Former Worker Medical Surveillance Program at Idaho National Engineering and Environmental Laboratory (INEEL) Phase I: Needs Assessment

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EXECUTIVE SUMMARY

Purpose We report the results and analysis of a one year needs assessment study evaluating whether a medical monitoring and risk communication program is justified for former workers at the Idaho National Engineering and Environmental Laboratory (INEEL).

Methods To complete this study, we used available exposure assessment data from paper records and electronic databases and reviewed all studies that had been completed at the plants. We interviewed investigators who have completed or are currently engaged in studies at INEEL. We also gathered "expert" former and current workers to conduct risk mapping sessions and focus groups to obtain in-depth information about the plants. We collected and analyzed responses to a questionnaire that was sent to a stratified random sample of 1,000 former INEEL workers. We obtained employee rosters and basic employment data, to the extent available, from the contractors and other institutions.

Findings Former INEEL workers have had significant exposure to pulmonary toxins (nickel, asbestos, beryllium, and acids), carcinogens (external and internal radiation, asbestos, beryllium, and cadmium), renal toxins (chlorinated solvents and lead), neurotoxins (mercury, solvents and lead), hepatotoxins (carbon tetrachloride and other solvents) and noise. Epidemiologic studies at INEL are lacking. Workers are concerned about previous exposures and are interested in a medical screening and education program. Former workers have good access to health care and engage in periodic health examinations. However, most do not believe that their primary care providers know much about the exposures that they had at INEEL. The focus groups and questionnaire responses also provided useful guidance about how to establish effective risk communication and medical surveillance programs.

The target population for a medical screening program among former INEEL workers is estimated to range from 2,300 to 17,500. This range requires refinement, but the roster with names and addresses that would allow initiation of screening at the lower end of this range is currently available.

Conclusion The findings of this needs assessment study support a targeted medical surveillance program. This conclusion is based on 1) the evidence that large numbers of workers have had significant exposures to detrimental agents, and 2) the need and desire expressed by former workers for a credible targeted program of medical surveillance and education. A health protection and risk communication program should center on workers at risk for 1) cancer, 2) chronic respiratory disease, including chronic obstructive lung disease and the pneumoconioses, 3) kidney and liver disease, and 4) hearing loss. These conditions are amenable to early intervention, amelioration, and/or primary prevention. A risk communication delivered by a credible source will reduce uncertainty and distrust. After participation in the proposed screening program, former DOE workers will have increased real knowledge about their personal health status, what is known about their risks, and how they can promote their own health. We believe that mounting such a program in Phase II will make a tangible contribution to the health of former INEEL workers.

PART I: OVERVIEW

I. INTRODUCTION

In October, 1997, a consortium led by the Oil Chemical Atomic Workers (OCAW) International Union initiated a needs assessment study to evaluate whether former Department of Energy (DOE) workers at the Idaho National Engineering and Environmental Laboratory (INEEL) would benefit from the establishment of a program of medical surveillance. This assessment was conducted under a contract from and with the guidance of the Department of Energy. The OCAW consortium was constituted by Queens College of the City University of New York, the University of Massachusetts Lowell (UMass Lowell), and the OCAW International Union. The needs assessment at the INEEL facility benefited from the experience that the consortium gained in 1996-1997 when we conducted a similar needs assessment at the three gaseous diffusion plants owned by the Department of Energy (Oak Ridge Gaseous Diffusion Plant (K-25), Portsmouth Gaseous Diffusion Plant, and Paducah Gaseous Diffusion Plant).

To conduct this needs assessment, the OCAW/Queens College/UMass Lowell consortium identified the need for four domains of information. These include:

- Exposure characterization for the workforce at INEEL
- Epidemiologic and other health studies, to the extent available
- Educational needs and organizational context for delivery of medical surveillance and risk communication programs
- Demographic profile of target population

These domains correspond to the criteria established by the DOE in its document, Guidance for Phase I Reports and Phase II Applications.

Through a vigorous and focused 12 month effort organized in these domains, we have addressed the specific issues raised by the Department of Energy in determining whether a medical surveillance program is needed and would benefit the targeted populations. These specific issues include characterizing the type and degree of relevant detrimental exposures; defining essential health impacts; defining the size of the target populations, and finally, documenting the need for establishing a program that will combine medical monitoring with risk communication.

To provide answers to these questions in one year was an ambitious task. Unlike several of the other grantees in this program, the OCAW consortium had not been funded previously to conduct a systematic investigation at INEEL facility. Further, unlike some of the other DOE facilities, INEEL has been little studied, so we were unable to utilize much previous work, such as exposure characterization and roster identification. NIOSH is presently conducting INEEL's first systematic health study ever, a cohort mortality study. While its results will be very useful to our project when available, the study is still in progress. Hence, available data from INEEL are quite limited.

On the other hand, we had the great advantage of having excellent access to and high credibility with many members of the workforce that operated INEEL and excellent cooperation of two of the main contractors who operate the site, Lockheed-Martin (LMTCO) and Argonne-West.. Our challenge during the past 12 months has been to harness the enormous knowledge possessed by the DOE workforce in combination with mining available health physics data and limited industrial hygiene records. To the extent possible, we rely upon the knowledge that has been accumulated by NIOSH and the CDC in their studies. As further information from those studies becomes available, we will use this additional information for planning and conducting a medical surveillance program. In particular, if DOE supports Phase II of the program, the NIOSH cohort mortality study will be useful in refining the population at risk and in specifying types and levels of risks that the target population has experienced.

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Throughout the needs assessment process, the OCAW consortium has abided by a central principle of the project: to maximize involvement of rank and file workers from INEEL in all aspects of the conduct of the needs assessment process and the planning of the medical surveillance and risk communication program. We have used this method for several essential reasons. The most obvious is the that rank and file workers are excellent sources of information for identifying the hazards that have existed at INEEL over the past 40 to 50 years. This is especially true since there is a dearth of industrial hygiene data and an absence of epidemiological studies at the site. Second, the study consortium understands that any program planning process will be effective only to the extent to which the so-called recipients of the program are involved. Finally, health protection, the ultimate goal of the DOE Former Worker Medical Surveillance Program, requires workers acting on their own behalf. Beginning to overcome the many years of distrust, uncertainty and ignorance that some workers at DOE facilities have requires an open and participatory process from the very beginning of a medical surveillance program.

This report does not contain an exhaustive list of all of the medical needs that workers at INEEL might have as a result of their occupational exposures. Creating such an exhaustive inventory of all health risks that INEEL workers have or might have was beyond the scope, the mandate and the resources available to the OCAW consortium in the past 12 months. We recognize that the DOE former worker medical surveillance program is pilot in nature and will be limited in funds over the next several years.

Hence, we concentrated on exposures and possible health outcomes that best meet the criteria that DOE has established for this program as reflected in Section 3162 that created the program. Specifically, we have attempted to identify significant exposures, as supported by available qualitative and quantitative data, that have or are likely to produce health impacts that might be alleviated by early detection and/or by communication with the potentially affected workers. There are undoubtedly other exposure-disease relationships expressed in INEEL workers that deserve the attention of the Department of Energy. This would include possible health impacts that have not yet been fully investigated in the workforce; exposures for which data are insufficient to allow judgment about the likelihood of their significance; health impacts that are not amenable to screening or for which early detection does not lead to fruitful intervention. Pursuing these possibilities, however important, was not part of the mandate that we received from the Department of Energy. Nor could we take responsibility for following up these potential or actual occupational risks, given the limited time and resources available to us during this 12 month needs assessment.

This report is organized into two parts to satisfy the competing goals of being succinct and of being substantive. Part I (Introduction, Methods, and Principal Findings) is intended as an overview in order to communicate the principal methods used and the results thereby obtained. This overview distills the more detailed collections and summaries of data which are presented in Part II (Sections 5 through 8). Section 5 provides details about the type and levels of exposures experienced by former workers at INEEL as identified in available industrial hygiene and health physics data and through risk-mapping sessions. Section 6 presents the results of focus groups of former and current INEEL workers in assessing health concerns, evaluating the level of knowledge and perceived risks, and eliciting opinions about how to conduct a medical surveillance program. Section 7 provides the results of a questionnaire sent to 1,000 former INEEL workers to collect information on exposures and current health care. Section 8 summarizes information obtained through construction of community inventories of health care and educational resources. Readers are encouraged to read Part II in detail to gain a full understanding of study methodology and the types of information that underlie the summaries presented in Part I.

II. <u>METHODOLOGY</u>

We employed a number of methods of study during this 12 month needs assessment. These methods were chosen based on the ability to obtain reliable data within a limited time period, the desire to include rank and file workers in the data gathering process, and the need to acquire information that would allow us to plan the risk communication and health service component of a medical surveillance program.

A. <u>Review of Existing Exposure Records</u>

The primary focus of this component of the exposure assessment was to determine, to the extent possible, the nature and intensity of major exposures as a function of building, area, department, and/or job classification. Another primary need was to determine whether we could establish an approach for linking the building, department and exposure data to individuals within the former worker cohort.

The primary documents and data files which were used for this preliminary exposure assessment are listed below. A full listing of the major sources of health physics and industrial hygiene data that we used from the gaseous diffusion sites is provided in Section 5.

Principal Sources of Data for Exposure Assessment

The primary documents / data files which were identified during this preliminary assessment included:

- "Master Update Dump" or MUD Database (1944 1985 External and Internal Radiation Exposure Records)
- 2) Radiation Dosimetry System (RDS) (1986 current External and Internal Radiation Exposure Records)
- 3) Security Information Management System (SECIMS) Database (personnel and work history information)
- 4) Roster Database (Revision of SECIMS being developed by NIOSH)
- 5) Naval Reactor Facility (NRF) Dosimetry Database (1949-1991 External and Internal Exposure Records for NRF Westinghouse employees)
- 6) Naval Reactor Facility (NRF) Work History Database (personnel and work history information for Westinghouse employees)
- 7) Off-Site Dose Reconstruction, Chemical Dose Reconstruction Draft Report, CDC
- 8) Off-Site Dose Reconstruction, Preliminary Assessment, SCA, Inc.
- 9) CDC Dose Reconstruction Database (INELCHEM Database)
- 10) NIOSH, Preliminary Protocol for an Epidemiological Study of Workers at the INEEL
- 11) Occupational Radiation Exposure History of the Idaho Field Office Operations at the INEL, J. Horan
- 12) Annual Health and Safety Division Reports, 1958 1971, USAEC Idaho Operations Office
- 13) ICPP Industrial Hygiene Database (HP-3000 Database, primarily records post 1985)
- 14) CFA System 80 Industrial Records database (1989 current records for TAN, TRA and CFA)
- 15) ICPP Annual and Quarterly Production Reports, (1955 1971)
- 16) CPP Operator Process Make-Up Handbook (contained process chemistry for CPP-601 operations)
- 17) CDC Interview Transcripts (Personnel and Retiree interview transcripts from CDC Database)
- 18) Dosimetry Program Reports (IDO-12007, IDO-12070, ACI-167)
- 19) Work History Database (Dr. Dale Minter, MD) -(location still undetermined).

B. Risk mapping

Risk Mapping is an approach that has been used extensively at industrial facilities as a tool to assist workers and/or joint health and safety committees in determining high risk areas within their facilities. Traditionally, the technique is used to identify current problem areas with a facility and to assist in developing an intervention strategy for resolving the problem areas. For this project, the risk mapping approach was used to map past exposure conditions at INEEL.

In addition to using the mapping process for locating past exposure conditions within the buildings of interest, the method was modified to allow the field researchers to collect semi-quantitative exposure data for each identified exposure of concern. Field researchers also collected data regarding other building and process characteristics (i.e., description of major processes, number of workers in the building of interest, and years of operation).

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Several steps were necessary to develop the risk mapping activity at INEEL. We customized the risk mapping method for use in retrospective exposure assessment. We used the following tools, which we had previously developed at the DOE gaseous diffusion plants, for field use:

Job Exposure Information Sheet to collect job/process/exposure information for each chemical agent identified on the risk map.

Building Characteristics Report Form to allow field researchers to collect descriptive information on the buildings of interest over time (i.e., description of major process, number of workers, and years of operation).

Risk Mapping Training Guidebook to train the field researchers in the risk-mapping technique.

The study consortium, led by UMass Lowell, conducted a two day train the trainer session for the field researchers. The field researchers included OCAW local union worker trainers, local union health and safety representatives, and retirees.

"Experts" were then selected for the initial risk mapping session at each of the three sites. The UMass Lowell, the OCAW International, and OCAW Local Union worked at INEEL together to identify and to assemble an "expert" team of former workers for the initial risk mapping sessions. The "experts" selected for the initial sessions consisted primarily of hourly workers with extensive experience at the site. Several line supervisors were also included in these sessions. "Experts" were not selected at random, but based on their vast amount of site experience and the broad array of job classifications and process buildings where they worked.

The initial risk mapping session focused on the entire INEEL complex and was conducted to assist in determining priority areas for future, more specific, risk mapping sessions. As a product of this session, the expert group produced a list of five primary facilities of highest concern regarding retrospective exposures: CPP, TAN, TRA, CFA and ANL. This list, along with information obtained through review of other monitoring data, was used to identify areas for subsequent risk mapping sessions.

The second round of risk-mapping sessions were specifically conducted to learn more about the priority buildings at each of the facilities that were identified in the initial session. Information was systematically collected utilizing the tools list above: the Job Exposure Information Sheet and the Building Characteristics Report Form.

All of the information obtained for risk-mapping sessions was compiled into a database to allow for assessment of the data.

To date, a total of 20 risk mapping sessions have been conducted. These risk-mapping activities have included approximately 60-70 retirees. In each session, an attempt was made to obtain the participation of representatives from a variety of job titles who worked in the building in question. We succeeded in that we were able to include representatives from supervision, scientists/engineers, HPs, operators, and maintenance crafts.

The findings of the risk mapping sessions are summarized within Section III of Part I of this report and the database report of the data collected from the individual sessions is included in Section V. A breakdown of exposures by building is included within an appendix of Section V.

C. Focus groups

Focus groups of former workers were conducted in order to obtain in-depth information about a variety of issues, including exposures, perceptions of risk, health concerns, health care, and receptivity to a health screening program. The overall design, recruitment strategy, training, and analysis was led by Sylvia Kieding of OCAW International Union and consultant Susan O'Brien, who directs training for the New York Committee for Occupational Safety and Health (NYCOSH). The actual implementation of the focus groups was led by former or current workers from INEEL.

Established OCAW Occupational Safety and Health Education Coordinators (OSHECs) at INEEL were recruited to serve as moderators for the focus group sessions. They were trained using a Moderator Guide specifically developed for this project (available upon request). To prepare, moderators participated in a day long training seminar and role-play. Another OCAW member was recruited and trained to serve as the scribe for each focus group session.

Two focus Groups were held at INEEL on June 22, 1998. A total of 23 people participated in the two focus groups. The sessions were held in the OCAW union hall at INEEL. All participants received a participant information sheet and signed informed consent forms that had been read aloud to the group before the session. The sessions were audio taped with the full knowledge and consent of participants.

The initial focus group at each site was comprised of "experts" selected by the local union officers and OCAW field staff due to their knowledge of the plant and familiarity with plant operations. A second focus group at each site included retired and terminated workers who were randomly selected from employee rosters obtained in the course of the needs assessment.

In a preliminary analysis of the transcripts of focus group sessions, an initial coding scheme of important themes was developed. Ms. O'Brien has undertaken a basic coding and sorting of themes and have provided illustrative quotes from the transcriptions. These are presented in detail in Part VI of this report.

D. Questionnaire Survey

In order to obtain exposure and limited health information from a broad cross-section of the former workforce at INEEL, a questionnaire was developed and sent to a random sample of 1,000 retired and terminated INEEL workers. The base population from which this sample was drawn included a total of 5,154 workers, consisting of 2,140 retirees who currently receive pension from Lockheed-Martin; 2,709 workers terminated by Lockheed-Martin since 1964 (when Lockheed-Martin became the site contractor); and 305 retirees who currently receive pension from Argonne West.

In order to ensure adequate representation from the retirees who had left INEEL in the 1960s and 1970s, we stratified the list of Lockheed-Martin retirees by decade of retirement. We selected all of the retirees on the Lockheed-Martin retiree list from the 1960s and the 1970s (n = 120) and 480 of the 2,020 Lockheed-Martin retirees from the 1980s and the 1990s. This represented a 23.7% random sample of the retirees from the 1980s and the 1990s. In addition, we selected randomly 300 (11%) of the 2709 workers who had been terminated from INEEL from 1994 to the present. Finally, we randomly selected 100 (33%) of the 305 Argonne retirees. Hence, we weighted the sample in favor of retirees (versus terminated workers), especially the earlier INEEL retirees and the Argonne West retirees. This weighting was done in order to ensure that we had maximum information from the group that was likely to have had the most employment during early calendar years of INEEL operation and also probably the highest duration of

employment and. This corresponds to the group that is *a priori* most likely at risk for occupational disease due to employment at INEEL.

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A seven-page questionnaire was developed (Section VII, Appendix A) that requested information on demographic status; history of job title, exposures, and job locations at INEEL; health concerns; current health care; and interest in screening and education. A check list of 35 specific exposures were included in the questionnaire. The questionnaire was approved by the Institutional Review Boards of LMTCO and Queens College of the City University of New York. A copy of the questionnaire was sent to the selected 1,000 individuals with a cover letter signed by Robert Wages (OCAW International President); the local OCAW union president at INEEL; and Steven Markowitz, MD. A second mailing of the same questionnaire with a slightly revised cover letter was sent to non-respondents approximately 6 weeks after the first mailing. Addressed stamped return envelopes were included in each mailing. The questionnaires were sent by first class U.S. mail in order that the letters with incorrect addresses would be returned to the project office.

We report here the preliminary findings from the returned completed questionnaires. We have recently received approval from the Institutional Review Boards of LMTCO at INEEL and Queens College to place telephone calls to former workers who have not responded to either of the mailings of the questionnaire. This will be done later in October in order to improve the response rate and to provide further information about correctness of the current address list that we have for former INEEL workers.

E. Community Inventories

As part of the needs assessment process, we have embarked on developing community profiles, identifying health care, educational, and community service facilities that will be useful in conducting Phase II of the program. This information has been collected by a former INEEL worker who was trained to construct systematic inventories of institutional resources in the communities that related to INEEL. Three specific instruments were developed with the assistance of former and current workers: 1) Health Care Facility Inventory 2) Health Care Provider Inventory, and 3) Community Services/Resources Inventory (available upon request).

These inventories contain essential information to develop strategies for referral of screened individuals for diagnosis and treatment, for provision of workers' compensation assistance, and for designing an effective educational and risk communication program. They also contain useful information for assembling program advisory groups in Phase II of the program. A summary of the inventories is provides in Section VIII of this report. Additional information will be collected according to the specific needs of the implementation phase of the medical surveillance program.

F. <u>Review of Epidemiologic Studies</u>

To our knowledge, there has been no epidemiologic study of the morbidity or mortality experience of INEEL workers. The NIOSH study described previously is the first systematic attempt to collect and analyze such data at INEEL. We obtained the results of a survey of the prevalence of nonmalignant asbestos-related disease among maintenance workers at INEEL that was undertaken in conjunction with a law firm from Texas.

G. Demographic Profile of Target Population

Employee rosters have been obtained from Lockheed-Martin and from Argonne West, the two principal contractors whose former workers we are evaluating for the need for medical screening. We have a list of the names and addresses of retirees currently receiving pensions from either of these two employers. We also have a list of names and address of workers who have been terminated by Lockheed-Martin since 1994.

Available data on retirees from Lockheed Martin include name, current address, and date of retirement. For terminated workers from Lockheed Martin, we have name, address (as of the fate of termination), home telephone number, and date of termination. For Argonne West retirees, we have obtained the name, current address, and home telephone number.

The vital status of the workforce at INEEL is currently under investigation by Utterback and colleagues at NIOSH., who are conducting a cohort mortality study at INEEL for NIOSH. Dr. Utterback, has constructed a roster of employees who ever worked at the INEEL site and has preliminary estimates of the numbers of these workers who have died. He has identified and assembled all available databases into a master database. He emphasizes that the following estimates are crude and are useful for consideration of relative magnitude of the sizes of the groups within the cohort.

III. PRINCIPAL FINDINGS

A. Hazards and Exposure Levels of Former INEEL Workers: Results of Records Review and Risk-Mapping

For the purposes of planning a medical surveillance program, it is most useful to organize the large numbers of diverse exposures encountered at INEEL facilities by principal human organ or organ systems affected. In cases where a health effect has been identified by job operation (e.g. -welding) rather than by single exposure, then job title or operation becomes the tool used to organize health effects. Employing this means of considering hazardous exposures yields Table I-I.

Our knowledge about the magnitude of the exposures cited above derives from several sources:, external radiation monitoring, industrial hygiene data, risk mapping sessions, focus groups, and questionnaire results. All of these methods have limitations, as detailed in Part II of this report. A brief summary of data for the most important exposures is provided in the section: the reader is urged to see the additional description in Part II.

