ray within the past year. Again, using a Chi-square test for homogeneity, the null hypothesis (H_o: the groups are similar) could not be rejected, demonstrating that the groups are similar in respect to their self-reported most recent chest x-ray ($X^2 = 7.2$; df = 4; $p \approx 0.10$). Seventy percent (70%) of focus group respondents had blood tests within the past year. In a Chi -square tests for homogeneity, the null hypothesis (H_o: the groups are similar) could not be rejected, demonstrating that the groups are similar in respect with respect to their self-reported most recent blood tests ($X^2 = 0.45$; df = 3; $p > 0.95$).

Table 7. Last Doctor Visit

Time Frame	N (%)
≤ 1 year	55 (86%)
≤ 2 years	6 (9.3%)
> 2 years	2 (3.1%)
Don't recall	1 (1.6%)
Never	0

Table 8. Last Chest X-ray

Time Frame	N (%)
≤ 1 year	18 (28%)
≤ 2 years	9 (14%)
> 2 years	28 (45%)
Don't recall	7 (11%)
Never	1 (1.6%)

Table 9. Last Blood Tests

Time Frame	N (%)
≤ 1 year	50 (78%)
≤ 2 years	8 (12.5%)
> 2 years	5 (8%)
Don't recall	1 (1.6%)
Never	0

General Health Status

The results of the mailing to former workers differ slightly from the focus group results as reported below. Table 10 shows the self-reported health status for this group of former workers. There is a range of perceived health status in these responses as was seen in the focus group responses. The main difference between the two groups is forty-two percent (42%) of these respondents rated their health as very good, whereas only twenty percent (20%) of the focus group respondents rated their health as very good. Twenty-one (21%) of the respondents rated their health as fair or poor, but thirty percent (30%) of the focus group respondents rated their health as fair or poor. However, in a Chi-square test for homogeneity, the null hypothesis (H_o: the groups are similar) could not be rejected, demonstrating that the groups are similar with respect to their self-reported general health status ($X^2 = 6.4$; df = 4; $p \approx 0.10$).

Table 11 shows that sixty-one percent (61%) of respondents reported "no concern at all" about their health because of their work. This differs from the focus group results in that only thirty percent (30%) of respondents reported no concern at all about their health because of their work at Los Alamos. Again using a Chi -square test for homogeneity, the null hypothesis (H_o: the groups are similar) was rejected, demonstrating that the groups are not similar with respect to their self-reported level of concern about their health because of work ($X^2 = 14.02$; df = 3; $p > 0.005$). This difference may represent a sampling issue, or it is possible that the discussions in the focus groups heightened each individual's level of concern about their health related to work based on what was said by other focus group members.

Table 10. General Health of Respondents

Health	N (%)
Excellent	10 (16%)
Very Good	27 (42%)
Good	14 (22%)
Fair	10 (16%)
Poor	3 (5%)

Table 11. Level of Concern about Health Because of Work

Level of Concern	N (%)
Not at all concerned	39 (61%)
A little concerned	18 (28%)
Very concerned	6 (9.3%)
No response	1 (1.6%)

Specific Health Concerns and Questions

Table 12 and 13 show that the health concerns and questions of the respondents are similar to those of the focus groups (See section 7, tables 7-7a, 7-7b, and 7-8). These concerns include the effects of aging, cancer, heart disease, lung disease, and exposure related health outcomes.

Table 12. Health and Exposure Concerns of Respondents

Concerns		N	(%)
No health concerns		15	23%
Effects of aging process - e.g. weight gain, Alzheimer's disease		9	14%
Heart disease		8	12.5%
Heart disease, hypertension, arrhythmia	4		
Heart disease & diabetes	1		
Heart disease & hearing loss	1		
Heart disease & prostate	1		
Heart disease, radiation, Be & asbestos exposure	1		
Cancer (Ca) Concern		8	12.5%
Basal cell Ca	1		
Colon & rectal Ca	1		
Colon Ca & Skin Ca	1		
Skin Ca	1		
Susceptibility to Ca	1		
Unspecified Ca - radiation exposure	1		
Used carcinogens - had prostate Ca	1		
No response		6	9.3%
Radiation exposure		4	6.2%
Lung disease		3	4.6%
Lung disease	1		
Lung - scar tissue	1		
Shortness of breath, macular degeneration	1		