Target Organ/Disease	Exposure Class	Important Examples	Selected Locations
Tuna			
Change ab structure	•		
	Irritants	Hydrofluoric acid	ICPP
lung disease		Hydrochloric acid	ICPP
		Sulfuric acid	ICPP
		Nitric acid	TAN, ICPP
		Cadmium	ICPP
		Welding fumes	TAN, TRA, ICPP
Pneumoconioses	Difference in dust		
1 neumocomoses	Fibrogenic dusts	Asbestos	CFA, Maintenance
Lung concer	C onstanting	Beryllium	TAN,TRA,
Lung cancer	Carcinogens	Asbestos	CFA, Maintenance
		Chromium	ICPP, CFA, TAN
		Welding	TAN, TRA, ICPP
Genitourinary system			
Renal toxicity	Renal toxins	Lead	CFA, ETR, TAN
		Chlorinated solvents	TAN, TRA
Endocrine			,
Thyroid cancer	Ionizing radiation	Ionizing radiation	ICPP
Hematopoietic system			
Leukemia	Benzene	Benzene	ICPP, TAN
Nervous System	CNS toxins	Mercury	ICPP. TAN
Cognitive dysfunction		Lead	CFA. ETR TAN
	•	Chlorinated solvents	TAN TRA
		e.gtrichloroethylene	
Gastrointestinal system	Hepatoxicity	Chlorinated Solvents	TAN TRA
Hepatitis		e.gcarbon tetrachloride	
Hearing	Noise	Noise	CFA TRA TAN
<u>Cardiovascular system</u>	Hypertension	Lead	CFA FTR TAN
	- •		ULA, LIK, IAN

 Table I-I

 Important Classes of Exposures at INEEL by Target Organ

A.1 External and Internal Radiation

The primary source of personnel external and internal exposure data is the MUD database (1950 – 1985) and the current database, the predecessor to MUD, the Radiation Dosimetry Records (RDR) database (1986 – present). The MUD database includes lifetime, cumulative, external radiation dose data for 49, 480 individuals. The MUD database will be obtained to identify those individuals exceeding established threshold for screening (i.e., 5 rem, 10 rem, 20 rem). In addition, an attempt will be made to determine whether a dosimetry file (developed by I. Aoki) can be retrieved.

Preliminary review of the Horan Occupational Radiation Dose Report (Horan, 1993) indicates that over 250 individuals from ICPP received in excess of 5 rem lifetime external dose. This report also suggests that the site with the greatest cumulative doses was the ICPP. The highest individual lifetime dose recorded is 79.1 rem. The highest ten individual lifetime doses ranged from 61.5 to 79.1 rem. It should be noted that none of these individuals were involved in any of the 4 accidents identified above. During risk mapping several individuals mentioned that "during the early years" it was common practice to not wear a

dosimeter when the worker was likely to be approaching the regulatory limit. A 1969 Annual Health and Safety Report (IDO-12073) includes a summary of exposures from 1960 through 1969 and concludes "the occupational crafts receiving the highest exposures were mechanics, reactor technicians, and pipe fitters". This seems consistent with the Horan report findings. The number of workers exceeding the radiation protection guidelines (varied from 15 rem/yr to 5 rem/yr) was reported as 12 individuals. These exposures were all the result of accidents.

The Horan report and initial discussions with an individual in the Radiation Records Department suggest that exposure to internal emitters at the INEEL have not been extensive. Other references, along with risk mapping data, suggest that workers at the CPP process buildings and pilot plants had a high potential for internal exposure. (ACI-167) Current plans include reviewing records of dose reconstruction work that has been done (approximately 300 individuals). An assessment of the MUD data file will also be performed to determine if there is any association between internal dose monitoring (i.e., # of urine samples/yr, # of WBCs, etc) and cumulative external dose.

Finally, selection of individuals for medical screening should be based on lifetime doses (as recorded in the MUD database or the RDR database) based on a threshold lifetime dose. Further investigation will be conducted to determine who and where internal exposures were encountered and, if possible, to determine approximate magnitudes of lifetime doses associated with internal exposures.

A.2 <u>Beryllium</u>

The most broad-based use of beryllium on the INEEL site identified during this preliminary exposure assessment study was the use of beryllium as a reflector for neutrons in several reactors (MTR, ETR, ATR, EBR-II, ZPPR, ANP project, EBOR). The CDC chemical dose reconstruction report notes that in 1990 a SARA report indicates an inventory of 45,455 pounds of Beryllium Oxide. (CDC, 1998) It appears that the majority of this material exists as solid bricks used as reflectors in the various reactors around the INEEL site.

During the risk mapping sessions it was determined that beryllium machining was performed at various buildings at the INEEL site. Based on the preliminary review performed during this assessment the following buildings were identified as having including beryllium machining and or hand filing: TAN-607, ATR, ETR, MTR, WRRTF, and TRA-653. The job classifications associated with the reported exposures include: Machinists (Experimental Machinists (TAN) and Machinists (TRA)), Mechanics, Pipe fitters, Equipment Operators, Process Operators and Reactor Operators. The exposures reported associated with the ATR, ETR, and MTR were associated with the instillation of new beryllium during shutdown. During a risk mapping session, it was also indicated that in the TAN-607 (New Machine Shop) beryllium blocks were cut with a chop saw for purposes of disposal. In this case no protective equipment was being used.

In addition to beryllium machining and hand filing for use within reactors at INEEL, a review of the IH System 80 database identified building CF-689 as an area where beryllium surveys were being performed. Further review of the survey data sheet indicated that CF-689 Room 128 had been used for "Beryllium Thermocouple Fabrication" and that the operations performed included "trim, weld, and splice, braze and solder". The decontamination work and subsequent IH surveys were performed in 1989. However, no current information is available regarding the time frame of the beryllium thermocouple fabrication work.

A broad-based approach to defining the group potentially exposed to beryllium is recommended since published data (Newman 1989, Kreiss 1996) demonstrate that while there are job-related and exposure-related elevated risks for chronic beryllium disease (CBD), individuals with low-level exposure can be affected. For this reason a two-tiered approach is recommended based on exposure groupings.

For beryllium exposure at the facilities reviewed an attempt was made through the use of risk mapping to identify locations and job titles which were associated with beryllium use. Since the risk

mapping efforts for this preliminary assessment focused on priority areas and buildings, we were not able to review all areas where beryllium was used. Locations and job titles relating to beryllium use are provided in Section V.

A.3 Lead

Potential exposure to and handling of lead was performed throughout the site. The primary use of lead on the site was as shielding materials, such as lead sheeting, lead pellets, and shot used for shielding and lead pipes. The lead shop at the CFA (CFA-687) was the only area identified where lead was melted and poured (recycling lead shielding). The lead shop housed two oil fired bottom poured lead pots along with accessory molds and pouring tables. Additionally, one instance where lead powder was used to repair cracks in shielding at the ETR reactor.

Risk mapping reports indicated that handling of shielding at the reactor facilities (including hand filing, sawing, etc.) was a common practice due to frequent changes in shielding configuration for various experiments housed at the reactor facilities. The handling of lead did not usually involve the use of PPE (especially during instillation when radiation issues were not a concern).

Limited quantitative data are available from several decades ago. The 1962 Annual report indicates that a "serious lead fume exposure condition occurred in a construction area". The incident involved nine lead burners working in a confined space at the bottom of a cement basin. Airborne levels of 30-85 times the TLV ($0.2 \text{ mg}/\text{m}^3$) were identified by IH staff. Maximum blood lead level was determined to be 0.097 mg Pb / dl of blood; average urine was identified to be 0.416 - 0.600 mg Pb / liter of urine. Three of the men developed clinical symptoms of lead intoxication. The report also noted that these workers had performed similar type of work for many years.

Overall, the results of the risk mapping performed during this preliminary assessment identified the following buildings to be associated with potential high exposure to lead: CF-665 (Big Shop), CF-649 (Lead Shop), CPP-630 (Old Maintenance Building), TAN-607 (Hot Shop and Hot Cells), TAN-607 (Weld Shop), TR-603 (MTR reactor), TR-642 (ETR Reactor), and TRA-653 (Old Machine Shop). In addition, we identified the following job classifications to be associated with potential high exposure to: body men, decon techs, laborers, machinist, mechanics, pipe fitters, lead burners, process operators, and welders.

A.4 Mercury

At the ICPP, mercuric nitrate was used as a catalyst for the dissolution process (aluminum clad fuel elements). The mercuric nitrate was added to the dissolution process from the process make-up floor of the CPP-601 building. Reportedly, most of the mercury remained in solution with the raffinate, which was then sent to the WCF building for calcining. A safety analysis from 1963 estimated that 20% of the mercury introduced into the WCF with the feed might be vaporized and released to the air in the off-gas. For "commonly processed waste" this was estimated to yield concentrations of approximately 0.007 mg/m³ (TLV for mercury vapor is currently 0.05 mg/m³). IH data for the WCF building was not identified. (CDC)

Mercury was also used at the TAN facility in association with the ANP program. The mercury was used during the testing of the D102A turbojet engine reactor system and was used for shield augmentation. A large mercury spill in 1958 was detected during routine health physics surveys 30 years later in 1988. A removal action was performed in 1995. (CDC CHEM) During risk mapping activities, retirees recalled frequent "small" spills of less than 1 gallon of mercury along the rail tracks and within the building (TAN-607). The CDC report also references interviews with past ANP workers who estimated that total mercury used during the ANP project to be approximately 50 tons.

Overall, the results of the risk mapping performed during this preliminary assessment identified the following buildings to be associated with potential high exposure to mercury (or mercuric nitrate): CPP-601, CPP-633, CPP-630, CPP-602, and TAN-607. In addition, the following job classifications were

identified to be associated with potential high exposure to mercury: helpers, decon technicians, hot shop technicians (TAN-607), and instrument technicians.

A.5 <u>Cadmium</u>

Cadmium exposures were reported as cadmium sulfate and cadmium nitrate within the Chemical Processing Plant. The cadmium compounds were reportedly used as "poisons" added to the process during dissolution of fuel elements. The cadmium compounds were reportedly used only for the zirconium clad fuel elements from the Naval Nuclear Reactor program. Originally, this process was housed within CPP-601 (the E-Cell) and was later moved to an upgraded facility known as the FAST facility (CPP-666) in 1985. The primary exposures reported were associated with the process make-up area. Based on discussions with current workers and retirees it was determined that a FAST pilot project was conducted within Building CPP-637 (Multi-curie cell) and pilot testing (cold pilot runs – no radioactive material) may have also been conducted in building CPP-627.

Some IH data is available for the FAST process building (HP-3000 Database at ICPP) which, based on a preliminary scan, appears to include primarily results of below detectable limits. A copy of this database has been requested from the contractor and will be reviewed further. Additionally, further investigation is necessary to determine whether cadmium exposures were more extensive during the pilot testing of the FAST process. Further investigation is necessary to determine the buildings and job classifications associated with exposure to cadmium. However, based on risk mapping conducted to date, it appears that the following job classifications would have the greatest potential to exposure to cadmium: operators and helpers at CPP.

A.6 Chromium

Chromium exposures were reported during risk mapping sessions from various manufacturing operations. At the Chemical Processing Plant, chromic acid (CrO3 and CrO4) was used within the dissolution process. High exposures were reportedly associated primarily with operations on the Process Make-up floor of CPP-601 and also at CPP-627 and CPP-637. At the Central Facilities Area, high exposures were reported within the machine shop (machining operations) and within the big shop. At the TAN facility, high exposures were reportedly related to machining operations. Overall, the results of the risk mapping performed during this preliminary assessment identified the following buildings to be associated with potential high exposure to chromium compounds: CF-665 (Big shop), CF-640 (Machine Shop), CPP-601, and TAN-607 (Machine Shop). We also identified the following job classifications to be associated with potential high exposure to chromium compounds: helpers, machinists, and body men.

A.7 Hydrofluoric Acid

Hydrofluoric acid exposures were reported during risk mapping sessions for the ICPP facility, especially in the dissolution operations (CPP-601), the FAST dissolution operations (CPP-666), and at CPP-627 and CPP-637. Reportedly HF was also used for dissolution of Zirconium clad fuel elements. We also identified the following job classifications at ICPP to be associated with potential high exposure to HF: operators, helpers, mechanics, instrument technicians, and HP technicians.

A.8 <u>Nitric Acid / Nitrogen Oxide</u>

Nitric acid was primarily reported during risk mapping activities at the CPP facility. Nitric Acid was extensively used during dissolution of aluminum clad fuel elements. Handling of the concentrated Nitric Acid on the Process Make-up floor of the CPP-601 and CPP-633 buildings appears to have been the source of the greatest exposures. Risk mapping participants reported "constant noticeable fumes" on the process make-up floor of CPP-601.

Nitrogen oxides, primarily nitrogen dioxide, are formed during the decomposition of nitrates in the waste solution that is calcined at the WCF building (CPP-633). Overexposures to oxides of nitrogen were reported in 1968 Annual Health and Safety Report.

Overall, the results of the risk mapping performed during this preliminary assessment identified the following buildings to be associated with potential high exposure to Nitric Acid / Nitrogen Oxide (see Appendix B of Section V): CPP-601, CPP-633, CPP-627 and CPP-637, and TAN-607 (Decon Shop). In addition, the following job classifications were associated with potential high exposure to nitric acid /nitrogen oxide: operators, helpers, mechanics, instrument technicians, pipefitters, welders and HP Technicians (all from the CPP facility) and decon technicians (TAN-607).

A.9 Chlorinated Solvents

Chlorinated solvents, especially carbon tetrachloride, methylene chloride, and TCE, were used throughout the site. Uses reported included parts-degreasing and general area decontamination. The facilities where potential high exposures to chlorinated solvents was most frequently reported in risk mapping sessions were the TAN facility and the TRA facility. In particular, the following buildings were associated with potentially high exposure to chlorinated solvents: CPP-602 (Instrument Shop), CF-654 (Paint Shop), TAN-607 (Decon Shop, Pipe Laundry Area, Hot Shop 101), TRA-603 (MTR), and TRA-642 (ETR). The following job classifications were associated with potentially high exposure to chlorinated solvents: instrument technicians (CPP), painters (CFA), mechanics, pipe fitters, welders, laborers, electricians and decon technicians (TAN) and laborers, mechanics, process operators, and reactor operators (TRA).

A.10 Noise

Noise exposures were reported throughout the INEEL site. However, based on risk mapping sessions, the process areas where highest noise levels existed were infrequently occupied. Machine shops at CFA, TRA and TAN were all reported to have high noise levels along with significant occupancy.

The following buildings were reportedly associated with potential high exposure to noise: CF-640 (Machine Shop), CF-649 (Lead Shop/ Old Weld Shop), TAN-607 (Pipe Shop and Machine Shop), TRA-670 (ATR – Diesel Generator Pit), TRA-603 (MTR), TRA-642 (ETR) and TRA-653 (Machine Shop). The following job classifications were associated with potentially high exposure to noise: machinists, mechanics, process operators (TRA), pipefitters (TAN) and welders.

A.11 Asbestos

Asbestos insulation was used extensively in the 1950's when many facilities at the INEEL were initially constructed. Asbestos-containing materials are found in roofing, pipe and vessel insulation, building insulation, gaskets, packing, siding and other building materials. Asbestos exposure may also have occurred in relation to work with asbestos blankets and asbestos gloves. In addition, mechanics working at the CFA Big Shop were exposed to asbestos during brake work on buses and other site vehicles.

Exposure to asbestos was reported at all of the facilities reviewed during risk mapping, especially among the following job classifications: decontamination technicians, instrument technicians, insulators, mechanics, pipe fitters, and operators.

A.12 <u>Welding Fumes</u>

Welding fume exposures were reported throughout the INEEL site. The exposures reported during risk mapping activities include exposures within the maintenance shop buildings and during field work (i.e., maintenance work, new construction work, or system modification work).

The 1969 Annual Health and Safety report mentions a special pulmonary function testing program for 38 welders involved in the LOFT project at the TAN facility. Three individuals in this group were reported to have abnormal results. (IDO-12073)

CF-649 (Old Weld Shop), CPP-630 (Old Weld Shop), TAN-607, TRA-670 (ATR), TRA-603 (MTR), TRA-642 (ETR), and TRA-653.

Overall, results of the risk mapping performed during this preliminary assessment identified the following job classifications to be associated with potential high exposure to welding fumes (see Appendix C and D): machinists, mechanics, pipefitters and welders.

B. Questionnaire Results

The above-cited agent-specific analysis is principally the results of the risk-mapping sessions in combination with limited industrial hygiene and radiation monitoring data. We also sent a questionnaire to a broad cross-section of retirees and terminated workers (n = 1,000) and have, to date, received nearly a 50% response rate. A full description of the methods and results of this questionnaire is available in Section VII in Part II of this report.

A seven-page questionnaire was developed (Section VII, Appendix A) that requested information on demographic status; history of job title, exposures, and job locations at INEEL; health concerns; current health care; and interest in screening and education. A check list of 35 specific exposures were included in the questionnaire. A copy of the questionnaire was sent to the 1,000 individuals that represented a stratified random sample of retirees and terminated workers from INEEL and of retirees from Argonne West

Of the 1,000 questionnaires sent, 62 (6%) were returned by the U.S. Postal Service due to incorrect address. Of the remaining 938 individuals, we received 450 (48%) completed questionnaires. There were 7 questionnaires returned from family members of former INEEL workers indicating that the workers had died.

Most (80%) of the questionnaires respondents were retirees from INEEL or Argonne West. Twothirds of respondents were between ages 60 and 79, with the remaining one-third was evenly divided between workers aged 59 or less or ages 80 and over. Three-quarters (77%) of the respondents live in Idaho. An additional 10% (n=47) of the respondents lived in states that the border with Idaho, including Montana, Wyoming, Nevada, Utah, Oregon, and Washington. Of note is that only 27% (n=111) of respondents had been members of OCAW. Information about membership in other unions at the facility was not requested.

Table I-2 lists the exposures and their reported frequencies on the completed questionnaires. External radiation exposure was reported by almost one-half of the respondents (45%, n=205). One-fifth of respondents reported exposure to acetone, asbestos, and noise. Additional common exposures, defined as greater than or equal to 10% of respondents reporting exposure, were internal radiation, acids (i.e. - nitric, sulfuric, hydrofluoric, and hydrochloric); cutting oils; welding fumes; mercury; and carbon

Chemicals and Agents	No. of Respondents Reporting Exposure	<u>%</u>
External Radiation	205	44.9%
Acetone	yda o shina ana a na sifaa ka ahaa dha dha ahaa ahaa ahaa ka waxaa ahaa ahaa yaya 97	21.2%
Noise	92	20.1%
Asbestos	91	19.9%
Internal Radiation	65	14.2%
Nitric Acid	60	13.1%
Cutting Oils		12.9%
Welding Fumes	57	12 5%
Sulfuric Acid (Battery Acid)	57	12.3%
Mercury	52	11.4%
Carbon Tetrachloride	51	11.2%
Hydrofluoric Acid (HF)	46	10.1%
Hydrochloric Acid (HCL)	45 ⁵⁷¹ - 10 - 10 - 10 - 10 - 10 - 10 - 10 -	9.8%
Heat	41	9.0%
Paint or Paint Thinners	40	8.8%
Cadmium	37	8.1%
Dusts (Wood, Coal, Fibers)	35	7.7%
Beryllium	33	7.2%
Trichloroethane	33	7.2%
Other	32	7.0%
Sodium Hydroxide	30	6.6%
Chlorine	29	6.3%
Copper	29	6.3%
Freon	29	6.3%
Benzene	26	5.8%
Chlorinated Solvents	24	5.3%
Chromium or Chromic Acid	24	5.3%
Methyl Ethyl Ketone (MEK)	24	5.3%
Repetitive Motion, Vibrations	22	4.8%
Nickel	15	3.3%
Silica	15	3.3%
Fluorine	12	2.6%
Methylene Chloride	11	2.4%
Arsenic	n en	1.1%
Acrylonitrile	4	0.9%
Phosgene	4	0.9%

Most Commonly Reported Exposures among Former INEEL Workers

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tetrachloride. Beryllium exposure was reported by 7% of respondents. Cadmium exposure was reported by 8% of respondents.

We also examined how many respondents reported exposure to at least one of the following agents: asbestos, acids (nitric, sulfuric, hydrofluoric, and hydrochloric), beryllium, mercury, chromium, cadmium, nickel, welding fumes, benzene, cutting oils, carbon tetrachloride, trichloroethylene, and trichloroethane. Over one-third (36%) of the respondents reported exposure to at least one of these agents. This percentage increases to 40% if noise is added to the list of exposures. Note that radiation and lead are not included on this list. (Lead was inadvertently omitted from the questionnaire.) Over one-half of questionnaire respondents reported exposure to at least three of the agents on the above-cited list.

Table II-3 provides the breakdown of questionnaire respondents by work site at INEEL. Approximately 1/3 of respondents reported having worked at CFA, TRA, or ICCP. An additional onequarter of respondents reported working at TAM and IF. Of note is that individuals usually worked at more than one site at INEEL so that the exposures occurred over multiple sites.

Table I-3 Facilities Where Questionnaire Respondents Worked

<u>Facility</u>	No. of Respondents Reporting Work	<u>%</u>
CFA	180	39.5%
TRA	172	37.7%
ICPP	171	37.5%
TAN	146	32.0%
IF	118	25.9%
AW	85	18.6%
ARA	56	12.3%
PBF	53	11.6%
RWMC	50	11.0%
NRF	50	11.0%
OMRE	4	0.9%
AEC	2	0.4%
EOCR	2	0.4%
WRF	2	0.4%

We also obtained information about job titles that respondents had over their careers at INEEL. Over 300 job titles have been cited. We are currently aggregating these job titles in order to better characterize common exposures among similar job titles.

C. Nature and Extent of Health Impacts Experienced by INEEL Workers

There has not been any epidemiological study of INEEL workers. The NIOSH cohort mortality study is ongoing, but will not be completed for some time.

The only morbidity survey that we could identify was a cross-sectional study of asbestos-related fibrosis among 119 long-term INEEL workers (≥ 20 years since onset of employment). It was sponsored by a law firm. Chest films were read by a B reader. Of the 119 workers examines, 20 (17%) showed parenchymal and/or pleural scarring on the chest x-ray that was characteristic of previous asbestos exposure. While the validity and representativeness of this survey is difficult to determine, the prevalence of abnormal chest-rays found in the survey is typical for maintenance workers in similar industrial settings. It is also compatible with the common report of asbestos exposure from the risk-mapping sessions and the questionnaire responses.

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D. Educational Needs and Health Concerns of Former Workers

We have two sources of information on the health concerns, health care, and educational needs of former INEEL workers: the focus groups and the questionnaire results.

D.1 Focus Group Results

The focus groups were invaluable in providing insight about how former workers viewed the "significance" of their prior exposures, and their current state of knowledge, health concerns, and health care. Inclusion of 23 workers, most of whom had more than 25 to 30 years of employment at INEEL, provided a broad spectrum of opinion. A wide range of job titles were represented in the groups.

The following themes arose during the two focus group sessions:

- Participants believe a serious health risk exists for them because of unsafe conditions in the industry in the early years (ie. 20 years ago). Concern about cancer was especially high.
- In the early years, the management/government responsible for the facility did not do enough to protect the workers.
- Participants felt angry that physicians at the facility inadequately cared for their occupationally related health concerns.
- Former workers expressed concern for new (current) workers and wanted their experience at INEEL to be safer.

For the purposing of designing a medical surveillance program, the following observations were made about current health care:

• Former workers are generally conscientious about current medical care despite insurance limitations.

- Focus groups expressed trust and a preference for their personal physicians and distrust of occupational physicians.
- Personal physicians do not have enough information about occupationally-related illnesses.
- There was a positive feeling toward participating in a health program.
- Focus group participants expressed very positive feelings about participating in a health program and felt co-workers would feel the same way.

Education about occupational exposures should be provided to the former workers.

- Participants want the health program to portray the nuclear power industry in a positive light
- Former workers may deny that they by have health problems.
- Former workers may distrust the program if it is being run by INEEL or DOE.

As part of Phase I, we have also constructed community inventories of health and community organizations that can be used in planning and implementing Phase II.

Additional detail regarding these issues is provided the complete analysis by Susan O'Brien in Section VI of Part II of this report.

D.2 **Questionnaire Results**

Most respondents reported to be in fine health. Three-quarters of the respondents reported that they had seen a physician during the 12 months prior to completing the questionnaire (n=348, or Y%). Three-quarters of respondents reported having a personal physician. Two-thirds of respondents (n=300, Y%) reported that they have periodic checkups when they are not ill. Indeed, 90% of these respondents who report having regular checkups had a checkup during the 12 months prior to completing the questionnaire. The vast majority of respondents have health insurance (n=392, or 86).

When asked whether they were concerned that their health might have been affected by working at INEEL, 40% (n=164) reported that they were somewhat or very concerned about this issue. The remaining 60% (n=248) reported that they were not concerned that their health was affected by working at INEEL. On the other hand, the majority of the respondents were interested in participating in a medical screening if offered. Nearly 60% of respondents (n=242, or 59%) stated that they were somewhat to very interested in participating in a screening.

The majority of respondents reported that their personal physician knew that they had worked at INEEL. However, when asked if their personal physicians were aware of their specific exposures that they had had at INEEL, the vast majority (295, or 78%) reported that they did not believe that their physician was aware of the specific exposures that they had had at INEEL.

Additional details on questionnaire methods and result can be found in Section VII of Part II of this report.

E. Size of the Target Population

Estimating the size of the target population naturally requires defining what the target population is. In the following section, we provide the rationale for a targeted medical surveillance program that meets the criteria established by the Department of Energy. If requested, we will submit a full plan for Phase II, which will describe in detail the rationale and design of a medical surveillance and risk communication program.

To fulfill the mandate for medical surveillance established by the DOE, we will propose a medical monitoring program designed to detect and to reduce the burden of chronic lung disease, cancer, kidney and liver disease, and hearing loss.

• **Preventive Pulmonary Health** Workers at INEEL are likely to be at increased risk of a variety of lung diseases, including chronic obstructive lung disease, pneumoconioses, and lung cancer. They worked with a variety of irritants, fibrogenic dusts and lung carcinogens (asbestos and beryllium, at a minimum). It is justified to include all workers with significant

exposures to lung irritants, asbestos and beryllium in a medical screening and risk communication program. Since several of these agents were in widespread use at INEEL, large numbers of INEEL workers were likely to have experienced these exposures.

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Cancer Detection program Some former workers had excessive exposure to external radiation and probably to internal radiation as well. Such workers would benefit from a targeted cancer detection and education program.

Hearing Loss While excessive noise exposure occurred at selected parts of the INEEL complex, large numbers of workers were apparently not employed in those areas. For workers who were in those areas, a hearing testing program would be justified and beneficial.

Diseases of Other Organs Exposure to metals and solvents was common at INEEL. Screening for kidney and liver disease would be appropriate for such workers. For leadexposed workers, it may also be useful to examine the bone lead level, in order to determine whether an appreciable exposure occurred in the past. Such information would help determine whether screening for lead-related outcomes is appropriate.

These screening program elements and targeted conditions are entirely consistent with the currently-funded DOE former worker medical surveillance programs at other sires and with the national medical screening protocol established by DOE for this program.

Results of the risk-mapping exercises yield observation on which facilities, buildings and job titles appear to be associated with the greatest likelihood of significant levels of specific exposures. The details were provided in a previous section and also in Section V of Part II of this report. Unlike our work at the gaseous diffusion plants, we do not currently have a former INEEL employee roster that also includes information on facility, building, and job title according to individual employee. We cannot yet sort former employees by these variables that would us to identify a group at highest risk of significant exposure and risk of disease. The roster database that NIOSH is compiling may provide some of this information but probably not for workers who were first hired prior to 1983.

According to the results of the questionnaire, 36% of the sampled workers reported exposure to at least one of the following agents: asbestos, beryllium, numerous acids, TCE, trichloroethylene, (add addl exposures). An additional 4% of workers who did not report any of the above exposures reported noise exposure. Of note is that radiation and lead were not included in the above group of exposures. (Lead was inadvertantly omitted from the questionnaire.) If these two exposures are added, the percentage of workers who reported exposure to at least one of these targeted exposures is probably 45% to 50%. This would be the group that would be targeted for the proposed medical screening program.

We currently have a roster of retirees and terminated (since 1994) workers from Lockheed-Martin and of retirees from Argonne West. The total is 5,154. This is the population, from which we sampled 1,000 people to whom to send a questionnaire. If 45% to 50% are eligible for screening due to exposure as described above, then the size of the population to be screened would be 2,320 to 2,575.

As part of the NIOSH mortality study, Utterback has developed estimates of the number of INEEL employees by major facility and vital status. estimates that there were approximately 105,000 individuals who ever worked at INEEL, including 15,000 to 17,000 Navy sailors who spent some time at the Naval Reactor Facility (NRF). Deleting these sailors leaves a cohort of approximately 90,000 workers. He believes that there were about 5,000 additional workers who ever worked at NRF, not including employees of sub-contractors at NRF. He further estimates that there were roughly 30,000 construction workers, including major and minor construction sub-contractors, who ever worked at INEEL. The range of workers ever employed at Argonne West is 5,000 to 10,000, including 1,800 workers as of 1992. The majority of the remaining workers, that is, 40,000 to 50,000 workers, were principally employed by the

succession of prime contractors, most recently, Lockheed Martin. This estimate includes the 12,000 workers who were employed as of 1992, and the 8,000 who are currently employed.

Dr. Utterback estimates that about 15% of this workforce has died and has identified thus far roughly 10,000 actual deaths, using the National Death Index and SSA records.

As part of the NIOSH database at INEEL, sequential job titles are available for INEEL employees beginning in 1983. Prior to 1983, only initial job titles (at the date of hire) are available. At NRF (which is not part of our project), additional detailed information is available. The IBM tapes that have the dosimetry data have additional information on job location and possible job title, but NIOSH has not yet used these tapes and does not plan to do so in this phase of the cohort mortality analysis. The NIOSH database is not yet ready for use outside of the cohort mortality analysis for which it was created. Estimate date of readiness is mid-1999.

From the NIOSH data, there appears to be a significant number of former workers who may be alive but for whom we have not yet identified the names and addresses for inclusion in the roster of former workers. As noted above, Utterback estimates that there have been roughly 40,000 to 50,000 workers who have been employed by the prime contractors over the history of INEEL, including current workers, who number 8,000 to 10,000. If approximately 15% of these workers have died, it suggests that there should be 25,000 to 35,000 workers who are still alive who are former INEEL workers. If 45% to 50% have had at least one of the targeted exposures, then the size of the group targeted for screening would be in the range of 11,000 to 17,500. This is obviously much higher than the lower range cited above. Many of this discrepancy may be due to the fact that we do not electronic lists of workers terminated prior to 1994. There is considerably more uncertainty attached to the higher part of the range. When NIOSH is able to release its master roster (expected in 1999), some of this uncertainty may be reduced.

It is reasonable to initiate the screening program with the roster of 5,154 workers that we currently have. This roster includes the retirees from Lockheed-Martin and from Argonne West and is, therefore, likely to represent many of the workers with the longest duration of employment at INEEL.

Given the incompleteness of information available at present, the estimate of the size of the population at risk must be regarded as approximate. It is, however, sufficient for planning purposes and can be refined in 1999 when NIOSH data become available.

IV.. NEED FOR MEDICAL SURVEILLANCE AND RISK COMMUNICATION

The results of the 12 month needs assessment study support the need for a medical monitoring and risk communication program. This conclusion is based on the evidence that large numbers of workers had exposures to detrimental agents and the strong need expressed by former workers for a credible targeted program of medical surveillance and education. While there have been no specific epidemiologic studies at INEEL that would inform us about risks, the toxicity of the exposures at INEEL are sufficiently well-known to allow establishment of a rational screening program.

In Phase II, we propose to develop and implement a health protection and risk communication program for INEEL workers centered on the workers at risk for 1) chronic respiratory disease, including chronic obstructive lung disease (COPD) and the pneumoconioses, 2) cancer, 3) kidney and liver disease, and 4) hearing loss. We select these conditions, because they meet the criteria established by the DOE for medical monitoring and risk communication. Our logic is two-fold. First, these diseases are caused by exposures that have occurred at INEEL. Second, a medical monitoring program framed around these conditions can provide tangible benefits. It can lead to early detection of cancer, which can increase survival and quality of life. A well-designed program can identify COPD and the pneumoconioses for which advice about proper treatment (COPD), vaccinations, and prompt treatment of superimposed infections will be highly beneficial. Lung cancer is not yet amenable to early detection through rational screening, but smokers can be enrolled in smoking cessation programs, thereby reducing both occupational

and non-occupational risks. The severity of kidney and liver disease can be reduced by control of other risk factors (e.g. – hypertension and alcohol consumption).

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The risk communication will be a centerpiece of a health protection/medical monitoring program. While there remains considerable uncertainty about the health risks experienced as a result of working at INEEL, this uncertainty must be openly communicated by credible sources. In combination with a medical surveillance program designed to protect health, accurate information about risks will be itself health promoting. We propose the hard outcomes noted above for medical monitoring, in part, because they can be identified with certainty. The health outcomes that we seek to include a monitoring program are highly amenable to screening on a population basis. After participation in the screening program, former INEEL workers will have increased real knowledge about their personal health status, what is known about their risks, and how they can promote their own health. In conclusion, mounting such a program in Phase II should make a tangible improvement in people's lives.

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Section V

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REPORT ON EXPOSURE ASSESSMENT AND RISK MAPPING RESULTS

Appendices:

Appendix A: Risk Mapping Results Appendix B: Risk Map Exposures Appendix C: High Exposure Ranking Matrix Appendix D: Average Dose Factor Matrix

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I. DESCRIPTION OF INEEL FACILITIES

The Idaho National Engineering and Environmental Laboratories (INEEL) (formerly the INEL and the National Reactor Testing Station) was established in 1949 as a place where the US Atomic Energy Commission could build, test, and operate various types of nuclear reactors, allied plants and related equipment. The INEEL has been one of the nation's centers for developing uses for atomic energy. The INEEL site included the world's largest and most varied collection of reactors: research, testing, power, and propulsion.

Centered on a former Naval Proving Grounds which served the Navy's Pocatello (Idaho) Ordnance Depot, the INEEL covers some 572,000 acres of sagebrush land on the Snake River Plains in Southeastern Idaho. Most of the site lies in Butte County although it also extends into Bingham, Bonneville, Jefferson, and Clark Counties. Its 894 square mile size (3/4 the size of Rhode Island) enabled scientists to carry out nuclear experiments that they could not have in a populous area. (Figure 1)

The following sections briefly describe 16 major facilities at the INEEL site. These facilities are as follows:

- 1. Idaho Chemical Processing Plant (ICPP),
- 2. Test Area North (TAN),
- 3. Test Reactor Area (TRA),
- 4. Central Facilities Area (CFA),
- 5. Argonne National Laboratory- West (ANL-W),
- 6. Radioactive Waste Management Complex (RWMC),
- 7. Power Burst Facility (PBF),
- 8. Naval Reactor Facility (NRF),
- 9. Auxiliary Reactor Area (ARA),
- 10. Argonne National Laboratories-West (Original Location which included the Boiling Water Reactor Experiment (BORAX) and the Experimental Breeder Reactor I (EBR-I)),
- 11. Waste Reactor Research Test Facility (WRRTF),
- 12. The Army Above Ground Radiation Testing (ARVFS) program,
- 13. The Idaho Falls Laboratories,
- 14. The Experimental Organic Cooled Reactor,
- 15. The Experimental Dairy Farm, and
- 16. The Naval Ordinance Test Facility (NOTF).

The description of the facilities includes a brief history of the facility, a brief description of the activities at each facility and for those facilities identified as priority facilities (ICPP, TAN, CFA, TRA, and ANL-W), during retiree risk mapping sessions, a more in-depth description of primary buildings of concern and occupational exposures.

Idaho Chemical Processing Plant (ICPP)

Since it began operations in 1953, the ICPP has been the principal facility for the receipt, interim storage and reprocessing of spent nuclear fuels. The ICPP also manages high-level radioactive solid waste from other DOE facilities and all wastes generated at the ICPP. In 1992, DOE announced that the ICPP would no longer process spent fuel although its interim storage function for radioactive wastes would remain. The facility was also directed to develop remediation technologies for radioactive environmental contamination.

The spent nuclear fuels which are stored at the ICPP come from the naval propulsion program and other INEL research reactors including MTR and EBR-II. The fuel is transported to the ICPP by truck where it is unloaded and then placed in storage in either dry containers or in water filled basins.

Fuel processing at the ICPP was initiated in 1952 in the processing plant (CPP-601). By the mid-1980s the facility had multiple capabilities for dissolving several types of nuclear fuels with various cladding

including aluminum, zirconium, stainless steel, graphite and ceramic. In general, the process involves the dissolution of the fuel rod in an appropriate acid followed by liquid-liquid extraction with an appropriate solvent to separate the uranium from the cladding material and the fission products and transuranic elements with which it is associated in the fuel elements. The uranium is then solidified and transported to the Oak Ridge National Laboratory.

Prior to 1963, liquid wastes (containing transuranics and fission products) generated during fuel processing were concentrated by evaporation and stored as liquids in large underground stainless-steel tanks. The Waste Calcining Facility (CPP-633) was constructed in 1963, to convert high-level radioactive liquid waste to more stable, solid, calcined granules, using a fluidized bed process (developed at the ICPP). The waste calcining facility was shut down in 1981, and subsequently replaced with the New Waste Calcining Facility (CPP-659) in 1983. The new process involved spraying liquid waste onto coarse granules in an oven. After the calcine was formed the granules were transported through pneumatic tubes by airstream to underground storage bins.

The ICPP also contains the Rare Gas Plant that recovers krypton-85 from the processing of spent nuclear fuel. The krypton is shipped to Oak Ridge National Laboratory where it is sold for commercial purposes.

A more detailed description of fuel reprocessing and the calcining process are included within section IV of this report.

Test Area North (TAN)

Situated approximately twenty-seven miles north of the CFA in the northern half of the INELs territory, TAN was established in the early 1950's to support the joint Aircraft Nuclear Propulsion program of the US Air Force and the Atomic Energy Commission.

Areas of primary concern at the TAN facility include: the Initial Engine Test (IET) area, the Loss of Fluids Test (LOFT) facility, the Specific Manufacturing Capabilities (SMC) project, the general shops and Hot Cells (TAN-607), and the Hot Cell Annex.

The IET operated from 1961 through 1967 as part of the Space Nuclear Auxiliary Power Transient program. This program investigated beryllium-reflected reactor performance under varying environmental conditions. Between 1966 and 1967, the IET area was inactive. In 1977 the facility was used for decommissioning a reactor from Nebraska. Since 1978 the facility has been inactive.

The Loss-of-Fluid Test reactor was established to perform loss-of-coolant experiments under simulated accident conditions. This reactor was a small-scale model of a commercial pressurized water reactor used to test accident conditions. This facility operated from 1965 through 1975.

The Specific Manufacturing Capabilities (SMC) project produces armor plate from depleted uranium for the US Army. Most of the operations occur in a converted airplane hangar and one other more recently constructed building. This project has been in operation from 1986 to present.

Primary exposures of concern at the TAN facility included: external and internal radiation, mercury (used in IET), beryllium (machining and use in IET, EBOR, and WRRTF), lead, welding fumes, asbestos, and chlorinated solvents.

It should be noted that the SMC facility, currently housed in former IET airplane hanger, was not reviewed as part of this assessment.

Test Reactor Area (TRA)

The Test Reactor Area (TRA) provided facilities for testing the performance of reactor materials and equipment components in environments of high neutron flux, which allowed scientists to obtain information essential for new reactor design. For the most part the experiments involved static irradiation (in capsules) or dynamic irradiations (in loops).

Originally started in the early 1950s, with the building of the Material Test Reactor, the TRA has since seen two additional test reactors built, the Engineering Test Reactor (ETR), as well as the Advanced Test Reactor (ATR). There are currently 80 buildings at the TRA that provide space for reactors, analytical chemistry and radiation laboratories, and maintenance and support service buildings.

The Materials Test Reactor (MTR) was built in 1952, to provide the capability for irradiating fuels and materials test samples and to provide neutron beam sources for basic research. The MTR used a variety of Fuel elements ranging from 20% enriched Uranium – 93% enriched Uranium and Plutonium-239 fuel elements. The MTR was permanently shut down in 1970.

The Engineering Test Reactor (ETR) was constructed in 1957 with full power achieved in 1958. The ETR grew out of the need for more high flux testing space as well as capability of "through the core" testing which allows for irradiations within the high flux area of the core itself. The bulk of this need was for evaluation of fuel, coolant, and moderator characteristics under different environments. The ETR complex also included the Engineering Test Reactor Criticality Facility (ETRC). This reactor was a small-scale version of the ETR that was used to mock up all experiments prior to being run at full power on the ETR. Both the reactor and its associated support facilities have been inactive since 1982.

The Advanced Test Reactor (ATR) was completed in 1965, and initially started up in 1967. The ATR began operation at full power in 1969. The ATR was designed to provide an extremely high neutron flux for a multiplicity of high-pressure loops. The ATR is a light water moderated and cooled system. The ATR complex also included an Advanced Test Reactor Criticality Facility (ATRC) which served a similar purpose as the ETRC. The ATR complex was originally constructed to continue the irradiation programs being performed by the ETR.

Additional facilities at TRA include: 1) the TRA Hot Cells Facility, equipped for the remote handling and metallurgical analysis of radioactive materials; 2) TRA Machine Shop, 3) Gamma Irradiation Facility, and 4) Metallurgical Research Facilities.

Central Facilities Area (CFA)

The CFA is the oldest site at the INEEL complex with some US Navy military activities beginning in the early 1940s. In addition to the various administrative functions presently performed at the CFA, it also includes laboratories, security and fire operations, medical facilities, communications operations, warehouses, vehicle and equipment pools, a maintenance shop, a bus system and laundry facilities. Currently, approximately 1000 people are employed there.

Buildings of particular interest are outlined within section IV.

Argonne National Laboratory-West (ANL-W)

Construction of the Experimental Breeder Reactor-I began in 1949. Since the inception approximately 2000 employees have worked at ANL-W and presently it employs approximately 800 individuals.

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Primary facilities of interest at the ANL-W include: 1) Experimental Breeder Reactor-II (1961-1996), 2) the Fuel Conditioning Facility (FCF), 3) the Hot Cells (Hot Fuel Examination Facility (HFEF) and the Junior Caves), 4) the Zero Power Physics Reactor (ZPPR), 5) the Transient Reactor Test Facility (TREAT), 6) the Fuel Manufacturing Facility (FMF), Machine Shops and Weld Shops. A more detailed description of the primary buildings is included within section IV.

Argonne National Laboratories-West (ANL-W) Original Site

The primary facilities of interest at this site include The Boiling Water Reactor Experiment (BORAX) reactors: BORAX I-V that operated from 1953 through 1964, the Experimental Breeder Reactor-I (EBR-I) which operated from 1949 through 1964, Zero Power Reactor -3, a Hot Cell Facility, a machine shop and a weld shop.

Radioactive Waste Management Complex (RWMC)

The RWMC mission has three primary components: 1) to provide waste management of transuranic contaminated solid, and low-level radioactive wastes, 2) to retrieve, examine, and certify stored transuranic waste for ultimate shipment to the DOE Waste Isolation Pilot Plant in New Mexico; and 3) to provide research and development, including demonstration projects in waste management.

The RWMC began operation in 1952, as a 13-acre disposal site for the burial of solid radioactive waste in trenches. In 1954, the RWMC also began accepting transuranic wastes from Rocky Flats. In 1957, the site was enlarged to 88 acres and from 1960 to 1963, the RWMC accepted beta-gamma waste from private sources.

The Transuranic Storage Area was established in 1970 for interim storage of transuranic wastes and was enlarged to its present size in 1986.