Eye problems		2	3.1%
Eye problems	1		
Eye problems & hearing loss	1		
Allergies		1	1.6%
Asbestos removal & low level rad exposure		1	1.6%
Chemical exposure		1	1.6%
Machined Be without protection - no lung problems		1	1.6%
Metals, asbestos, dust & radiation particles		1	1.6%
Prostate		1	1.6%
Side effects of short and long term exposures		1	1.6%
Solvent exposure (trichloroethylene)		1	1.6%
Sport injuries		1	1.6%

Table 13. Health Questions of Respondents

Questions		N	(%)
No health questions		26	41%
No response		11	17%
Cancer (Ca)		5	8%
Skin cancers	3		
Partial colectomy age 38	1		
Was Ca related to work environment	1		
Lung Disease/Problems		3	4.7%
What is the cause of chest problems	1		
Concerns about lungs	1		
What is the cause of lung disease	1		
Aging - arthritis, heart disease		3	4.7%
Benign Prostatic Hypertrophy (BPH)		3	4.7%
Prostate problems	2		
Prostate, colon, coronary	1		
Are current health problems related to work environment?		1	1.6%

Body burden of Pu	1	1.6%
Effects of radiation exposure	1	1.6%
Effects of carcinogens	1	1.6%
Hand shakes more than normal	1	1.6%
Headaches, fatigue, stress	1	1.6%
I hope I am OK	1	1.6%
Is my exercise program OK? What is a reasonable cholesterol level?	1	1.6%
Is radiation exposure related to polycythemia?	1	1.6%
Legally blind, shortness of breath, constant pain, hearing loss	1	1.6%
Live downwind from Hanford - should my family have concerns?	1	1.6%
Questions about health while at LANL and elsewhere	1	1.6%
What studies have been done on the relative health of LANL workers and Los Alamos residents?	1	1.6%

Communicating Health Information

Table 14 shows whom the respondents felt should answer workers questions about health. Unfortunately, twenty-eight percent (28%) of the respondents did not answer the question. Nineteen percent (19%) of the respondents felt that either the Occupational Medicine Group at Los Alamos (LANL) or Los Alamos and/or their personal physician, a contractor or an investigator from this project should answer workers questions about health . Fourteen percent (14%) felt that their personal physician should answer their questions. Three respondents did not want Los Alamos or the Department of Energy (DOE) to answer their questions.

Table 14. Who Should Answer Workers' Health Questions

Responses		N (%)
No Response		18 (28%)
LANL or LANL/personal physician or LANL/contractor		12 (19%)
Los Alamos Occupational Medicine Group	7 (11%)	
Los Alamos, a credible contractor, this study	3 (4.8%)	
Personal physician or Los Alamos	2 (3.2%)	
Workers' personal physician		9 (14%)

Don't know	6 (9.4%)
Department of Energy	4 (6%)
Independent, knowledgeable physician	3 (4.7%)
Doctors (unspecified)	3 (4.7%)
MD in this study	2 (3.1%)
Medical researchers or anyone other than the LANL/DOE group	2 (3.1%)
Specialists in the specific areas of concern	2 (3.1%)
Not particularly concerned	1 (1.6%)
No one	1 (1.6%)
Qualified EH doctors from outside the Laboratory	1 (1.6%)

Table 15 shows the results of the question "how should questions about health be answered?" Twenty-five percent (25%) of respondents felt that questions should be answered by a letter. Eleven percent (11%) felt there should be some form of personal communication with individuals to answer health questions. Twenty-two percent (22%) of the respondents indicated a preference for a combination of communication methods. Several respondents suggested some form of public communication, such as, the mass media or a weekly publication.