Power Burst Facility (PBF)

The PBF was originally designed for testing transient behaviors of nuclear fuels and performing other safety studies of light-water moderated enriched fuel reactor systems. Four experimental reactors, known as Special Power Excursion Reactor Tests (SPERT) I-IV, were constructed during the 1950s and early 1960s. The last PBF reactor, SPERT IV, was shut down in 1970. The PBF is currently divided into five areas: 1) the PBF control area, 2) the PBF Reactor Area, 3) Waste Engineering Development Facility, 4) Waste Experimental Reduction Facility and 5) Mixed Waste Storage Facility.

SPERT I was constructed in a below grade pit and it began testing in 1956. The reactor was decommissioned in 1964, and the pit demolished in 1985.

SPERT II started operation in 1960, becoming chronologically the third functioning reactor at the PBF. It was designed to study the influence of prompt neutron lifetime on reactor transient behavior by using various moderators, or reflectors. Four years later, in 1964, SPERT II was placed on standby status, and subsequently decommissioned in 1980, when many of its components were removed. The facility was modified in 1986.

SPERT III became operational in 1958. It was designed to study behavior in high-power, high temperature, heterogeneous light water reactors. The reactor was placed on standby status in 1968, and decontaminated in 1980.

SPERT IV became operational in 1961. It was a large pool type facility, built to extend the range and type of controlled test parameters, and to provide a facility for the kinetic testing of reactor cores. The reactor was eventually placed on standby status in 1970.

The present PBF reactor was built in 1970 and was put on standby status in the mid 1980s.

Naval Reactor Facility (NRF)

Located near the center of the INEEL territory, the NRF has been in existence since the laboratory's earliest days. Four major installations originally comprised the NRF: 1) Submarine Prototype (S1W), 2) the Large Ship Reactor (A1W), 3) the Expended Core Facility (ECF), and 4) the Natural Circulation Reactor (S5G). The facility performs research and development for naval propulsion nuclear reactors and serves as a training site for naval nuclear reactor operators. Approximately 800 civilian workers and a comparable number of US Navy personnel are currently employed at NRF.

All employment, and health and safety information for the NRF is maintained independently of other INEL contract organizations. DOE oversight for the NRF is through the Pittsburgh Naval Reactor Office.

Auxiliary Reactor Area (ARA)

The ARA program consisted of four areas, ARA-I through ARA-IV. The program was established in 1957 and ultimately phased out by 1965. The reactors associated with each area are summarized below:

ARA-I – Compact Power Reactor (mobile reactor which could undergo quick shutdown and startup) ARA-II – Stationary Low Power Reactor-I (SL-I) (Reactor accidentally destroyed in '61 killing 3 workers) ARA-III- Army Gas Cooled Reactor Experiment

ARA-IV- Mobile Low Power Plant-I (portable gas cooled, water moderated power reactor)

Idaho Falls Facilities

The INEEL employs approximately 4000 people who work in 35 buildings that are scattered through the city's business district. The primary mission of the Idaho Falls facilities is to provide technical, analytical and administrative support and oversight. These facilities include: INEL Research Center (approximately 480 people), Technical Center (approximately 475 people), DOE Idaho Falls Field Office (approximately 280 people), INEL Supercomputing Center (approximately 250 people), Secured Access Facility, and the Willow Creek Building (approximately 1200 people).

Other Facilities of Interest at the INEEL Site

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Over the history of the INEEL site there were several programs designed to intentionally release radioactive materials to the environment for research purposes including examination of the dispersion of materials, the levels in the environment and the effect on the environment. Several of the major programs are listed below:

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SNAP Transient Program (SNAPTRAN)

UMass / Lowell

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Fission Product Field Release Test (FPFRT)

The Army Above Ground Radiation Testing (ARVFS) program

Controlled Environmental Radioiodine Test (CERT)

These programs were not directly considered during this preliminary assessment however, it is believed that the primary occupational exposures associated with these projects would have been to radiation and therefore personnel exposure data for those individuals involved in these programs would be incorporated in the radiation dose records database.

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II. INEEL ORGANIZATION

Below is a table that gives an overview of the major contractors at the INEEL site since 1949. As will be discussed in more detail later in this report (section III) the large number of contractors along with the frequent change in contractors at many of the facilities adds complexity to the assessment of past health and safety records since each contractor varied in approach.

ICPP	CFA	TRA	TAN	Argonne	NRF	SMC
American	American	American	General	ANL-W	Westinghouse	Rockwell
Cyanamid	Cyanamid	Cyanamid	Electric	University of	(1953-current	INEL
(1950-1953)	(1950-1953)	(1950-1953)	(1950-1953)	Chicago		(1986-1991)
				(1949-current)		
Phillips	Phillips	Phillips	Phillips			Babcock and
Petroleum	Petroleum	Petroleum	Petroleum			Wilcox
(1953-1967	(1953-1967	(1953-1967	(1953-1967			(1991-current)
Idaho Nuclear	Idaho Nuclear	Idaho Nuclear	Idaho Nuclear			
(1967-1972)	(1967-1972)	(1967-1972)	(1967-1972)			
Allied	Arojet	Arojet	Arojet			
Chemical	(1972-1976)	(1972-1976)	(1972-1976)			
(1972-1979)						
Exxon (1979-	EG&G	EG&G	EG&G			
1984)	(1976-1995)	(1976-1995)	(1976-1995)			
Westinghouse	Lockheed	Lockheed	Lockheed			
Idaho Nuclear	(1995-current)	(1995-current)	(1995-current)			
(WINCO)						
(1984-1995)						· · ·
Lockheed						
(1995-current)						<u> </u>

Overall employment on the entire site has gone from approximately 1000 individuals in 1950 to a peak of approximately 13,000 in 1993. Currently the total number of workers at the INEEL site is approximately 8,000.

III. METHODOLOGY

To best summarize the exposures at the INEEL facility three basic approaches were initiated: 1) Risk Mapping of Priority Facilities and Buildings, 2) Exposures Records Review and Assessment, and 3) Development and Dissemination of a Questionnaire to former workers. The approach to each of these items is detailed within this section.

Risk Mapping

Risk Mapping is an approach that has been used extensively at industrial facilities as a tool to assist workers and/or joint health and safety committees in determining high-risk areas within their facilities. Traditionally the technique is used to identify current problem areas within a facility and to assist in developing an intervention strategy for resolving the problem areas. (ref 1,2) For this project the risk mapping approach was used to map past exposure conditions at the identified priority facilities and the priority buildings within those facilities.

In addition to using the mapping process for mapping past exposure conditions within the buildings of interest, the method was also modified to allow the field researchers to collect semi-quantitative exposure data for each identified exposure of concern. In addition, the field researchers were also tasked with collecting data regarding building/process characteristics (i.e., description of major processes, number of workers in the building of interest, years of operation, etc.).

Several steps were necessary in developing and running the risk mapping sessions. The steps were as follows:

- The University of Massachusetts Lowell customized the risk mapping method for use in retrospective exposure assessment. Part of customizing the risk-mapping tool included the development of a "job exposure information sheet" which was used to collect job/process/exposure information for each chemical / agent identified on the risk map. (see Attachment 1) In addition, a "Building Characteristics Report Form" was developed to allow the field researchers to collect descriptive information on the building of interest (i.e., description of major processes, number of workers, years of operation, etc.). (see Attachment 2)
- 2) The University of Massachusetts Lowell in conjunction with the OCAW International staff developed a training guidebook for use in training the field researchers in the technique. The guidebook was constructed to include baseline information regarding the project as well as basic information regarding medical surveillance.
- 3) The University of Massachusetts Lowell in conjunction with the OCAW International conducted a train the trainer for the field researchers. The field researchers for this project included OCAW Local Union worker trainers and Local Union retirees. The train the trainer session was a two-day session to familiarize the field research team with the risk mapping methodology.
- 4) Selection of "experts" for initial risk mapping session for the INEEL complex. The University of Massachusetts Lowell coordinated with the OCAW International along with the OCAW Local Union research teams to assemble an "expert" team of former workers for the initial risk mapping session of the INEEL complex. The "experts" selected for the initial session consisted primarily of hourly workers with extensive experience at the site. Several line supervisors were also available for the "expert" session. While the group did not consist of a typical expert panel which might be assembled by researchers in order to characterize past exposures at an industrial site, the group had a vast amount of site experience and was selected to encompass a broad array of job classifications, facilities, and process buildings of interest.

5) The initial risk mapping session focused on the entire INEEL complex and was conducted to assist in determining priority areas for future, more specific, risk mapping sessions. Facility wide risk mapping results are included within Appendix A. As a product from each of these sessions, the expert group

produced a listing of the primary facilities of concern with respect to occupational exposures at the INEEL and a listing of priority buildings of greatest concern at each of the five primary facilities (CPP, TAN, TRA, CFA, and ANL). These lists, along with information obtained through review of previous research studies, were used to identify areas for future risk mapping sessions. These lists are included below.

- 6) Building specific risk mapping sessions were conducted for priority buildings at each of the facilities. These risk mapping sessions allowed for the collection of the aforementioned data sheets: Job Exposure Information Sheet and the Building Characteristics Report.
- 7) The Job Exposure Information Sheet data along with information from the Building Characteristics Reports were compiled into a database to allow for assessment of the data.

The initial risk mapping session was conducted using an INEEL territory map with the goal of identifying priority facilities within the INEEL complex. Retirees identified major facilities of concern based on past occupational exposures.

The facilities / programs that the retiree group identified as priority were as follows:

- 1) Test Reactor Area (TRA)
- 2) Chemical Processing Plant (CPP)
- 3) Test Area North (TAN)
- 4) Central Facilities Area (CFA)
- 5) Argonne National Laboratories West (ANL-W)
- 6) Radioactive Waste Management Complex (RWMC)
- 7) Power Burst Facility (PBF) and Special Power Excursion Reactors (SPERT)
- 8) ARVFS (Army aboveground radiation tests)
- 9) Naval Reactor Facility (NRF)
- 10) Water Reactor Research Test Facility (WRRTF)
- 11) Auxiliary Reactor Area (ARA)
- 12) Idaho Falls Laboratories
- 13) Experimental Dairy Farm (EDF)

The group identified the first five facilities on the above list (TRA, CPP, TAN, CFA, and ANL-W) as highest priority.

The next step was to identify retirees to perform risk mapping on each of the above five facilities. From this session preliminary data regarding types of exposure which took place in each building was collected. (See Appendix A) After reviewing all of the buildings (that involved possible industrial exposures) the group was asked to develop a list of priority buildings – the buildings they believed to be the locations where chemical/agent exposures posed the highest risks to workers.

Below is a table listing the priority buildings identified within each facility. It should be noted that not all of the buildings identified, as priority buildings were risk mapped in time for inclusion within this report.

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ált. Ar	СРР	TRA	TAN	CFA	ANL-W
1911 (P.1	CPP-633	TRA-603,604	TAN-607	CF-665	ANI -765
	Old Waste	MTR Complex (*)	Manufacturing and	Old Big Shop (*)	Fuel Conditioning
	Calciner (*)		Assembly (*)		Facility
	CPP-601	TRA-642,3,4	TAN-633	CF-621/622	ANL-766.7.8
	Main Process Bldg	ETR Complex (*)	Hot Cell Annex (*)	New Craft Shop	EBR-II
	(*)			Seeding and a second second second	2010 II
	CPP-602	TRA-670	Experimental	CF-667	ANL-787
	Analytical Labs (*)	ATR Complex (*)	Beryllium Oxide	Old Weld Shop	Fuel Assembly and
			Program (*)	F	Storage
	CPP-637	TRA-653	ANP / IET	CF-649	ANL-752
	Process	Machine Shop (*)	Program (*)	Lead Shop (*)	Laboratories
	Improvement				
	Facility				
19 - 02	CPP-666	TRA-635	TAN-604	CF-669	ANL-753
	FAST Process	Material Receiving	Maintenance Bldg	Old Hot Laundry	Maintenance Shop
	Bldg.	Area / Lab	-	2	Shop
, Cha	CPP-630	TRA-662	TAN-667	CF-617	ANL-782
	Old Maintenance	Receiving and	Small Machine	New Hot Laundry	Machine Shop
	(*)	Maint. Bldg	Shop		
			-		
	CPP-663	TRA-632		CF-	ANL-704
	New Maintenance	Hot Cells		New Big Shop	Fuel
					Manufacturing
					Facility
e.	CPP-627			CF-640	
	Remote Analytical		a second and a second and a second second	Old Machine Shop	
	Facility			(*)	
	CPP-684			CF-654	
	Remote Analytical			Old Craft Shop (*)	
	Laboratory			,	
3.14	CPP-640			CF-633	
	Decon Shop			Labs	
	CPP-603			CF-664	
	Spent Fuel Storage			Service Station	

*- Indicates a retiree risk mapping session was conducted for that building.

To date, a total of 20 risk mapping sessions have been conducted. These risk-mapping activities have included approximately 60-70 retirees. In each session an attempt was made to get representatives from a variety of personnel who worked in the building in question. We were successful in that we were able to include representatives from supervision, scientists/engineers, HPs, operators, and maintenance crafts.

The findings of the risk mapping sessions are summarized within section IV of this report and the database report of the data collected from the individual sessions is included in Appendix A. A breakdown of exposures by building is included within Appendix B.

Exposure Records Review and Assessment

The primary documents / data files which were identified during this preliminary assessment included:

- 1) "Master Update Dump" or MUD Database (1944 1985 External and Internal Radiation Exposure Records)
- Radiation Dosimetry System (RDS) (1986 current External and Internal Radiation Exposure Records)
- 3) Security Information Management System (SECIMS) Database (personnel and work history information)
- 4) Roster Database (Revision of SECIMS being developed by NIOSH)
- 5) Naval Reactor Facility (NRF) Dosimtery Database (1949-1991 External and Internal Exposure Records for NRF Westinghouse employees)
- 6) Naval Reactor Facility (NRF) Work History Database (personnel and work history information for Westinghouse employees)
- 7) Off-Site Dose Reconstruction, Chemical Dose Reconstruction Draft Report, CDC
- 8) Off-Site Dose Reconstruction, Preliminary Assessment, SCA, Inc.
- 9) CDC Dose Reconstruction Database (INELCHEM Database)
- 10) NIOSH, Preliminary Protocol for an Epidemiological Study of Workers at the INEEL
- 11) Occupational Radiation Exposure History of the Idaho Field Office Operations at the INEL, J. Horan
- 12) Annual Health and Safety Division Reports, 1958 1971, USAEC Idaho Operations Office
- 13) ICPP Industrial Hygiene Database (HP-3000 Database, primarily records post 1985)
- 14) CFA System 80 Industrial Records database (1989 current records for TAN, TRA and CFA)
- 15) ICPP Annual and Quarterly Production Reports, (1955 1971)
- 16) CPP Operator Process Make-Up Handbook (contained process chemistry for CPP-601 operations)
- 17) CDC Interview Transcripts (Personnel and Retiree interview transcripts from CDC Database)
- 18) Dosimetry Program Reports (IDO-12007, IDO-12070, ACI-167)
- 19) Work History Database (Dr. Dale Minter, MD) Not yet located

Chemical Exposure Data

Overall, quantitative data regarding past chemical exposures appears to be limited. Some quantitative data was included within the Annual Health and Safety reports (1958 – 1971) however, this was very limited. Further efforts are underway to determine whether additional useful information regarding chemical exposures exists, including record searches at the Seattle Federal Records Center and at the Central Facilities Area (CFA) Records Storage Facility. Approximately 33,000 boxes of INEL files are stored either on-site, or at the Federal Repository. To determine whether records useful for the development of a medical screening program exist the following steps will be performed: 1) key word searches of the documents control system database, 2) review of documents identified by NIOSH, and 3) review of the documents coded as relevant to epidemiological and/or health studies. Preliminary searches were performed on the existing CDC INEL database and many documents that were available at the INEEL Technical Library were obtained for this preliminary assessment. Other documents identified are archived at various repositories including the Seattle records center. A list has been identified and efforts are underway to gain access to reviewing box contents.

For purposes of the preliminary assessment, the most useful references included the ICPP Annual Production reports and Safety Analysis reports and the CDC Chemical Dose Reconstruction report and associated database. These references were beneficial primarily in determining the types of primary exposures associated with various operations. This information was used to corroborate information reported by retirees during risk mapping sessions (see Section V).

Additional quantitative data for more recent operations (1985 to current) was identified, and to some extent reviewed, however, the chemicals identified and the associated airborne levels identified may not be indicative of the chemicals and/or exposure levels of earlier time periods.

Table 1 lists chemicals of potential concern, as identified for the INEEL Dose Reconstruction Study and the NIOSH Mortality Study. (RAC for CDC, May 1998)

Radiation Exposure Data

Quantitative data regarding past radiation exposures is much more extensive and available. The document entitled "Occupational Radiation Exposure History of the Idaho Field Office Operations at the INEL" proved to be a very useful document for summarizing radiation exposure data from 1955 through 1991 at INEL. In addition, the project team has requested the Master Update Dump Database. The shortcomings of the data in both of these references appear to be the whole body count and urinalysis/fecal analysis data. While the above summary report suggests that internal doses were insignificant, past Annual Reports, risk mapping and select interviews suggest that internal exposures may be more extensive (especially at the ICPP facility).

The Master Update Dump Database includes two data sets: exp_history (exposure history) and individ_id (individual identification). The individ_id file includes 49,480 unique badge numbers while the exp_hist file includes data for the same number of badge numbers (49,480) however, includes a total of 207,663 observations. These data files include annual dose estimates from 1944 through 1985. The database includes fields for external dose, Beta dose, Neutron dose, Whole Body Count (WBC), Special Whole Body County (SWBC), Urinalysis, Thyroid, and Special Thyroid. These fields, however, only indicate the number of times per year a particular test was performed on an individual (no activity or dose data). This information could be helpful in identifying priority facilities or job classifications (with the assumption that those included in the monitoring programs were at greatest risk of internal exposure). The Individ_id file has fields for craft code and facility code however; it appears that only one entry exists for each person (no work history).

The Radiation Dosimetry Records (RDR) is similar to the MUD database but includes data from 1986 through current. The RDR database includes lifetime exposures, annual exposures, internal dose estimates, urinalysis results, fecal sampling results, and whole body counting results.

These data systems appear to be very useful in estimating individual external lifetime exposures however, the data regarding internal exposures, over the years of primary interest (1944-1975) is insufficient to allow for assignment of a dose estimate to an individual.

INEEL has on file a group of individuals for which internal dose reconstruction was performed (approximately 300 individuals). A summary of this dose reconstruction will be requested from the site contractor.

Table 2 is a comprehensive listing of radionuclides used and/or released at the INEEL site. Primary radionuclides of concern include Uranium, Plutonium, fission products, and activation products.

Several factors, unique to the INEL facility, will make radiation dose assessment more difficult, these include:

- 1. Each individual site contractor designed their Health Physics program to meet the regulations as they interpreted them and to meet their site needs,
- 2. Individual site records more detailed than those submitted to the primary contractor (the records we have access to),

- 3. The regulatory requirements and the respective contractor programs changed over time (this is especially important for internal exposure information which often was only reported if in excess of an administrative or regulatory requirement),
- 4. Work rotation between sites (often from CFA, TRA, or TAN to CPP) to distribute dose would create a situation where a worker assigned to CFA could have received the identified exposure at CPP (more of a problem with respect to internal dose).
- 5. Inclusion in an internal dose-monitoring program was based upon the likelihood that they could develop internal deposition of radioactive materials. From 1958 to 1971 the number of urine and fecal samples analyzed dropped from 10,821 to 114 (Annual H&S Reports). For the most part these samples were analyzed for Gross Alpha and Gross Beta (very little isotope specific sampling).
- 6. Inclusion in a whole body counting program was also based upon the likelihood that an individual could develop internal deposition of radioactive materials, however, the whole body counting was performed at a centralized facility. The number of whole body counts performed per year from 1963 through 1971 appears to be fairly constant at approximately 1300 whole body counts per year (Annual H&S reports).

Criteria for identifying primary exposures

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The basis for determining the primary exposures for purposes of determining the need for a medical screening program for former workers will be the data collected during the risk mapping. For external radiation exposures, lifetime doses as recorded in available database systems will be used as a determining factor.

To analyze the data collected during the risk mapping sessions conducted at the five facilities the following approach was employed:

- Identify chemicals/agents which high level exposures were reported and develop a matrix of job title vs. chemical / agent for reported High exposures (Appendix C). It should be noted that the matrix in Appendix C includes a 'count' of how many times the job title / chemical combination was reported as High during the risk mapping sessions.
- 2) Using the self reported exposure level (High, Medium, Low) and the Frequency assign a "Dose Factor to each Job Title / Chemical combination. To do this we assigned numerical weights to the qualitative values (High = 10, Medium=5 and Low=1) and multiplied that value by the frequency (in hours/day) to obtain a "Dose Factor". A matrix showing "Dose Factors" for each job title / chemical combination is included within Appendix D.
- 3) Extract Job Titles associated with High level exposure to priority chemicals / agents (a listing of job titles is included in the Discussion portion of this document). Note: The "Dose Factor" method described above was used to assure that job titles with the greatest cumulative exposure to a chemical / agent were included. For example; in step 1 a job title associated with High exposures to a chemical but only exposed for 1 hour a day would be included in the analysis whereas a job title with Medium exposure to the same chemical for 8 hours a day would not be included. By incorporating the "Dose Factor" method the second individual is included since he/she would have a "Dose Factor" score of 40 (8 hours * 5).

IV. PRINCIPAL BUILDINGS/PROCESSES AND ASSOCIATED EXPOSURES

This section provides a more detailed description of the buildings and processes at five primary production facilities: ICPP, TRA, TAN, CFA and ANL-W. In addition to building and process description an overview of the primary exposures, number of employees, and job classification is also provided.

Idaho Chemical Processing Plant (ICPP)

Main Process Building (CPP-601)

Building Description

The process building, which operated from 1953 through 1994, contains 25 process cells, numerous corridors, and auxiliary cells that house the equipment and controls for separating uranium from fission products. Much of the processing equipment in the process building is located in heavily shielded cells and must be operated remotely. However, the entire plant was based on a direct-contact maintenance philosophy, i.e., maintenance was performed by direct manual contact during process shutdowns.

The Process Building operations may be divided into several individual steps including: 1) Receipt, handling, and storage of irradiated fuel elements, 2) **dissolution** of the fuel elements in various reagents, 3) **separation** of the unburned uranium from fission products and fuel element structural materials by solvent extraction, 4) salvage or recycle operations of off-specification product, or waste solutions that exceed the disposable fuel concentration limits, 5) Product packaging, storage and shipment, 6) fission product recovery, and 7) waste collection and disposal.

The first step in processing the fuel is the dissolution of the fuel in acid. The types of cladding would to some extent require changes in the dissolution process. The facility processed aluminum, zirconium, stainless steel, and graphite fuel elements (Table I). Intermittently, heel clean-outs consisting of making successive dissolutions without addition of fuel until the U-235 total grams and/or concentration is at a safe level with regard to nuclear criticality concerns. It should be noted that several criticality accidents did occur at the facility over the course of operation with the most significant occurring in October 1959. (Horan, 1993)

Type of Fuel Element **Dissolution Process** Process Make-Up Chemicals Navy Fuel (Zirconium Cladding) Zirconium Dissolution Boric Acid, HF, Nitric Acid. CrO4, Sodium bicarbonate MTR/ATR/ETR Fuel Aluminum Dissolution Nitric Acid, Mercuric Nitrate, (Aluminum cladding) Ammonium Hydroxide, CrO3, Aluminum Nitrate Stainless Steel (EBR-II) Electrolytic Ammonium Hydroxide, Aluminum Nitrate, Nitric Acid, Mercury, Gadolinium, Boric acid Graphite Fuels (Rocket fuels) Fluidized Bed-Combustion -Nitric Acid Nitric Acid Dissolution (with Centrifuge separation)

TABLE I: DISSOLUTION PROCESSES

The next step is the separation of uranium from the fission products and alloying metal by continuous liquid-liquid extraction. The process recovers greater than 99 percent of the uranium and produces a product essentially free of plutonium and with a fission product activity level that permits further processing without shielding. Three extraction cycles are normally required for adequate decontamination. Normally Tributylphosphate (TBP) dissolved in kerosene (NPH) is used as the selective solvent in first cycle extractions. Hexone (Methyl Isobutyl Ketone) is used in the second and third extraction cycles. In the initial extraction, the Uranium is preferentially extracted into the TBP-kerosene solvent, leaving the bulk of the fission products and cladding material (Aluminum, Zirconium, etc.) in the aqueous phase, which is removed as raffinate. The second and third cycle extractions are performed using hexone.

After the separation phase, the raffinate aqueous solution was sent to the Calcining facility (CPP-633) and the uranium in the solvent phase was concentrated in the Evaporator to a concentration of approximately 350 grams U-235 per liter. From here the Uranyl Nitrate solution was either shipped to Oak Ridge as product or run through the denitrating process (CPP-602) to convert the aqueous uranyl nitrate into granule uranium oxide which was subsequently shipped to Oak Ridge.

One of the original cells was modified for the recovery of intensely radioactive fission product Ba-La-140 (the Radioactive Lanthanum (RaLa) Cell) from short-cooled MTR fuel elements. This was known to be the "hottest" operation in the entire ICPP. The RaLa process operated from 1955 through 1963.

Another secondary function performed at CPP-601 was the recovery of the valuable rare gases – Krypton and Xenon.

Primary Exposures

Primary exposures reported include: CrO3 and CrO4, HF, Nitric Acid, Oxalic Acid, Sulfuric Acid, Sulfamic Acid, Aluminum Nitrate, Ferrous Ammonium Sulfate, Ammonium Hydroxide, Gadolinium Oxide, Asbestos, Cadmium Sulfate, Cadmium Nitrate, Calcium Nitrate, Kerosene (NPH), Mercuric Nitrate, Boric Acid, Hexone (Methyl Isobutyl Ketone), Sodium Hydroxide, TBP (Tributylphosphate), Uranyl Nitrate, external radiation, internal radiation, and beta radiation, TCE, Carbon Tetrachloride, and Turco 4502 "Purple Cow" (Potassium Permanganate).

Health Physics Up-grade Report (ACI-167, B.L. Rich, 1974) noted that the CPP-601 Access Corridor is "contaminated routinely to several thousand dpm/100cm². A specific contributing problem is the centrifuge; however, contamination potential exists from each of the cells, which are highly contaminated. The greatest contamination potential exists as a result of spills or during plant shutdown periods when the centrifuge shielding is removed. However, general levels in the corridor during normal operations require protective clothing and contamination control barriers routinely. Significant levels (greater than 10⁵ dpm/100 cm²) of Pu contamination have been identified recently in a number of cells (Cells D, Y, K, etc.)."

Description of Workforce

The workforce included the following: Operators (including operators, operator helpers, and senior operators) (25), Rad Techs (3) and Supervision (3). Maintenance workers performing work in CPP-601 (assigned to the Maintenance Building (CPP-630, CPP-663)) consisted, on average, of Instrument Techs (6), Pipefitters (3), Welders (3), Mechanics (3) and Electricians (3).

CPP Laboratories (CPP-602)

Building Description

CPP-602 houses laboratory facilities for process control, uranium accountability, and research and development. In addition the building contains a product packaging and storage area where uranyl nitrate liquid is either packaged, stored or converted to uranium oxide powder (denitration facility) for shipment (Product packaging area located in the basement of CPP-602). The Product packaging area includes the following processes: 1) Fluidized Bed Denitration, 2) Aqueous Uranyl Nitrate Packaging, 3) Granular Uranium Product Packaging, and 4) Uranium Product Storage and Shipping.

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Primary Exposures

Primary exposures identified during risk mapping activities included: external radiation, internal radiation, flammable solvents, chlorinated solvents (carbon tetrachloride, TCE), beryllium, cadmium, lead, mercury, and acids (Nitric acid, Hydrofluoric Acid).

Radiation samples handled within the labs range from a few mr/hr on contact up to 200 R/hr on contact. No samples were permitted in hoods or glove boxes if the radiation level exceeded 1R/hr at 2 inches. All samples at higher levels would be handled in a laboratory cave. (ACI-167)

Exposure concerns in the Denitration facility include: Pu-238, U-234, U-235, Ru-106 along with Nitric Acid, Uranyl Nitrate, and NO2. (IN-1314, 1969)

Description of Workforce

The workforce consisted of the following: Chemists, Engineers, and Laboratory Technicians.

Waste Calcining Facility (CPP-633)

Building Description

The Waste Calcining Facility was constructed in 1963 and operated until 1981. It was designed to convert high-level radioactive liquid waste to more stable, solid, calcined granules. The Waste Calcining used a fluidized bed process to convert the high level radioactive liquid to a solid. The calcination was done by spraying the waste solution into a bed of alumina particles fluidized with air in the calciner vessel. The solid reaction products from the thermal decomposition of the waste solution build up in layers on the bed particles, while the gaseous products are swept from the vessel with the fluidizing air.

Bed temperatures of 400 degrees Celsius were required for proper decomposition and calcination reactions. The bed was maintained at this temperature through the use of heated Sodium-Potassium (NaK) flowing through a heat exchanger within the fluidized bed.

The gaseous products that are swept away from the calciner vessel with the fluidizing air are sent to the Off-Gas Decontamination System. Decontamination of the off-gas is achieved through a series of devices which include a spray quench tower, a venturi scrubber and associated cyclone-type entrainment separators, heaters, silica gel absorbers, and high efficiency filters. The off-gas is ultimately discharged to a 250-foot high stack.

Primary Exposures

Primary exposures reported during risk mapping sessions included: Asbestos, Mercury, External Radiation, Internal Radiation, NaK, Nitric Acid, Noise, and Heat.

During shutdown periods, the WCF cells present a high contamination potential with contamination levels commonly at 10⁶ dpm/100cm² and above. The most troublesome problem was Ru-106 (beta emitter), a major contaminant which became a very difficult decontamination issue and also created problems with personnel dosimetry measurement reliability (B.L. Rich, 1974).

Description of Workforce

The workforce consisted of the following: operators (25), Rad Techs (2), and Supervision. The average maintenance workforce in the building (Maintenance workers from CPP-630, 663) included: Pipefitters (2), Instrument Techs (2), mechanics (2) and welders and electricians occasionally.

Remote Analytical Facility (CPP-627)

Building Description

CPP-627 houses the remote analytical laboratories, the multi-curie cell, a radiochemistry laboratory, and a decontamination facility. The facility was designed for remote handling of highly radioactive samples. The multi-curie cell was used for bench-scale, radioactive development work with alpha and beta/gamma sources ranging up to kilocurie levels. The multi-curie cell housed a custom process for fuel dissolution (similar to FAST except on a smaller scale). An explosion occurred in this cell in the late 1980s while working on the dissolution of Argonne fuel. The decontamination facility provides for specialized decontamination procedures to be performed on radioactively contaminate equipment; decontamination is usually accomplished by scrubbing, washing, and soaking in a variety of strong chemical reagents.

Primary Exposures

Primary exposures included: external radiation, internal radiation (Plutonium, etc.), flammable solvents, chlorinated solvents (carbon tetrachloride, TCE), beryllium, cadmium, lead, mercury, cadmium sulfate, cadmium nitrate, fluorocarbon resins, epoxy and polyurethane resins, acids (Nitric acid, Hydrofluoric Acid), and Perchloric Acid. (ICPP-SRD-1, 1974)

Samples in excess of 1 R/hr and contaminated to 10⁷ dpm/100 cm² and above were routinely handled and decontaminated within this facility. The permanent shielding in the RAL was originally designed to reduce the exposure on the outside of the cells to approximately 1 mr/hr or less. However, an ICPP Health Physics Up-Grade Report issued in 1974 (B. Rich, 1974) concludes that "Isolation of highly contaminated equipment is impractical in the present facility; consequently, the facility is routinely contaminated. Contamination spread and personnel exposure potential is high."

Description of Workforce

The workforce consisted of the following: Operators, Engineers, Chemists, and Maintenance (from CPP-630, 663).

FAST Facility (CPP-666)

Building Description

The FAST process building replaced the E-Cell dissolvers in the Process Building CPP-601used for Zirconium Clad Fuel from Naval Nuclear Reactor Fuel. The FAST facility operated from 1984 through 1990. The FAST facility consisted of a fuel dissolution area and a fuel storage area (similar to CPP-603 fuel storage area). The FAST dissolution operation would dissolve the fuel and the dissolved product would be sent to CPP-601 for separation and recovery of the Uranium.

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Primary Exposures

Primary Exposures include: HF, Boric Acid, Nitric Acid, Aluminum Nitrate, Cadmium Sulfate, Cadmium Nitrate, external radiation and internal radiation. Radiation exposures for workers in this building were lower since the facility was designed for much more remote operation, decontamination and maintenance.

A large HF spill was reported to have occurred circa 1985. (Ref: Interview with David Fry)

Description of Workforce

The workforce consisted of the following: Operators (18), Foreman (3), Supervision (3), and HP Techs (3). Maintenance worked in area on as needed basis (from CPP-630, 663) with the most frequently used crafts being pipefitters and mechanics.

New Waste Calcining Facility (CPP-659)

Building Description

The New Waste Calcining Facility was constructed in 1983 and is presently operating. The new calcining process involves spraying liquid waste onto coarse granules in an oven. After water evaporation was achieved, the dry coarse granule, calcine, was transported pneumatically to underground storage bins.

In addition to the Waste Calcining area this building included a decontamination facility.

Primary Exposures

Primary exposures reported during risk mapping sessions included: Asbestos, Mercury, External Radiation, Internal Radiation, NaK, Nitric Acid, Noise, and Heat.

Description of Workforce

The workforce consisted of the following: operators (25), HP Techs (2), Decon Techs (3), and Supervision. The average maintenance workforce in the building (Maintenance workers from CPP-630, 663) included: Pipefitters (2), Instrument Techs (2), mechanics (2) and welders and electricians occasionally.

Old Maintenance Building (CPP-630)

UMass / Lowell

Building Description

The maintenance building housed several storage areas, a maintenance repair shop, electrical shop, instrument shop, weld shop, and a machine shop. The primary purpose of the facility is to provide support to the ICPP area. Routine maintenance on such items as valves, pumps, blowers, etc. is performed in this area. Welding, fabrication, and repairs involving electric arc, heliarc, and gas welding are carried out in the weld shop. This maintenance shop operated from 1952 through approximately 1978. Subsequently, maintenance operations were moved to CPP-663 (operated 1978 – present).

Maintenance crews working from this building could be assigned anywhere on the CPP site. Machinists were the only craft that spent most of their time within the maintenance building.

Primary Exposures

Primary exposures reported during risk mapping activities included: TCE, cutting oils, external radiation, internal radiation, acetone, beryllium, lead, mercury, uranium oxide, welding fumes, and zirconium.

This was the only maintenance shop at the ICPP and therefore was used for both "hot" and "cold" work. Items contaminated to several mrad/hr (B.L. Rich, 1974) were worked on routinely and/or stored in this area.

In addition, in an interview with a former machinist it was reported that Beryllium machining was performed within this building. (Ref: anonymous interview)

Description of Workforce

The workforce consisted of the following: Pipefitters (20), Mechanics (20), Instrument Techs (30-35), Electricians (30), Welders (10), Machinists (5), Painters (4), and Insulators (2).

Hot Pilot Plant/Decontamination Shop/Headend Processing Plant/Rover Facility (CPP-640)

Building Description

The Headend Processing Plant (HPP) contained five heavily shielded cells for new headend process for recovering uranium from spent reactor fuel. The Process Makeup Area of the HPP contains vessels for mixing process chemicals, decontamination solutions, or other chemical solutions for use in the HPP process cells.

This building served as the Headend Processing Plant/Rover Facility from 1974 through 1984. Prior to this the building was used as a Hot pilot plant and a decontamination facility (1952-1974).

The Rover Facility was involved in the dissolution of graphite fuel that reportedly resulted in extensive contamination (ref: interview with David Fry).

This facility was decontaminated in the late 1980s.

Primary Exposures

UMass / Lowell

Primary exposures reported during facility wide risk mapping included: External radiation, internal radiation, caustics and solvents.

Description of Workforce

The workforce consisted of the following: Operators (8), supervision, pipefitters and electricians (as needed from CPP-630, 663).

Process Improvement Facility/ Low Bay Laboratory (CPP-637)

Building Description

CPP-637 is a chemical engineering laboratory facility where highly versatile equipment is located primarily for non-radioactive testing of plant processes and for the development of new processes. CPP-637 began operations in the early 50s and continues to operate today. While testing primarily involves non-radioactive materials, some testing was conducted with depleted or natural uranium. This facility was used for pilot runs for the processing plant, calcining operations and the FAST facility.

This facility had a permanent maintenance crew assigned to building CPP-637.

Primary Exposures

Primary exposures include: HF, Nitric acid, sulfuric acid, hexone, TBP, kerosene, mercuric nitrate, chromium, cadmium sulfate, cadmium nitrate, TCE, external radiation and internal radiation. (ICPP-SRD-1, 1974)

Description of Workforce

The workforce consists of the following: Process Technicians, Engineers, Chemists, and Maintenance (pipefitters, mechanics, electricians, welders and instrument technicians).

Test Area North (TAN)

TAN Hot Shop (TAN-607)

Building Description

TAN-607 was the main shop for fabrication work performed at the TAN facility. From the late 1950s through 1967 the facility was used for fabrication work for the Initial Engine Test (IET), a beryllium-reflected reactor. From the early 70s through 1980 the facility was used for fabrication of the Mobile Test Assembly for the Loss of Fluids Test (LOFT) reactor. This facility was also used for the fabrication of the Experimental Beryllium Oxide Reactor (EBOR) from 1962 through 1970s. This facility was also involved in the fabrication of the Heat Transfer Reactor Experiments (I-III) from 1951 through 1961 (HTRE-III project involved a large mercury spill in 1958 during rail transfer of the reactor from the TAN facility to the IET area).

This building included several unique support facilities including: Decontamination shop, Pipe Laundry Area, Hot Cells, Hot Cell Annex (building attached to 607, TAN-633), Fuel Storage Pool, Machine Shop, Weld Shop, Maintenance Shop, and a Pipefitter shop.

TAN-607 Building was also used extensively for decontamination activities resulting from the SL-1 accident in 1961. Reportedly these decontamination activities involved high external radiation exposures along with a high potential for internal radiation exposure.

Primary Exposures

Primary exposures reported during risk mapping activities include: Beryllium, Mercury, lead, TCE, acetone, alcohol, chromium, external radiation, internal radiation, heat, methylene chloride, nitric acid, noise, silica, stoddard solvent, Turco decon solutions, and welding fumes.

Description of Workforce

At the peak operations in the early to mid 1970s approximately 160 people worked in TAN-607. This included: Hot Cell Technicians (5), Decontamination Technicians (4), pipefitters (20-50), Health Physics Technicians (5-15), machinists (20), welders (15-40), maintenance mechanics (20), materials handling (3), engineering (15), and administrative staff (15).

Initial Engine Test (IET) Area

Building Description

This program was involved in investigation of beryllium-reflected reactor performance under atmospheric conditions, nuclear excursions resulting from the immersion of the reactor in water, and from both non-destructive and destructive tests. This area was active from 1961 through 1967. In the late 1970s through late 80s decontamination work on the area was initiated.

Primary Exposures

Primary exposures reported during risk mapping activities included: Mercury, Beryllium, Lead, internal radiation, external radiation,

Description of Workforce

Primary job classifications reported during risk mapping activities included:

UMass / Lowell

Test Reactor Area (TRA)

Materials Test Reactor (MTR Complex) (TRA-603, TRA-604)

Building Description

The Materials Test Reactor operated from 1952 through 1970. The Materials Test Reactor (MTR) was built to provide the capability for irradiating fuels and materials test samples and to provide neutron beam sources for basic physics research. The MTR was permanently shut down in 1970.

Primary Exposures

Primary exposures reported during risk mapping activities included: Asbestos, acids, beryllium, cadmium, carbon tetrachloride, external radiation, internal radiation, lead, mercury, nitric acid, noise, solvents, stoddard solvents, and welding fumes.

Description of Workforce

The total workforce includes approximately 140 people per day. This includes: HP Technicians (12), Maintenance Mechanics (12), Electricians (8), Instrument Maintenance (11), Reactor Instrument (7), Pipefitters (5), Welders (2), Heavy Equipment Operators (3), Process Operators (15), Reactor Operators (45), Administrative (10), Laborers (4), and Custodians (2).

Engineering Test Reactor (ETR Complex) (TRA- 642, TRA-643, TRA-644)

Building Description

The Engineering Test Reactor (ETR) operated from 1957 through 1981. The Engineering Test Reactor (ETR) was constructed in 1957, for gas-cooled reactor system testing. Both the reactor and its associated support facilities have been inactive since 1981.

Primary Exposures

Primary exposures reported during risk mapping activities included: Acetone, asbestos, beryllium, cadmium, chlorine, external radiation, heat, internal radiation, lead, mercury, nickel, nitric acid, noise, sodium metal, sodium hydroxide, stoddard solvent, sulfuric acid, TCE, Turco decon solutions, and welding fumes.

Description of Workforce

The total workforce includes approximately 140 people per day. This includes: HP Technicians (12), Maintenance Mechanics (12), Electricians (8), Instrument Maintenance (11), Reactor Instrument (7), Pipefitters (5), Welders (2), Heavy Equipment Operators (3), Process Operators (15), Reactor Operators (45), Administrative (10), Laborers (4), and Custodians (2).

Advanced Test Reactor (ATR) (TRA-670)

Building Description

The Advanced Test Reactor (ATR) has operated since 1968 and is still in operation presently. The ATR began operation at full power in 1969. It was originally constructed to continue the irradiation programs being performed by the ETR.

Primary Exposures

Primary exposures reported during risk mapping activities included: Acetic Acid, acetone, beryllium, citric acid, external radiation, internal radiation, Isopropyl alcohol, lead, nitric acid, noise, sodium hydroxide, sulfuric acid, TCE, Turco decon solutions, and welding fumes.

Description of Workforce

The total workforce includes approximately 140 people per day. This includes: HP Technicians (12), Maintenance Mechanics (12), Electricians (8), Instrument Maintenance (11), Reactor Instrument (7), Pipefitters (5), Welders (2), Heavy Equipment Operators (3), Process Operators (15), Reactor Operators (45), Administrative (10), Laborers (4), and Custodians (2).

TRA Machine Shops (TRA-653, TRA-635, TRA-662)

Building Description

TRA-653 Machine shop has operated since 1957. The facility consisted of a machining area (mills and lathes), a weld shop, a paint shop, an electrical and instrument shop and a tool room.

Primary Exposures

Primary exposures reported during risk mapping included: Acetone, asbestos, beryllium, cadmium, chromium, alcohol, external radiation, internal radiation, lead, nickel, nitric acid, noise, silica, stoddard solvent, sulfuric acid, TCE, and welding fumes.

Description of Workforce

TRA-653 had between 80 to 120 maintenance people per day working out of the building. The crafts included: Insulators (2), Maintenance mechanics (20), machinists (12-16), pipefitters (20), welders (18-42), painters (2), and laborers (15).

Central Facilities Area (CFA)

Big Shop (CFA 665, CFA 664)

Building Description

The Big Shop operated from 1949 through 1995 (CFA 665 and CFA 664). Primary activities of concern include bus fleet maintenance, bus painting, sanding, welding and brake work.

Primary Exposures

Primary exposures of concern include: asbestos (brakes), chromium, cadmium and lead (painting and sanding of buses – yellow paint was lead chromate based), carbon monoxide, noise, cleaning solvents, ethylene glycol, TCE, stoddard solvent, and welding fumes.