Table 15. Answering Health Questions

Responses	N (%)
Letters	16 (25%)
No response	14 (22%)
Face to face, direct contact, in-person, personal interviews, office consultation	7 (11%)
Letter than a telephone call	4 (6.2%)
Telephone call	4 (6.2%)
Anyway	3 (4.7%)
In-person and a letter or a written report	3 (4.7%)
Depends	2 (3.1%)
Letter, mass media	2 (3.1%)
Don't care	1 (1.6%)
Letter, e-mail	1 (1.6%)

Letter, face to face, telephone call	1 (1.6%)
Letter, telephone call, video	1 (1.6%)
Letter, video	1 (1.6%)
No need	1 (1.6%)
Telephone call, in - person interview	1 (1.6%)
Video	1 (1.6%)
Weekly publication	1 (1.6%)

Conclusions from the Mailing to Former Workers

Statistically, the groups were similar with respect to their age distribution ($X^2 = 5.9$; df = 4; $p > 0.25$). The respondents to this mailing were slightly older than the focus group participants but not significantly so.

There was a higher percentage of male respondents (94%) to the mailing versus eighty percent (80%) in the focus groups. In a Chi-square test for homogeneity, the null hypothesis (H_o: the groups are similar) was rejected, demonstrating that the groups are not similar with respect to gender distribution ($X^2 = 4.05$; df = 1; $p > 0.05$). There were six women out of thirty participants (20%) in the focus groups versus four women out of sixty-four respondents (6%) in the mailing. While this is an unusually high percentage of male responders in both groups, the overall gender distribution of the former worker population at Los Alamos is approximately sixty-five (65%) male and thirty-four percent (34%) female for University of California workers. An even greater difference in gender distribution is seen with ZIA/Pan AM/JCI workers (see Table 6-1).

The respondents to the mailing were ninety-seven percent (97%) white versus seventy-seven percent (77%) white in the focus groups. In a Chi-square test for homogeneity, the null hypothesis (H_o: the groups are similar) was not rejected, demonstrating that the groups are similar with respect to race distribution ($X^2 = 2.665$; df = 2; $p > 0.50$). While the percentages were higher in this group, the demographics of this former worker population is approximately seventy-five (75) to eighty (80) percent white. It should be noted that ninety-four percent (94%) of the sample for this mailing was chosen from the original database shown in Table 6-1.

The ethnic distribution of the respondents was sixty-three (63%) non-Hispanic versus forty-seven (47%) non-Hispanic in the focus groups. Again using a Chi-square test for homogeneity, the null hypothesis (H_o: the groups are similar) was not rejected, demonstrating that the groups are similar with respect to ethnic distribution ($X^2 = 5.54$; df = 3; $p > 0.25$). Unfortunately, the ethnicity of the population is not available for comparison.

Eighty-six (86%) of respondents had access to medical care in the past year because

fifty-five out of sixty-four visited a physician in the past year. This finding compares to the focus groups in that ninety percent (90%) of focus group participants visited a physician within the previous year as well. While we did not collect information on the reason for the visits, fifty-five percent (55%) of respondents stated that their laboratory tests were done as part of an annual physical.

Fifty-eight percent of respondents rated their health as excellent to very good. Only thirty-seven (37.3%) of respondents reported being a little or very concerned about their health because of their work as compared to sixty percent (60%) of the focus group respondents. As discussed in the text, these differences may be related to sample selection or the focus group discussions made each individual's concerns more salient.

Finally, although these individuals reported a higher general health status, and did not report as high a level of concern about their health related to their previous work at LANL as did the focus group participants, the health and exposure-related concerns expressed by this group were very similar to those of the focus groups.

Appendix F Worker Notifications at Los Alamos National Laboratory

NOTICE

MEDICAL SURVEILLANCE PILOT PROGRAMS FOR FORMER DOE WORKERS

PURPOSE: In September 1996, pilot medical programs for former Department of Energy (DOE) workers began at six sites (Hanford, Nevada Test Site, Rocky Flats, Portsmouth, Paducah, and Oak Ridge). Four additional awards were made early in fiscal year 1998 to assess medical surveillance needs for former workers at three other sites (Savannah River Site, Los Alamos National Laboratory (LANL), and Idaho Engineering and Environmental Laboratory). Each site-specific program is divided into two phases. Phase I activities over the first year of each project determine the size of selected former worker cohorts (e.g., construction workers, production workers) at each site, assess the nature and extent of health hazards that these former workers encountered while working at DOE facilities, and determine the advisability and need for further follow-up, including medical surveillance. Phase II, if warranted, is funded through continuation awards. Experience with these programs will help DOE to evaluate options for a more comprehensive program for former workers and determine how such a program could be effectively integrated with other site activities.