Description of Workforce

During peak operations the Big Shop housed approximately 250 employees including bus drivers, office staff, dispatchers, servicemen, maintenance mechanics, and parts room staff. Currently the new Transportation Building (CFA 696) houses 152 employees (17 office staff, 94 drivers, 6 dispatchers, 6 servicemen, 24 mechanics, and 3 parts room staff).

Weld Shop (CFA 667)

Building Description

CFA 667 was established as the Weld Shop in 1961. From 1952 to 1961 the welding operations were housed in building CF-649, which subsequently became the lead shop. CF-667 operated as the weld shop from 1961 to approximately 1980. Personnel from this building performed welding tasks within CF-667 as well as performing work at various buildings throughout the INEL site.

Primary Exposures

Primary exposures identified during a brief interview with a retiree included: Welding fumes, lead, and solvents. Risk mapping of this building was not completed.

In a 1962 Health and safety report nine "lead burners" were reported to have been exposed to elevated airborne concentrations of lead while working in a confined space. (IDO-) Although retirees interviewed do not recall a job classification of lead burner they believed that the nine individuals involved in this overexposure were most likely from the Weld shop (CFA-667).

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Description of Workforce

The Workforce consisted of the following: Welders (10-20) and Sheet Metal Workers (3).

Lead Shop (CFA 687)

Building Description

Lead Shop (CFA-687) which operated from 1953 through 1987 housed two oil-fired bottom-pour lead pots along with accessory molds and pouring tables. This facility also had radioactive contamination concerns since many of the lead bricks being recycled were contaminated.

Primary Exposures

Primary exposures reported during risk mapping activities included: lead (fumes and particulate), external radiation, and internal radiation. Review of associated literature suggests that arsenic exposures would have occurred.

Description of Workforce

The Workforce consisted of the following: Welders (8), Laborers (2), and equipment operators (2).

Old Hot Laundry

Building Description

The laundry facility operated from the 1940s through 1981. The Laundry facility provided laundry for all of the prime contractor facilities.

Primary Exposures

Primary exposures reported during a brief interview with a retiree included: Cleaning solvents, internal radiation, and external radiation. Risk mapping was not completed on this building.

Description of Workforce

Old Machine Shop (CF-640)

Building Description

This building housed machining operations from 1955 through 1979. In 1979 the machining operations were moved to the TAN facility.

Primary Exposures

The primary exposures reported during risk mapping activities included: cutting oils, carbon tetrachloride, Stoddard Solvent, TCE, acetone, alcohol, arsenic, asbestos, cadmium, chromium, copper, lead, nickel, nitric acid, noise, and zirconium.

Contaminated materials were reportedly occasionally handled within these shops (Stroschein and Maeser (1967).

Description of Workforce

The workforce in this building consisted of approximately 16 machinists.

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Old Craft Shop (CF-654)

Building Description

This building housed operations including a paint shop, carpenter shop, electrical shop, and a pipefitters shop. This building functioned as the Craft shop from approximately 1955 through 1994.

Primary Exposures

The primary exposures reported during risk mapping activities included: acetone, asbestos, carbon tetrachloride, cutting oils, epoxy, freon, hydrochloric acid, herbicides, pesticides, lead, noise, paint thinner, PCBs, and silica.

Description of Workforce

The workforce consisted of the following: painters (10), maintenance mechanics (15), electricians (12), pipefitters (15), carpenters (6), laborers (25), and insulators (1).

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Argonne National Laboratories- West (ANL-W)

Experimental Breeder Reactor-II (EBR-II) (ANL-767, ANL-768, ANL-766)

Building Description

The EBR-II is an unmoderated, heterogeneous, sodium-cooled reactor which incorporated lessons learned from EBR-I. The reactor was designed as a prototype fast breeder (creating more fuel than the operation consumes) reactor to demonstrate the engineering feasibility of this concept for power generation and also to develop plutonium fuels for use in future power reactors. During its operational history the EBR-II had reactor cores consisting of both enriched uranium fuel as well as plutonium fuel.

Primary Exposures

The primary exposures reported during risk mapping sessions included: Acetone, alcohol, lead, welding fumes, chromium, sulfuric acid, sodium hydroxide, hydrazine, noise, asbestos, heat, mercury, sodium potassium, external radiation, internal radiation, and sodium metal.

Description of Workforce

The workforce as described during risk mapping participants included: Fuel handlers, Maintenance, Reactor Operators, Chemical Technicians, Chemists, Instrument Technicians, and HP Technicians.

Fuel Conditioning Facility (FCF) (ANL-765)

Building Description

The Fuel Cycle Facility, or Fuel Conditioning Facility was designed for the purpose of reprocessing spent fuel from the EBR-II reactor. The facility was designed to allow for separation of both uranium and plutonium. An enclosed passageway connects FCF and EBR-II and provides a means for transferring EBR-II spent fuel assemblies to FCF by way of an airlock large enough to accommodate either of two 18-ton interbuilding casks (IBCs). There are two washstations (located between the reactor and the hot cells) where residual external sodium is removed from spent fuel assemblies while they are still in the IBCs.

Primary Exposures

The primary exposures reported during risk mapping sessions included: Hydrochloric Acid, acetone, carbon tetrachloride, trichloroethylene, lead, cadmium, mercury, sodium, sulfuric acid, external radiation, noise, heat, asbestos, and potassium permaganate.

Description of Workforce

The workforce as described during the risk mapping participants included: Engineering Technicians, HP technicians, and Maintenance.

Other Buildings of Interest at ANL-W

Other buildings which were identified as priority buildings during preliminary facility risk mapping sessions included:

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Fuel Manufacturing Facility (ANL-704)

Maintenance Shop (ANL-753, ANL-788)

Machine Shop (ANL-782)

Fuel Assembly and Storage Facility (ANL-787)

Analytical Laboratory (ANL-752)

Field researchers will complete these building risk mapping sessions within the next few months.

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V. DISCUSSION

External and Internal Radiation

The primary source of personnel external and internal exposure data is the MUD database (1950 – 1985) and the current database, the predecessor to MUD, the Radiation Dosimetry Records (RDR) database (1986 – present). The MUD database includes lifetime, cumulative, external radiation dose data for 49, 480 individuals. The MUD database will be obtained to identify those individuals exceeding established threshold for screening (i.e., 5 rem, 10 rem, 20 rem). In addition, an attempt will be made to determine whether a dosimetry file (developed by I. Aoki) can be retrieved. This dosimetry reportedly contains annual dose summaries for individuals from 1950 through 1979. According to the Horan 1993 report "Occupational Radiation Exposure History at INEL", the total collective dose for the period from 1950 through 1979 based on the Aoki database is approximately 41,695 rem (which differs slightly from the Horan data – 39,935 rem). According to an INEEL HP records contact (Marie Hill) the Aoki database tapes are retained at the INEEL.

Lifetime Exposure

Preliminary review of the Horan Occupational Radiation Dose Report (Horan, 1993) indicates that over 250 individuals from ICPP received in excess of 5 rem lifetime external dose. This report also suggests that the site with the greatest cumulative doses would be the ICPP. "The ICPP has been the major source of the highest exposures and collective dose at the INEL. This was basically due to the 1950 through 1960 plant design that provided for direct maintenance. As the reprocessing plant (CPP-601) and the original waste calcining plant (CPP-633) aged, they required more and more repairs and maintenance. It is during the shutdown periods when shielding is removed that the vast majority of occupational exposures occur." (Horan, 1993)

The highest individual lifetime dose recorded is 79.1 rem. The highest ten individual lifetime doses ranged from 61.5 to 79.1 rem (Table 3). This group included 5 pipefitters, 3 operators, 1 mechanic and 1 HP Technician. It should be noted that none of these individuals were involved in any of the 4 accidents identified above. In fact, only 2 of the individuals have annual doses of greater than 5 rem for any time during their career. During risk mapping several individuals mentioned that "during the early years" it was common practice to not wear your dosimeter when you were likely approaching the regulatory limit. A 1969 Annual Health and Safety Report (IDO-12073) includes a summary of exposures from 1960 through 1969 and concludes "the occupational crafts receiving the highest exposures were mechanics, reactor technicians, and pipe fitters". This seems consistent with the Horan report findings.

Annual Exposures

Number of workers exceeding 5 rem/yr whole body exposure (from approx. 1952 through 1992) based on site radiation records (MUD database) was 159 people, Table 4. (Horan, 1993) Independent review of the Annual Health and Safety reports, which were used as a reference for parts of the Horan report, suggests that the total number of workers exceeding 5 rem/yr may have been slightly higher (approx. 200) however, a better understanding of the data is necessary prior to making any conclusions. It should be noted that the Horan report used a combination of the MUD database records and the summary data from Annual H&S reports to summarize the INEL exposure history from 1952 through 1992 and that in at least one instance (1965 data) the MUD results were quite different (approx. 30-50% lower) than the Annual H&S report – Horan's report uses the MUD data in the summary.

It should be noted that the Horan Summary report does not include workers at all of the INEL facilities (e.g., ANL-W and NRF are not included) and therefore the overall cumulative exposures are underestimates of the exposures sustained by the entire workforce throughout the history of the facility. It should also be noted that from 1952 through 1958 site wide practice involved the issuance of weekly film badges (detection limit of 30 mrem). This policy was changed in 1958 and personnel were issued monthly

or quarterly badges. This early weekly monitoring program could have resulted in underestimates of annual exposures for the years from 1952 through 1958 (ref IDO-12012).

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Exposures in Excess of Radiation Protection Guidelines

The number of workers exceeding the radiation protection guidelines (varied from 15 rem/yr to 5 rem/yr) was reported as 12 individuals. These exposures were all the result of accidents:

- 1. July 23, 1956 Exposure during MTR Reactor Shutdown; 21.6 rem (Included 7 other high
- exposures ranging from 2.5 rem to 10.6 rem)
- 2. October 16, 1959 ICPP Criticality; 8 rem
- 3. January 1, 1961 SL-1 Reactor Accident; 9 individuals from 15 to 27 rem (overall approximately 63 individuals involved in the initial emergency response with an individual mean dose for the rescue team members of 3.83 rem)
- 4. December 12, 1986, Exposure during Industrial Radiography ICPP; 7.73 rem

Internal Exposure

The Horan report and initial discussions with an individual in the Radiation Records Department suggest that exposure to internal emitters at the INEL have not been extensive. Other references, along with risk mapping data, suggest that workers at the CPP process buildings and pilot plants had a high potential for internal exposure. (ACI-167) Current plans include reviewing records of dose reconstruction work that has been done (approximately 300 individuals). An assessment of the MUD data file will also be performed to determine if there is any association between internal dose monitoring (i.e., # of urine samples/yr, # of WBCs, etc) and cumulative external dose.

A 1974 Health Physics Upgrade Report (ACI-167) indicates that "the ICPP programs do not appear to have been conducted under the true "spirit" of the ALAP philosophy for some years." The report goes on to say "conditions exist currently at the ICPP that should not be permitted under any (current or past) guidelines." "The unavoidable deteriorating attitude of plant personnel, which accompanies deteriorating plant conditions, is one of the major obstacles to the upgrading program. For example, it is hard for an operator to be concerned about 0.1 mrad/hr on a shoe when he routinely works with equipment and samples reading tens to hundreds of rad/hr with no apparent ill effects. In addition, a littered plant fosters carelessness."

The report also specifies some areas where contamination levels are excessive and need to be better controlled including:

- 1) "The 601 Access Corridor is contaminated routinely to several thousand dpm/100 cm^2"
- "Significant levels (>10^5 dpm/100 cm^2) of Pu contamination have been identified recently in a number of cells (eg, Cells D, Y and K)"
- 3) CPP-627 "Items reading up to several rad/hr and contaminated to 10^7 dpm/100 cm^2 and above are routinely decontaminated in this area contamination spread and personnel exposure potential is high"
- 4) CPP-630 Maintenance Shop "items contaminated to several mrad/hr are worked on routinely ... and the potential for cross contamination and spread exists"
- 5) WCF (CPP-633) "During shutdown periods, the WCF cells present a high contamination potential with contamination levels commonly to 10⁶ dpm/100 cm²"

6) Analytical Laboratories "High levels of contaminants are handled routinely and analyzed in a variety of facilities ranging from Remote Analytical Facilities and transuranic glove boxes to hoods and bench tops. Higher than usual (other nuclear facilities) activity is handled on an open bench tops and hoods presently. Compared to analytical facilities at some other sites, contamination spread and personnel exposure potential are significant."

The report also recommends upgrading the existing WBC to allow for lower detection limits (specifically for Plutonium). The report states that currently "measurements of the quantity of Pu in the lung at <MPBB are very difficult". The report goes on to say "It has been increasingly apparent recently that a large fraction of the routinely encountered alpha activity at the ICPP is Pu-239 and Pu-238."

Finally, selection of individuals for medical screening should be based on lifetime doses (as recorded in the MUD database or the RDR database) based on a threshold lifetime dose. Further investigation will be conducted to determine who and where internal exposures were encountered and, if possible, to determine approximate magnitudes of lifetime doses associated with internal exposures.

Beryllium

The most broad based use of Beryllium on the INEEL site identified during this preliminary exposure assessment study was the use of Beryllium as a reflector for neutrons in several reactors (MTR, ETR, ATR, EBR-II, ZPPR, ANP project, EBOR, etc.). The CDC chemical dose reconstruction report notes that in 1990 a SARA report indicates an inventory of 45,455 pounds of Beryllium Oxide. (CDC, 1998) It appears that the majority of this material exists as solid bricks used as reflectors in the various reactors around the INEEL site.

During the risk mapping sessions it was determined that Beryllium machining was performed at various buildings at the INEEL site. Based on the preliminary review performed during this assessment the following buildings were identified as having including Beryllium machining and or hand filing: TAN-607, ATR, ETR, MTR, WRRTF, and TRA-653. The job classifications associated with the reported exposures include: Machinists (Experimental Machinists (TAN) and Machinists (TRA)), Mechanics, Pipefitters, Equipment Operators, Process Operators and Reactor Operators. The exposures reported associated with the ATR, ETR, and MTR were associated with the instillation of new Beryllium during shutdown.

During a risk mapping session it was also indicated that in the TAN-607 (New Machine Shop) beryllium blocks were cut with a chop saw for purposes of disposal. In this case no protective equipment was being used.

In addition to Beryllium machining and hand filing for use within reactors at the INEEL, a review of the IH System 80 database identified building CF-689 as an area where Beryllium surveys were being performed. Further review of the survey data sheet indicated that CF-689 Room 128 had been used for "Beryllium Thermocouple Fabrication" and that the operations performed included "trim, weld, and splice, braze and solder". The decontamination work and subsequent IH surveys were performed in 1989 however, no current information is available regarding the timeframe of the Beryllium Thermocouple fabrication work.

A broad based approach to defining the group potentially exposed to beryllium is recommended since published data (Newman 1989, Kreiss 1996) demonstrate that while there are job related and exposure related elevated risks for chronic beryllium disease (CBD), individuals with low-level exposure can be affected. For this reason a two-tiered approach is recommended based on exposure groupings.

For Beryllium exposure at the facilities reviewed an attempt was made through the use of risk mapping to identify locations and job titles which were associated with Beryllium use. Since the risk mapping efforts for this preliminary assessment focused on priority areas and buildings we were not able to review all areas where beryllium was used.

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Overall the results of the risk mapping performed during this preliminary assessment identified the following buildings to be associated with potential high exposure to beryllium (see Appendix B): TAN-607, TR-603 (MTR reactor), TR-642 (ETR Reactor), TR-670 (ATR Reactor), EBOR, WRRTF, and TRA-653 (Old Machine Shop). Additionally, based on the review of System 80 IH records building CF-689 (Beryllium Thermocouple Fabrication) should be included.

Overall, results of the risk mapping performed during this preliminary assessment identified the following job classifications to be associated with potential high exposure to beryllium (see Appendix C and D): Machinists (Machinists (TRA-653) and Experimental Machinists (TAN-607), mechanics, pipefitters, reactor operators, equipment operators, and process operators. Job classifications associated with operations and decontamination of CF-689 are currently unidentified.

Lead

Potential exposure to and handling of lead was performed throughout the site. The primary use of lead on the site was as shielding materials, such as lead sheeting, lead pellets, and shot used for shielding and lead pipes.

The lead shop at the CFA (CFA-687) was the only area identified where lead was melted and poured (recycling lead shielding). The lead shop housed two oil fired bottom poured lead pots along with accessory molds and pouring tables.

Additionally, one instance where lead powder was used to repair cracks in shielding at the ETR reactor.

Also, risk mapping reports indicated that handling of shielding at the reactor facilities (including hand filing, sawing, etc.) was a common practice due to frequent changes in shielding configuration for various experiments housed at the reactor facilities. The handling of lead did not usually involve the use of PPE (especially during instillation when radiation issues were not a concern).

One incident was identified associated with the construction/instillation of shielding. This incident was summarized within the 1962 and 1963 Annual Health and Safety report and is included here since airborne measurements and medical monitoring of workers involved in the incident was performed.

The 1962 Annual report indicates that a "serious lead fume exposure condition occurred in a construction area". The incident involved 9 "lead burners" working in a confined space at the bottom of a cement basin (no area or building are specified). Airborne levels of 30-85 times the TLV ($0.2 \text{ mg} / \text{m}^3$) were identified by IH staff. Maximum blood lead level was determined to be 0.097 mg Pb / 100 cc blood; average urine was identified to be 0.416 - 0.600 mg Pb / liter of urine. Three of the men developed clinical symptoms of lead intoxication.

Half faced respirators were required after the exposure was identified. The report also noted that these workers had performed similar type of work for many years.

Overall the results of the risk mapping performed during this preliminary assessment identified the following buildings to be associated with potential high exposure to lead (see Appendix B): CF-665 (Big Shop), CF-649 (Lead Shop), CPP-630 (Old Maintenance Building), TAN-607 (Hot Shop and Hot Cells), TAN-607 (Weld Shop), TR-603 (MTR reactor), TR-642 (ETR Reactor), and TRA-653 (Old Machine Shop).

Overall, results of the risk mapping performed during this preliminary assessment identified the following job classifications to be associated with potential high exposure to lead (see Appendix C and D): Bodymen, Decon Techs, laborers, machinist, mechanics, pipefitters, process operators, and welders.

Based on the 1962 and 1963 Annual Health and Safety Reports mentioned above, Leadburners should also be included as a job classification associated with potential high exposure to lead.

Mercury

At the ICPP Mercuric Nitrate was used as a catalyst for the dissolution process (Aluminum clad fuel elements). The Mercuric Nitrate was added to the dissolution process from the process make-up floor of the CPP-601 building. Reportedly, most of the mercury remained in solution with the raffinate, which was then sent to the WCF building for calcining.

A safety analysis from 1963 estimated that 20% of the mercury introduced into the WCF with the feed might be vaporized and released to the air in the off-gas. For "commonly processed waste" this was estimated to yield concentrations of approximately 0.007 mg/m^3 (TLV for mercury vapor is currently 0.05 mg/m^3). IH data for the WCF building was not identified. (CDC)

Mercury was also used at the TAN facility in association with the ANP program. The mercury was used during the testing of the D102A turbojet engine reactor system and was used for shield augmentation (mercury was pumped into an outer primary shield tank while personnel accessed the reactor and then during testing the mercury was drained and water filled the shield area). A large mercury spill (which took place in 1958) was detected during routine health physics surveys 30 years later in 1988. A removal action was performed in 1995. (CDC CHEM) During risk mapping activities retirees recalled frequent "small" spills of less than 1 gallon of mercury along the rail tracks and within the building (TAN-607). The CDC report also references interviews with past ANP workers who estimated that total mercury used during the ANP project to be approximately 50 tons.

Overall the results of the risk mapping performed during this preliminary assessment identified the following buildings to be associated with potential high exposure to Mercury (or Mercuric Nitrate) (see Appendix B): CPP-601, CPP-633, CPP-630, CPP-602, and TAN-607.

Overall, results of the risk mapping performed during this preliminary assessment identified the following job classifications to be associated with potential high exposure to mercury (see Appendix C and D): Helpers, Decon Technicians, Hot Shop Technicians (TAN-607), and Instrument Techs.

Further investigation into the use of mercury associated with the ANP program will be conducted.

Cadmium

Cadmium exposures were reported as Cadmium Sulfate and Cadmium Nitrate within the Chemical Processing Plant. The cadmium compounds were reportedly used as "poisons" added to the process during dissolution of fuel elements. The cadmium compounds were reportedly used only for the Zirconium clad fuel elements from the Naval Nuclear Reactor program.

Originally, this process was housed within CPP-601 (the E-Cell) and was later moved to an upgraded facility known as the FAST facility (CPP-666) in 1985. The primary exposures reported were associated with the process make-up area. Based on discussions with current workers and retirees it was determined that a FAST pilot project was conducted within Building CPP-637 (Multi-curie cell) and pilot testing (cold pilot runs – no radioactive material) may have also been conducted in building CPP-627.

Some IH data is available for the FAST process building (HP-3000 Database at ICPP) which, based on a preliminary scan, appears to include primarily results of below detectable limits. A copy of this database has been requested from the contractor and will be reviewed further. Additionally, further investigation is necessary to determine whether cadmium exposures were more extensive during the pilot testing of the FAST process.

Further investigation is necessary to determine the buildings and job classifications associated with exposure to cadmium however, based on risk mapping conducted to date it appears that the following job classifications would have the greatest potential to exposure to cadmium: Operators (CPP) and Helpers (CPP).

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Chromium

Chromium exposures were reported during risk mapping sessions from various manufacturing operations. At the Chemical processing plant Chromic Acid (CrO3 and CrO4) was used within the dissolution process. High exposures were reportedly associated primarily with operations on the Process Make-up floor of CPP-601. Additionally, based on interviews with retirees, potentially high exposures to chromic acid may have also occurred at CPP-627 and CPP-637. At the Central Facilities Area high exposures were reported within the Machine Shop (machining operations) and within the Big Shop (body men painting and sanding yellow buses – lead chromate based paint). At the TAN facility high exposures were reportedly related to machining operations.

Overall the results of the risk mapping performed during this preliminary assessment identified the following buildings to be associated with potential high exposure to Chromium compounds (see Appendix B): CF-665 (Big shop), CF-640 (Machine Shop), CPP-601, and TAN-607 (Machine Shop).

Overall, results of the risk mapping performed during this preliminary assessment identified the following job classifications to be associated with potential high exposure to Chromium compounds (see Appendix C and D): Helpers, Machinists, and bodymen.

Hydrofluoric Acid

Hydrofluoric Acid exposures were reported during risk mapping sessions for the ICPP facility. HF was used extensively in the dissolution operations (CPP-601) and the FAST dissolution operations (CPP-666). Reportedly HF was used for dissolution of Zirconium clad fuel elements. Additionally, based on interviews with retirees, potentially high exposures to HF may have also occurred at CPP-627 and CPP-637.

Overall the results of the risk mapping performed during this preliminary assessment identified the following buildings to be associated with potential high exposure to HF (see Appendix B): CPP-601, CPP-666, CPP-627 and CPP-637.

Overall, results of the risk mapping performed during this preliminary assessment identified the following job classifications to be associated with potential high exposure to HF (see Appendix C and D): Operators, Helpers, Mechanics, Instrument Technicians, and HP Technicians (all from the CPP facility)

Nitric Acid / Nitrogen Oxide

Nitric Acid was primarily reported during risk mapping activities at the CPP facility. Nitric Acid was extensively used during dissolution of aluminum clad fuel elements. Handling of the concentrated Nitric Acid on the Process Make-up floor of the CPP-601 and CPP-633 buildings appears to have been the source of the greatest exposures. Risk mapping participants reported "constant noticeable fumes" on the process make-up floor of CPP-601.

Nitrogen Oxides, primarily nitrogen dioxide, are formed during the decomposition of nitrates in the waste solution that is calcined at the WCF building (CPP-633). Overexposures to oxides of nitrogen were reported in 1968 Annual Health and Safety Report.

Overall the results of the risk mapping performed during this preliminary assessment identified the following buildings to be associated with potential high exposure to Nitric Acid / Nitrogen Oxide (see Appendix B): CPP-601, CPP-633, CPP-627 and CPP-637, and TAN-607 (Decon Shop).

Overall, results of the risk mapping performed during this preliminary assessment identified the following job classifications to be associated with potential high exposure to nitric acid / nitrogen oxide (see

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Appendix C and D): Operators, Helpers, Mechanics, Instrument Technicians, pipefitters, welders and HP Technicians (all from the CPP facility) and Decon Techs (TAN-607).

Chlorinated Solvents

Chlorinated solvents were used throughout the site. Risk mapping reports included carbon tetrachloride, Methylene Chloride, TCE and TCA. Uses reported included parts degreasing and general area decontamination (cleaning floors of reactor containment area). Within the risk mapping sessions conducted the facilities most frequently reporting potential high exposures to chlorinated solvents were the TAN facility and the TRA facility.

Overall the results of the risk mapping performed during this preliminary assessment identified the following buildings to be associated with potential high exposure to chlorinated solvents (see Appendix B): CPP-602 (Instrument Shop), CF-654 (Paint Shop), TAN-607 (Decon Shop, Pipe Laundry Area, Hot Shop 101), TRA-603 (MTR), and TRA-642 (ETR).

Overall, results of the risk mapping performed during this preliminary assessment identified the following job classifications to be associated with potential high exposure to chlorinated solvents (see Appendix C and D): Instrument Technicians (CPP), Painters (CFA), Mechanics, pipefitters, welders, laborers, electricians and Decon Techs (TAN) and laborers, mechanics, process operators, and reactor operators (TRA).

Noise

Noise exposures were reported throughout the INEL site. However, based on risk mapping sessions the process areas where highest noise levels existed were infrequently occupied. Machine shops at CFA, TRA and TAN were all reported to have high noise levels along with significant occupancy.

Overall the results of the risk mapping performed during this preliminary assessment identified the following buildings to be associated with potential high exposure to chlorinated solvents (see Appendix B): CF-640 (Machine Shop), CF-649 (Lead Shop/ Old Weld Shop), TAN-607 (Pipe Shop and Machine Shop), TRA-670 (ATR – Diesel Generator Pit), TRA-603 (MTR), TRA-642 (ETR) and TRA-653 (Machine Shop).

Overall, results of the risk mapping performed during this preliminary assessment identified the following job classifications to be associated with potential high exposure to noise (see Appendix C and D): Machinists, mechanics, process operators (TRA), pipefitters (TAN) and welders.

Asbestos

Asbestos insulation was used extensively in the 1950s when many facilities at the INEEL were initially constructed. Asbestos materials may be found in roofing, pipe and vessel insulation, building insulation, gaskets, packing, siding and other building materials.

Asbestos exposures were also noted due to work with asbestos blankets and asbestos gloves used to protect against heat while working on production equipment. In addition, mechanics working at the CFA Big Shop would have been exposed to asbestos during brake work on buses and other site vehicles.

Exposure to asbestos was reported at all of the facilities reviewed during risk mapping.

Overall, results of the risk mapping performed during this preliminary assessment identified the following job classifications to be associated with potential high exposure to asbestos (see Appendix C and D): Decon Techs, Instrument Techs, Insulators, mechanics, pipefitters, and operators.

Welding Fumes

Welding fume exposures were reported throughout the INEL site. The exposures reported during risk mapping activities include exposures within the maintenance shop buildings as well as exposures during fieldwork (i.e., maintenance work, new construction work, or system modification work).

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The 1969 Annual Health and Safety report mentions a special pulmonary function testing program for 38 welders involved in the LOFT project at the TAN facility. Three individuals in this group were reported to have abnormal results. (IDO-12073)

CF-649 (Old Weld Shop), CPP-630 (Old Weld Shop), TAN-607, TRA-670 (ATR), TRA-603 (MTR), TRA-642 (ETR), and TRA-653.

Overall, results of the risk mapping performed during this preliminary assessment identified the following job classifications to be associated with potential high exposure to welding fumes (see Appendix C and D): Machinists, mechanics, pipefitters and welders.

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TABLE 1: CHEMICALS OF POTENTIAL CONCERN*

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Acetone Acetonitrile Aluminum	SC&A: ICPP, TRA, ANL-W; NIOSH; ATSDR SC&A: ICPP
Acetonitrile Aluminum	SC&A: ICPP
and a second	SC&A: ICPP, TAN, CFA, ANL-W; ATSDR
Ammonia	TAER: ICPP
Ammonium hydroxide	SC&A: ICPP, ANL-W
Ammonium nitrate	TRA
Aniliae Aniliae and the second s	SC&A: ICPP, ANL-W
Arsenic	SC&A: ICPP, TAN, NRF, ANL-W; NIOSH; ATSDR
Asbestos	SC&A: ICPP, TRA, TAN, NRF, ANL-W; NIOSH
Barium	SC&A: ICPP, TRA
Benzene	SC&A: ICPP, TRA, TAN, NRF, ANL-W; NIOSH: ATSDR
> Beryllium	TRA; NIOSH
BETZ compounds	SC&A: PBF-302 Injection Well TRA
Biphenyl	OMRE
N-Butyl Alcohol, butanol	NIOSH; SC&A: ICPP
✓ Cadmium	SC&A: ICPP, NRF; ATSDR
Carbon disulfide	SC&A: ICPP, NRF, ANL-W; NIOSH
Carbon monoxide	SC&A: TRA
 Carbon tetrachloride 	SC&A: ICPP, NRF, CFA, ANL-W; NIOSH; ATSDR
Chlorine	NIOSH
Chloroform	NIOSH; ATSDR
Chromium	SC&A: ICPP, TRA, TAN, NRF, ANL-W: NIOSH: ATSDR
Cobalt	ATSDR
Copper	NIOSH; ATSDR
Cyanide	TAN, NRF
Dichloroethane	ATSDR
Diesel fuels	SARA 312 Report
Diethanolamine	SC&A: TAN
Diethylhexylphthalate	ATSDR; TRA
Diethylphthalate	ATSDR
Dionodic	PBF-302 Injection Well and PBF Evaporation Pond
Dodecane	SC&A: ICPP TRA
Endrin	SC&A
Ethanol	TAER; NIOSH
Ethylbenzene	ATSDR
Ethylene glycol	TAN
Fluoride	SC&A: NRF
Fly ash	NIOSH
	Ammonium nitrate Aniline Arsenic Asbestos Barium Benzene Beryllium BETZ compounds Biphenyl N-Butyl Alcohol, butanol Cadmium Carbon disulfide Carbon monoxide Carbon monoxide Carbon tetrachloride Chlorine Chloroform Chromium Cobalt Copper Cyanide Dichloroethane Diesel fuels Diethanolamine Diethylhexylphthalate Diethylphthalate Dionodic Dodecane Endrin Ethanol Ethylbenzene Ethylene glycol Fluoride Fly ash

* Chemical list developed by CDC; INEEL Dose Reconstruction Study, 1998

TABLE 1: CHEMICALS OF POTENTIAL CONCERN*

Chemical	Reference and location ^a
Freons	NIOSH; ICPP
Gasoline	SC&A: CFA
Gallium oxide	SC&A
HEDP, Hexaethyldiphosphate	
Hydroxy diphosphoethane	SC&A: PBF Evaporation Pond
Hexachlorobutyldiene	ATSDR
Hexane	NIOSH; ICPP
Hexone (methyl isobutyl ketone) (MIBK)	SC&A: ICPP TRA; TAER
Hydrazine	SC&A: PBF-302 Injection Well TAN
Hydroborofluoric acid	SC&A: ICPP
Hydrocarbon diluents, paraffins	SC&A: ICPP
Hydrochloric acid	SC&A: ICPP; NIOSH
Hydrofluoric acid	SC&A: ICPP, TAN, CFA, ANL-W
Hydrogen fluoride	NIOSH
Hydroxylamine sulfate	SC&A: TAN
Kerosene (AMSCO)	SC&A: ICPP, TRA
Lead	SC&A: ICPP, TRA, TAN, NRF, ANL-W; NIOSH: ATSDI
Lindane	SC&A: ICPP, NRF, TAN
Lithium	SC&A: TAN
Magnesium	NIOSH; ATSDR; ICPP
Manganese	ATSDR; ICPP
Mercury	SC&A: ICPP, TRA, TAN, CFA, ANL-W: NIOSH: ATSDF
Mercuric nitrate	SC&A: ICPP, TRA, TAN, CFA, ANL-W
Methanol	TAER: ICPP. TAN
Methoxychlor	SC&A: NRF
MethoxyDDT	SC&A: ICPP, NRF, TRA
Methylene B15	SC&A: TRA
Methylene chloride	NIOSH; ATSDR
vlethyl ethyl ketone	NIOSH
Methylisobutyl ketone	ATSDR; ICPP
Monoethanolamine	TAN
Napthalenes	TAN
Nickel	TAER; ICPP
Vitrates	SC&A: ICPP; ATSDR
Nitric acid	SC&A: ICPP, NRF, ARL-W
Nitrous oxides	SC&A: ICPP; NIOSH
Dxalic acid	SC&A: ICPP, TAN
Perchloric acid	SC&A: ICPP
Phosphoric acid	SC&A: ICPP, TRA, NRF; NIOSH
°CBs	ATSDR; TRA, TAN

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* Chemical list developed by CDC; INEEL Dose Reconstruction Study, 1998

TABLE 1: CHEMICALS OF POTENTIAL CONCERN*

Potassium hudroxida	
Polassium hydroxide	SC&A: TRA
Propagol	TAED, SOLA, JODD TAN
Propylene giveol	RER, SCAR ICPP, TAIN
Selenium	SCAAL JORD NEEL AMEDD
Science in the second s	SCAA: ICPP, NRF; AISDR
Sliminida	SC&A: ICPP
Shinicide	SC&A: PBF-302 Injection Well
Socium Receiver de la sector	SC&A: ICPP
Sodium nydroxide	SC&A: ICPP, TRA, TAN, NRF, ANL-W; NIOSH
Sodium nitrate	SC&A: CFA
Sodium tulytriazule	SC&A: TRA, TAN
Stoddard solvent	SC&A: 500 gallons CFA, TAN; TAER
Styrene	NIOSH
Sulfuric acid	SC&A: ICPP, TRA, NRF, ANL-W
Sulfur dioxide	SC&A: ICPP, TAN, ANL-W
Terphenyls	MORE
Tetrachloroethylene	TAER
Toluene	SC&A: ICPP NRF ANL-W; NIOSH; ATSDR
Toluene di isocyanate (TDI	NIOSH
Toxaphene	NRF
Tributyl phosphate	SC&A: ICPP, TRA; ATSDR
Trichloroethane (TCA, Trichlor)	SC&A: ICPP, NRF: ATSDR
Trichloroethylene (TCE)	SC&A: ICPP. CFA. NRE CFA. ANI -W. ATSDR
Uranium	SC&A: TAN
Vanadium	SC&A: ICPP. TAN NRE ANI W ATSDP
Xylenes	NIOSH: ATSDR: TAN
Zinc	NIOSH: ATSDR: TAN
Zirconium	SC&A: ICPP TAN NRE ANI JW

^a ANL-W = Argonne National Laboratory-West; CFA = Central Facilities Area; ICPP = Idaho Chemical Processing Plant; NRF = Naval Reactors Facility; TAN = Test Area North; TRA = Test Reactor Area.

* Chemical list developed by CDC; INEEL Dose Reconstruction Study, 1998

TABLE 2: RADIONUCLIDES OF POTENTIAL CONCERN*

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Airborne Wastes	Praseodymium-143	Niobium-95	Niobium-94
	Promethium-147	Ruthenium-103	Niobium-95
Antimony-125	Protactinium-234	Ruthenium-106	Plutonium-238
Argon-41	Rhenium-188	Sodium-24	Plutonium-239
Arsenic-76	Rubidium-88	Strontium-89	Plutonium-240
Barium-139	Rubidium-89	Strontium-90	Plutonium-241
Barium-140	Ruthenium-103	Tantalum-182	Plutonium-242
Bromine-82	Ruthenium-106	Thorium-230	Praseodymium-144
Carbon-14	Sodium-24	Tellurium-129m	Radium-226
Cerium-141	Strontium-89	Tritium	Rhodium-106
Cerium-144	Strontium-90	Yttrium-90	Rubidium-86
Cesium-134	Strontium-91	Yttrium-91	Ruthenium-106
Cesium-136	Technetium-99m	Zinc-65	Selenium-75
Cesium-137	Tellurium-132	Zirconium-95	Silver-110m
Cesium-138	Thorium-234		Strontium-90
Cesium-139	Tritium	Solid Wastes	Tantalum-182
Cobalt-57	Uranium-234		Technetium-99
Cobalt-58	Uranium-238	Americium-241	Thorium-228
Cobalt-60	Xenon-133	Antimony-125	Thorium-230
Europium-152	Xenon-135	Barium-137m	Thorium-232
Europium-154	Xenon-135m	Barium-140	Tin-119m
Europium-155	Xenon-138	Carbon-14	Tin-121m
Hafnium-181	Yttrium-91	Cerium-141	Uranium-233
Iodine 129	Yttrium-99m	Cerium-144	Uranium-235
Iodine-131		Cesium-134	Uranium-238
Iodine-132	Liquid Wastes	Cesium-137	Yttrium-90
Iodine-133		Chromium-51	Zinc-65
lodine-134	Antimony-124	Cobalt-57	Zirconium-95
lodine-135	Antimony-125	Cobalt-58	
Iridium-192	Barium-140	Cobalt-60	
Krypton-85	Cerium-141	Curium-242	
Krypton-85m	Cerium-144	Curium-244	
Krypton-87	Cesium-134	Europium-152	
Krypton-88	Cesium-137	Europium-154	
Krypton-89	Chromium-51	Europium-155	
Lanthanum-140	Cobalt-58	Hafnium-181	
Mercury-203	Cobalt-60	Iridium-192	
Manganese-54	Europium-153	Iron-55	
Manganese-56	Europium-154	Iron-59	
Molybdenum-93	Halfnium-181	Iodine-129	
Molybdenum-93m	lodine-129	Lanthanum-140	
Molybdenum-103	lodine-131	Manganese-54	
Plutonium-238	Iron-59	Neptunium-237	
Plutonium-239	Lanthanum-140	Nickel-59	
Plutonium-240	Manganese-54	Nickel-63	د

* Chemical list developed by S. Cohen & Assoc. for CDC; INEEL Dose Reconstruction Study, 1994

TABLE 3: Highest Individual Collective Doses (1951-1992)*

and Schule and Schule A

Identification Number	Occupation	Working Years	Collective Dose in Rem	Year*	Rem*	Employment Status
102	Mechanic	40	79.1	1967	4.3	Retired '9
353	Operator	35	69.4	1971	4.7	Retired '8
626	Pipefitter	25	69.4	1961	4.3	Continuing
424	Pipefitter	23	66.1	1959	5.4	Retired '8
5056	Pipefitter	36	64.1	1959	4.3	Retired '8
159	HP Technician	32	63.7	1973	4.6	Continuin
3056	Pipefitter	33	62.5	1961	4.3	Retired '8
475	Operator	28	62.4	1972	4.5	Retired '
064	Pipefitter	24	62.2	1965	4.3	Retired 'S
020	Operator	38	61.5	1962	9.1	Retired 'S
Average		31.4	66.0		4.98	

• Highest annual dose.

* Listing from "Occupational Radiation Exposure History of Idaho Field Office Operations at the INEL", EGG-CS-11143, 1993. (J.R. Horan and J.B. Braun)

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TABLE 4: INEEL Historic Radiation Exposure Distribution(Occupational Whole Body Exposure in Rem)

							T		Y		
Cai				1			Site	Total	Collect.	Rad.Prot.	>
rear	<:1eas:0-1	1-2	2-3	3-4	4-5	>5	Pop.	Mont.	Dose	Guides	Guides
:951	•		1				2250	•	0	1	
:952	· 83 i	1	i				2350	·	15	ł	
953	- 738	34	3	2	2	<u> </u>	2175	·	209		ļ
1954	• 797	79	26	8	1	2	2525	•	388	15R	ļ
955	1336	120	76	29	10	4	3025	~ 2700 • • •	839		; ;
:956	964	125	61	24	9	11	3625	<u> 2810</u>	756		<u> </u>
957	1243 :	114	20	4	i		4550	4338	486		
1958	2785 -	260	143	47	24	29	5000	3288	1854		
· 959	2962	257	196	33	14	5	1 5075	3467	2462		1
:960	4020	220	94	51	11	1 1	5200	4397	2294	1	
:96:	3199	346	201	138	45	19	4920	3948	2700		9
. 365	: 31371	229	102	73	49	23	4755	3613	2156		<u> </u>
:963	3283	212	87	-77	23	<u> </u>	5310	3682	2156	1	
1964	2433	190	115	82	15		5900	2835	2330		
1965	2547	439	221	180	144	61	6025	-	3448	12 rem	
:966	2400	206	105	83	44	I	5800	2838	2412	4	L
:987	2502	226	109	95	53	<u> </u>	5825	2985	2114	_	
:968	2612	163	100	86	44	1	5850	3006	1781	_	
:969	2526	196	81	70	23	<u> </u>	5850	2769	1723	-	
:970	• 2936	168	77	59	33	1	5755	3273	1655		
1971	2723	136	57	27	4		5680	2947	1180		
:972	• : 2553	171	89	59	19		5875	2891	1381		[
: 973	2143	183	66	36	18	1	5975	• 	1091	· · · · ·	
:974	1885 889 1	133	62	20	11	<u> </u>	5950	2990	686	1	
:975	1036 1363	115	51	15	<u> </u>	<u> </u>	3643	2580	611	4	Ļ
:976	2585 1704	148	75	-7	<u> </u>		4145	4519	788		
1977	1939 1385	158	94	38	6	<u> </u>	5046	3520	929		
:978	2160 2027	161	88	18	3		5901	4457	898		· [
:979	2782 2318	163	61	3	I		6188	5327	876		i
1980	2672 1724	133	43				6544	4572	593		
1981	2556 1734	36	-	1			6695	4327	302	5 rem	
982	2565 1606	60	6	1			6653	4237	333		
1983	2780 1655	30					6391	_4465	353		
:984	3172 1818	68	7				6842	5065	441		1
:985	3470 1881	47	3				7186	5401	420		
:986	4689 2227	133	23		1	1	7853	1 7074	618	4	· :
1987	3901 1843	45	4		<u> </u>		7586	5793	314	4	}
1988	3829 1734	27	1	<u> </u>		<u> </u>	7998	5590	233	4	
1969	4144 1719	83	2	<u></u>		<u> </u>	8779	594.8	317	4	
2990	4787 1655	25	5			<u> </u>	10295	6472	228	<u> </u>	
Tota	\$ 79204	5639	2553	1365	596	159	220740	135524	44400		12

1 Data unavailable

1951-1974 Total Site Population: 1975-1990 DOE-ID & Contractors

···· Compiled from AEC & Contractor Employment Graph (RESL)

* Listing from "Occupational Radiation Exposure History of Idaho Field Office Operations at the INEL", EGG-CS-11143, 1993. (J.R. Horan and J.B. Braun)

Appendix A:

Risk Mapping Results

Appendix A1: Facility Risk Mapping Results

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100. - 10 100. - 10 Appendix A2: Building Risk Mapping Results (Database Report)