BACKGROUND: The National Defense Authorization Act for Fiscal Year 1993 directs the Secretary of Energy to develop medical evaluation programs for former workers at risk for work-related adverse health conditions from exposures while employed at DOE sites. The new pilot medical surveillance programs will complement epidemiologic studies conducted by the National Institute for Occupational Safety and Health (NIOSH) and DOE, and ongoing medical surveillance programs for current DOE workers.

TYPE OF STUDY: The pilot program at LANL will focus initially on two groups of former workers: machinists and beryllium exposed former workers. Other groups of former workers will be included as time and resources allow. Phase I of the program will be a needs assessment. During the needs assessment, investigators will review existing information and suggest ways to effectively identify former workers in the selected cohorts who may be at risk from significant exposures received while working at LANL. Investigators will examine exposure and health data, develop viable methods to contact affected workers, estimate the most significant worker hazards, problems and concerns, and recommend approaches for conducting medical surveillance. It is anticipated that Phase I will take approximately 1 year to complete.

CONFIDENTIALITY: Health researchers will need access to personnel records for this program, and sensitive information that could be used to identify individuals, such as name and social security number, will remain confidential and be protected from public disclosure to the extent permitted by law. One or more of four mechanisms protect sensitive information: (1) the Federal Privacy Act of 1974 limits the release of sensitive information from federally held records; (2) certain State privacy laws may limit the release of sensitive information held by contractors; (3) researchers under contract to the Federal Government are bound by the terms of their contracts to safeguard this information, as are researchers under contract to DOE

contractors; and (4) DOE, NIOSH, and virtually all other Federal Agencies require that researchers comply with requirements of an Institutional Review Board (IRB) to protect the health, safety, and records of individuals in the research. The IRB requires that researchers: (1) not use sensitive information to determine rights, benefits, or privileges; (2) take appropriate steps to prevent improper disclosure; and (3) establish administrative, technical, and physical safeguards to prevent unauthorized use or disclosure.

STUDY SPONSORS: The program is funded and managed by DOE through cooperative agreements. DOE and project investigators will receive advice from NIOSH and external advisory groups.

REPORTING RESULTS: Results from the Phase I needs assessments will be reported to the workers and other interested individuals and organizations. The results may also be distributed as health bulletins throughout DOE, as news releases to the media, and as publications in scientific and public health journals.

FOR MORE INFORMATION: The site-specific plan, IRB documentation, other confidentiality agreements, and related information will be available in LANL facility reading rooms.

POINTS OF CONTACT:

Los Alamos National Laboratory:

- Laurie Wiggs, LANL, Epidemiology Team Leader, (505) 667-8234
- Investigators: Dr. Brian Schwartz and Dr. Patrick Breysse, Johns Hopkins University, (410) 955-4037

DOE Los Alamos Area Office:

- Ron Reif, Certified Industrial Hygienist, Certified Health Physicist, (505) 845-5094
- Dave Barber, Certified Industrial Hygienist, (505) 667-3818

DOE Headquarters:

- John Peeters, Office of Occupational Medicine and Medical Surveillance, (301) 903-5902

Los Alamos
NATIONAL LABORATORY
memorandum
Environment, Safety, and Health Division

To/MS: All Employees
From/MS: Dennis J. Erickson, DDESH/K491
Phone/Fax: 7-4218 / 5-3811
E-mail: derickson@lanl.gov
Symbol: ESH-DO:98-043
Date: March 2, 1998

Announcement of Medical Surveillance Pilot Program for Former Los Alamos Workers

We are pleased to announce that the U.S. Department of Energy (DOE) has awarded a grant for a pilot medical surveillance program to examine the feasibility and need to provide medical surveillance for former Los Alamos workers. Phase I of this program, to be conducted this year, will determine the number of workers in selected subsets of the worker population, evaluate and assess the potential health hazards to which these former workers may have been exposed, and evaluate the need to provide suitable medical surveillance as part of a Phase II program. These Phase I activities will require researchers to access and review various current and historical records systems, including personnel, industrial hygiene, medical, and other records that may contain personally identified data. Personal data will remain confidential and protected from public disclosure to the extent permitted by law. Phase I activities will focus initially on former workers who were potentially exposed to beryllium or who were employed as machinists. Other groups of former workers may be included as time and resources permit.

This program is being conducted by a team of researchers led by investigators from Johns Hopkins University. The team also includes researchers from the Laborers Health and Safety Fund of North America and from LANL's Occupational Medicine (ESH-2) and Industrial Hygiene and Safety (ESH-5) Groups.

A copy of the DOE Notice describing this study is available electronically on the ESH Division Home page, or by WEB address:

http://drambuie.lanl.gov/~esh2/medical/reports/medsurveil_doewrk.html.

The notice and the study protocol are available at the Los Alamos Outreach Center and Reading Room located at 1350 Central Avenue, Suite 101 (665-2127).

Questions may be directed to the following points of contact:

Brian Schwartz (410) 955-4130 or Patrick Breysse (410) 955-3602, Johns Hopkins University

Laurie Wiggs (505) 667-8234, Occupational Medicine, LANL

Ron Reif (505) 845-5094 or Dave Barber (505) 667-3818, Los Alamos Area Office, DOE

John Peeters (301) 903-5902, Office of Occupational Medicine and Medical Surveillance, DOE

DJE:LW:dts

Cy: ESH-DO File
CIC-10, A150

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Former Lab and contract workers target of pilot medical surveillance program

The Department of Energy's Office of Occupational Medicine and Medical Surveillance has awarded a $500,000 grant to a team of researchers to begin the first phase of a pilot medical surveillance program. The pilot targets former Lab and contractor workers who worked here from 1943 to the present and may have been exposed to beryllium.

The pilot also targets former machinists who also worked with beryllium or other potentially hazardous materials. If deemed necessary, follow-ups may include suitable medical surveillance for selected groups of the former workers. Time and resources permitting, additional worker groups may be investigated for possible at-risk exposure.

Beryllium is a chemical element used in many industries and manufacturing applications, including the electronics, automobiles, aerospace and nuclear energy industries and nuclear weapons. If inhaled, it may pose a hazard to the upper respiratory tract. Also, irritations may result if skin is in contact with certain soluble beryllium compounds.

The team is headed by Brian Schwartz and Patrick Breysse of the School of Hygiene and Public Health at Johns Hopkins University, and includes other Johns Hopkins researchers and members of the Laborers Health and Safety Fund of North America, a labor union. The Lab is involved through Occupational Medicine (ESH-2) and Industrial Hygiene (ESH-5).

Some of the records the team may look at include, but are not limited to, industrial hygiene, personnel, medical and other historical and personal records. Researchers also will develop methods to identify and contact the affected workers, characterize the level of exposure involved and make recommendations on whether a follow-up, or second phase, is warranted. The first phase of the study is expected to take about a year to complete.

The Laboratory is one of three sites that was selected by DOE to participate in the pilot program this fiscal year, the other two being the Savannah River Site and Idaho Engineering and Environmental Laboratory. Additional research teams are conducting separate pilots at Savannah River and INEL under separate grants. An additional six sites went through this pilot program in 1996, including the Nevada Test Site, Rocky Flats and Oak Ridge.

A copy of the DOE notice and study proposal are available at the Los Alamos Reading Room in downtown Los Alamos, next to the Bradbury Science Museum. The notice also is available online at http://drambuie.lanl.gov/~esh2/medical/reports/medsurveil_doewrk.html on the Environment, Safety and Health (ESH) Division home page. For more information, call Laurie Wiggs of ESH-2 at 7-8234.

--Ternel N. Martinez

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DOE releases proposed cleanup strategy

The Department of Energy has released a draft plan to accelerate the cleanup and closure of 353 projects across the country. The period for public comment on the plan, called "Accelerating Change: Paths to Closure," ends May 1. More information is available in a DOE news release.

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