Appendix A1

Facility Risk Mapping Results

Preliminary Facility Risk Mapping Data -- CFA Facility

Map Dot.	Building Number	Chemical/Agent	Comments
20	617	external radiation	new laundry bldg.
20	617	internal radiation	new laundry bldg.
22	617	solvents	new laundry bldg.
3	621	metals	machining
4	621	solvents	maint bldg
2	622	welding fumes	weld shop
9	623	paint	
9	623	solvents	
9	624	paint	
9	624	solvents	
18	633	external radiation	counting lab
18	633	internal radiation	counting lab
5	640	metals	machining
5	640	lead	machining
6	654	metals	crafts shop
7	654	solvents	
14	664	sulfuric acid	
15	664	solvents	
1	667	welding fumes	weld shop
1	667	cadmium	weld shop
1	667	metals	weld shop
8	674	sulfuric acid	CPP chem research lab
25	688	asbestos	of the cheminesearch lab
25	689	asbestos	
25	690	asbestos	
23	696	paint	
23	696	solvents	
24	696	noise	
25	696	asbestos	brake linings
10	Big Shop	degreasers	Make inings
11	Big Shop	asbestos	
12	Big Shop	naint	
13	Big Shop	noise	
19	Old Hot Laundry	external radiation	
19	Old Hot Laundry	internal radiation	
21	Old Hot Laundry	solvents	
16	old lead shop	lead	Poursed to est
17	old lead shop	external radiation	
17			contam. Lead re-milled

Ineel_~1CFA

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Map Dot.	Building Number	Chemical/Agent	Comments
14	601	nitric acid	
15	601	MEK	
16	601	external radiation	
16	601	internal radiaiton	
1	602	Beryllium	1st floor of labs
1	602	Mercury	1st floor of labs
1	602	Cadmium	1st floor of labs
2	602	external radiation	1st floor of labs
2	602	internal radiaiton	1st floor of labs
3	602	carbon tetrachloride	1st floor of labs
3	602	benzene	1st floor of labs
3	602	MEK	1st floor of labs
4	602	x-ray	2nd floor of labs
6	602	asbestos	2nd floor of labs
23	603	external radiation	
24	603	welding fumes	
25	603	noise	
20	620	solvents	
21	620	metals	
22	620	caustics	
17	630	welding fumes	
18	630	noise	· · · · · · · · · · · · · · · · · · ·
19	630	cutting oils	
10	633	Kerosene	
11	633	nitric acid	
11	633	sulfuric acid	· · · · · · · · · · · · · · · · · · ·
12	633	external radiation	
12	633	internal radiaiton	
13	633	noise	
5	637	asbestos	glass blowing shop
20	637	solvents	
21	637	metals	
22	637	caustics	
7	640	external radiation	
7	640	internal radiaiton	
7	640	caustics	· · · · · · · · · · · · · · · · · · ·
7	640	solvents	
8	640	caustics	
9	640	solvents	
26	663	metals	
26	663	welding fumes	
27	663	solvents	
28	663	external radiation	
28	663		
29	663		
30	666		
31	666		
31	666	external radiation	

Ineel_~1CPP

	Map Dot.	Building Number	Chemical/Agent	Comments
	31	666	internal radiaiton	
- 11	32	666	cadmium sulfate	2
	33	666	cadmium nitrate	2

Ineel_~1CPP

Preliminary Facility Risk Mapping Data -- TRA Facility

Map Dot.	Building Number	Chemical/Agent	Comments
1	601	noise	
32	603	external radiation	
33	603	asbestos	
34	603	lead	shielding
17	604	noise	
35	604	acids	
35	604	caustics	
52	604	beryllium	. machining
52	604	halfnium	
52	604	cadmium	
52	604	lead	
52	604	graphite	
52	604	mercury	
52	604	welding fumes	
12	605	noise	
36	605	external radiation	
36	605	internal radiation	
13	607	noise	
29	608	sulfuric acid	
29	608	sodium hydroxide	
29	608	nitric acid	
29	608	chromates	
10	609	noise	
30	609	phosphates	
30	609	sulfates	
11	610	noise	
37	610	external radiation	
37	610	internal radiation	
38	613	external radiation	
53	614	bervllium	met. Lab
53	614	halfnium	
53	614	cadmium	
53	614	lead	
53	614	graphite	
53	614	mercury	
53	614	welding fumes	
4	619	noise	
26	623	PCBs	
10	625	stoddard solvents	
10	625	degreasing solvents	
10	625	acetone	
10	625	alcohol	
16	626	noise	
25	627	benzene	cleaner: dissolve #5 and #6 oils
27	631	sulfuric acid	
47	632	external radiation	
48	632	alcohol	
48	632	acetone	
30 30 30 31 32 33 33 54 19	609 609 610 610 610 613 614 614 614 614 614 614 614 614 614 614 615 623 625 625 625 625 625 625 625 625 625 625 625 625 625 625 626 627 631 632 632	phosphates sulfates noise external radiation internal radiation external radiation beryllium halfnium cadmium lead graphite mercury welding fumes noise PCBs stoddard solvents degreasing solvents degreasing solvents acetone alcohol noise benzene sulfuric acid external radiation alcohol acetone	met. Lab

Ineel_~1TRA

Preliminary Facility Risk Mapping Data -- TRA Facility

Map Dot.	Building Number	Chemical/Agent	Comments
5	633	noise	
51	635	beryllium	machining
51	635	halfnium	
51	635	cadmium	
51	635	lead	
51	635	graphite	
51	635	mercury	
51	635	welding fumes	
39	636	external radiation	
31	641	external radiation	
40	642	external radiation	FTR
40	642	internal radiation	ETR
41	642	NaK	ETR
41	642	lead	ETR
41	642	bervilium	ETR
41	642	cadmium	ETD
41	642	welding fumes	
42	642	ashestos	
46	643	noise	piping, gloves and blankets
14	644	noise	
44	644	acide	
44	644		
45	644	ashestos	
65	644	external radiation	piping
66	644	acida	
66	644		
15	645		and the second
43	648		
2	650		Piping
49	653		
49	653	stoddard solvents	
49	652	acetone	
49	652		
- 49	653		
50	003		machining
50	053		
50	053	cadmium	
50	053		
50	653	graphite	
50	653	mercury	
50	653	welding fumes	
54	653	external radiation	
54	653	internal radiation	
58	654	external radiation	
59	660	external radiation	
60	661	external radiation	
60	661	internal radiation	
55	662	beryllium	machining
55	662	halfnium	

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Map Dot.	Building Number	Chemical/Agent	Comments
55	662	cadmium	
55	662	lead	
55	662	graphite	
55	662	mercury	
55	662	welding fumes	
56	662	external radiation	
56	662	internal radiation	
57	662	paints	
57	662	paint thinners	
9	663	noise	
61	664	external radiation	
7	670	noise	
18	670	stoddard solvents	
18	670	degreasing solvents	
20	670	beryllium	handled, polished beryllium blocks for reactor
21	670	external radiation	
21	670	internal radiation	
22	670	lead	shielding
22	670	cadmium	
22	670	welding fumes	maint. And welders
23	670	acids	
23	670	chromates	
23	670	nitric acid	
3	672	noise	
6	674	noise	
28	677	sulfuric acid	
28	677	sodium hydroxide	
28	677	chlorine	
62	709	external radiation	
62	709	internal radiation	
63	714	Heat	
8	752	noise	
64	752	PCBs	
26	757	PCBs	
24	771	chlorine	
24	771	sulfuric acid	
24	771	chromates	
24	771	phosphates	

Preliminary Facility Risk Mapping Data -- TAN Facility

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Map Dot.	Building Number	Chemical/Agent	Comments
1	603	asbestos	general area: boiler bouse
2	603	TCE	
2	603	acetone	
3	603	water treat chemicals	
4	603	noise	
6	604	acetone	maint welders
6	604	stoddard solvent	maint, welders
7	604	welding fumes	
8	604	noise	weld shop sandblastor
8	604	silica	Weld shop sandblaster
18	607	acids	main work area
19	607	external radiation	tAN bot cells
19	607	internal radiation	tAN hot cells
20	607	welding fumes	weld shop
20	607	mercury	machine shop
21	607	noise	
22	607	solvents	
24	609	petroleum products	mechanics workshop
24	609	stoddard solvent	mechanics workshop
12	615	acetone	
13	615	welding fumes	
25	636	noise	carpenter shep
25	636	paint/thinners	
5	664	oils	
5	664	anti-freeze	
9	667	acetone	
10	667	metals	drinding machine
11	667	noise	grinding machine
23	668	mild cleaners	
14	633/723	nitric acid	
14	633/723	sulfuric acid	
15	633/723	TCF	
15	633/723	Methylene Chloride	
15	633/723	stoddard solvent	
15	633/723	acetone	
15	633/723	alcohol	
17	633/723	ashestos	piping and aphaeter black to the

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Map Dot.	Building Number	Chemical/Agent	Comments
1	701	munitions	
31	703	sodium	contaminated sodium
31	703	NaK	contaminated sodium
31	703	external radiation	contaminated sodium
55	704	external radiation	fuel manufacture
36	706	welding fumes	
49	709	noise	
49	709	diesel fuel	
65	720	external radiation	reactor
2	742	fuels	motor fuel
58	752	external radiation	labs / Hot cells
59	752	acids and caustics	labs
60	752	laser	labs
46	753	solvents	maint bldg
47	753	noise	maint bldg
48	753	welding fumes	maint bldg
4	754	chlorine	
22	755	diesel fuel	fuel oil tank
8	757	asbestos	
3	759	high pressure gases	
3	759	motor fuels	
50	764	external radiation	susp stack
43	765	liquid argon	
51	765	external radiation	hot cells
52	765	noise	
53	765	solvents	mock-up area
54	765	mercury	IBC cooling
21	766	sodium	reactor coolant
18	767	sodium	reactor coolant
19	767	external radiation	reactor
5	768	PCBs	
7	768	sulfuric acid	·
16	768	acids and caustics	·
17	768	noise	air compressors
20	768	sulfuric acid	battery storage
28	769	solvents	haz mat storage
28	769	acids and caustics	haz mat storage
35	771	external radiation	
45	772	photo chemicals	
62	775	external radiation	
62	775	internal radiation	
64	775	beryllium	
61	776	external radiation	reactor
34	779	biological hazard	sewage lagoon
41	781	liquid nitrogen	
38	782	welding fumes	machine shop
39	782	solvents	machine shop
40	782	noise	machine shop

Preliminary Facility Risk Mapping Data -- ANL Facility

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Map Dot.	Building Number	Chemical/Agent	Commente
63	784	external radiation	Comments
63	784	internal radiation	
23	· 785	external radiation	
24	785	hydraulic fluids	· · · · · · · · · · · · · · · · · · ·
42	785	liquid argon	
44	785	compressed gas	various types
66	787	external radiation	fuel assembly
66	787	internal radiation	fuel assembly
6	788	cleaning solvents	
37	788	welding fumes	maint bldg
11	793	sodium	
11	793	NaK	
30	794	external radiation	rad storage bldg
67	795	liquid nitrogen	
33	797	external radiation	
27	798	external radiation	
56	704A	noise	compressor
26	750C	Heavy metals	industrial waste pond
57	752A	noise	diessel generator
9	757-A	acids and caustics	
15	768E	cleaning solvents	
29	783A	Fuels/Oils	motor fuel
12	785A	Water Treatment chemicals	
13	793A	Alcohol	alcohol storage
14	793B	Alcohol	
10	793-C	external radiation	rad storage bldg
68	799A	caustics	

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Appendix A2

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Building Risk Mapping Results (Database Report)

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Chemical	TCE	HF	cadmium Sulfate	Chronic Acid	Mercuric Nitrate	Soda Ash	External Radiation	External Radiation	Uramium	Zirconium	welding fumes	Acetone	Lead	cutting oils	mercury	1.CE	NaK	NaK	NaK	NaK	hcat	hcat	licat	heat	noise	noise	noise	noise	Nitric Acid	ashestos	aspesitos	asbestos	External Radiation	Nitric Acid	External Radiation	Internal Radiation	External Radiation	Lixternal Radiation	Internal Kaduation	Internal Kadiation	Nitric Acid	Nitrie Acid	Aak Nak	Nak	lica	hcat	Nitric Acid	Freened Radiation				
Process/	Entire Building	Make-up Arca	PM Area	Make-up Area	Make-up (AL-Diss.)	Make-up Arca	Sample Corridor	Sample Corridor	Machine Shop	Machine Shop	Weld Shop	Weld Shop	Machine Shop	Machine Shop	Instrument Shop	Instrument Shop	Furnace Area	Furnace Arca	Furnace Arca	Furnace Area	Furnace Area	Furnace Arca	I-urnace Area	Furnace Area	Furnace Arca	Furnace Area	Furnace Arca	Furnace Area	PM Arca	PM Area	PM Arca	PM Area	cells	cells	fuel storage tanks	fuel storage tanks	fuel storage tauks	fuel storage tanks	off-gas cell	off-gas cell	Calciner Cell	Calciner (Cell	Calciner Cell		Calciner Cell	(alciner (ell	PNI AFCA	I'NI AICA				
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Building Name	Old Machine Shop	Process Bldg - PM Arca	Process Bldg - PM Area	Process Bldg-Op&Samp	Process Bldg-Op&Samp	Old Maintenance	Old Calciner	Old Calciner	Old Calciner	Old Calciner	Old Calciner	Old Caleiner	Otd Calciner	Old Calciner	Old Calciner	Old Calciner	Old Calciner	Old Calciner	Old Calciner	Old Calciner	Old Calciner	Old Calciner	Old Calciner	Old Calciner	Old Calciner	Old Calciner	Old Calciner	Old Calciner	Old Calciner	Old Calciner	Old Calciner	Old Catciner	Old Calciner	Old Caleiner	Old Calciner	Old Calciner	Old Calciner															
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在1990年代的中國國際國際部務部長的1991年1月1日。

-	Facility	Building Name	Bldg	Map	Start	Stop	Process/	Chemical/	Dot	Exp	Rank	Freq	ä	Job	Nun
. 16	CFA	Old Machine Shop	640	CF-640	55	6L	Entire Building	TCE	-	Low	-	3	3	machinist	16
61	СРР	Old Calciner	633	CPP-633-2			cells	External Radiation	~	High	9	~1	20	pipefitter	
20	CPP	Old Calciner	633	CPP-633-2			cells	External Radiation	*	High	2	•	20	electrician	
24	CPP	Old Calciner	633	CPP-633-2			cells	Internal Radiation	∞	High	01	7	3	welder	
25	СРР	Old Calciner	633	CPP-633-2			cells	Internal Radiation	∞	High	0	2	30	pipefuter	
126	СЪЪ	Old Calciner	633	CPP-633-2			cells	Internal Radiation	*	High	9	5	50	clectrician	
8	CP-	Old Calciner	633	CPP-633-2			cells	Nitric Acid	6	High	9	•	50	welder	
131	СРР	Old Calciner	633	CPP-633-2			cells	Nitric Acid	6	High	9	2	50	pipefitter	
32	CPP	Old Calciner	633	CPP-633-2			cells	Nitric Acid	6	High	01	2	30	electrician	
33	СРР	Old Calciner	633	CPP-633-2			cells	Nitric Acid	<u>م</u>	High	9	7	30	HP Techs	
117	СРР	Old Calciner	633	CPP-633-2			cells	External Radiation	80	Medium	s	∞	40	Operator	
13	CPP	Old Calciner	633	CPP-633-2		1	cells	Internal Radiation	×	Medium	S	×	40	Operator	-
129	CPP	Old Calciner	633	CPP-633-2		1	cells	Nitric Acid	6	Medium	\$	*	40	Operator	
121	CPP	Old Calciner	633	CPP-633-2			celis	External Radiation	*	High	0	æ	8	HP Techs	
127	СРР	Old Calciner	633	CPP-633-2			cells	Internal Radiation	80	High	9	~	8	HP Techs	
2	CPP	Process Bldg - Acc. Corr.	109	CPP-601-1			G&H Cell	External Radiation		High	9	0.1	-	Instrument Tech	0
14	CPP	Process Bldg - Acc, Corr.	109	CPP-601-1			G&II Cell	Internal Radiation	7	High	0	0.1	-	Instrument Tech	0
51	C.P.	Process Bldg - Acc. Corr.	109	CPP-601-1			K Cell	llexone	S	Norl	-	6	3	Operator	0
22	CPP	Process Bldg - Acc, Corr.	109	CPP-601-1			K Cell	licxone	S	Low	-	3	2	Helper	0
61	CPP	Process Bidg - Acc. Corr.	109	CPP-601-1			G&II Cell	Nítric Acid	4	Mcdium	Ś	2	2	Operator	0
20	CPP	Process Bldg - Acc. Corr.	3	CPP-601-1			G&H CeH	Nitric Acid	4	Medium	\$	``	9	Helper	0
22	CPP	Process Bldg - Acc. Corr.	109	CPP-601-1			Corridor	External Radiation	2	Medium	5	2	9	Operator	0
80	CP ⁰	Process Bldg - Acc. Corr.	10 <u>8</u>	CPP-601-1			G&II Cell	External Radiation	-	High	2	. 2	50	Operator	0
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11	CPP	Process Bldg - Acc. Corr.	109	CPP-601-1			C&II Cell	Turco 4502	~	High	01	7	50	Helper	0
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54	ŝ	Process Bldg - Acc. Corr.	108	CPP-601-1			Centrifuge	External Radiation	¢	High	<u>o</u> .	<u></u>	2	Helper	0
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113	TAN	Manufacturing and Assembly	607	TAN-607-1			Pipe Laundry	Nitric Acid	÷	worl	-	<u>ر</u> ب	~·	mechanic	
114	TAN	Manufacturing and Assembly	607	1-209-NVJ.			Pipe Laundry	101	≘	l.ow	-		<u></u> .	. pipetitter	
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51	TAN	Manufacturing and Assembly	603	TAN-607-1	2	5	Sandblast	External Radiation	. 15	Tow	-	<u></u>	~	painter	
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Process/ Entire Building	Saudblast	Highbay	llighbay	Highbay	llightay	Highbay	Highbay	Highbay	Highbay	tool crib	machine shop	machine shop	machine shop	machine shop	Decon Shop	Respirator Shop	Respirator Shop	I for Cell 109	Hot Cell 109	Not Cell 109	Hot Cell 109	Hot Cell 109	Hot Cell 109	Heat Cell 109	Hot Cell 109	Hot Cell 109		Hot Cell 109	Hot Cell 109	Hot Cell 109	Hot Cell 109	Hot Cell 109	Hot Cell 109	Hot Cell 109	Hot Cell 109	Hot Cell 109	Hot Cell 109	Hot Cell 109	Hot Cell 109	Hot Cell 109	Hot Cell 109	Hot ('ell 109	Hot Cell 109	Hot Cell 109	Hot Cell 109 Her Cell 109	1101 C CH 109						
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Building Name	Manufacturing and Assembly br>Manufacturing and Assembly	Manufacturing and Assembly	Manufacturing and Assembly	Manufacturing and Assembly	Manufacturing and Assembly	Manufacturing and Assembly	Manufacturing and Assembly	Manufacturing and Assembly	Manufacturing and Assembly	Manufacturing and Assembly	Manufacturing and Assembly	Manufacturing and Assembly	Manufacturing and Assembly	Manufacturing and Assembly	Manufacturing and Assembly	Manufacturing and Assembly	Manufacturing and Assembly	Manufacturing and Assembly	Manufacturing and Assembly																																	
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e	Facility	Building Name	Bldg	Alap	Start	Stop	Process/	Chenical/	Dot	Exp	Kank	- Fre	q DF	Job	Num
161	CFA	Old Machine Shop	640	CF-640	55	61	Entire Building	rce	-	Low	-	2	2	machinist	16
252	TAN	Manufacturing and Assembly	607	TAN-607-2			1 for Cell 109	gold	24	Low	-	2	3	Hot Cell Techs	
233	TAN	Manufacturing and Assembly	607	TAN-607-2	•		1 fot Cell 109	gold	24	Low	-	2	2	laborer	-
254	TAN	Manufacturing and Assembly	607	TAN-607-2			Hot Cell 109	halfnium	24	Low	-	2	2	Decon Techs	
255	TAN	Manufacturing and Assembly	607	TAN-607-2			1 kot Cell 109	halfuium	24	Low	-	2	2	Ilot Cell Techs	
256	TAN	Manufacturing and Assembly	607	TAN-607-2	1		Ilot Cell 109	halfnium	24	Low	-	2	5	laborer	-
57	TAN	Manufacturing and Assembly	607	TAN-607-2			Hot Cell 109	Nitric Acid	32	low	-	2	2	Decon Techs	-
258	TAN	Manufacturing and Assembly	607	TAN-607-2			Hot Cell 109	Nitric Acid	22	Low		2	2	Hot Cell Techs	
259	TAN	Manufacturing and Assembly	607	TAN-607-2			Hot Cell 109	Acetic Acid	25	Low	-	2	2	Decon Techs	-
500	TAN	Manufacturing and Assembly	607	TAN-607-2			Hot Cell 109	Acetic Acid	25	tow	_	3	2	Hot Cell Techs	
262	TAN	Manufacturing and Assembly	607	TAN-607-2			Hot Cell 109	Internal Radiation	26	Low	-	2	2	Decon Techs	
596	TAN	Manufacturing and Assembly	607	TAN-607-2			Instrument Shop	mercury	t 3	Low	-	3	7	Instrument Tech	
663	TAN	Manufacturing and Assembly	607	TAN-607-2			electrical shop	copper	46	l.ow	-	2	2	electrician	
ŝ	TAN	Manufacturing and Assembly	607	TAN-607-2			electrical shop	ashestos	47	l.ow		3	2	electrician	
ī	TAN	Manufacturing and Assembly	607	TAN-607-2			electrical shop	PCBs	48	Low	-	7	7	electrician	
347	TAN	Manufacturing and Assembly	607	TAN-607-2		-	Storage Pool Area	External Radiation	8	Low	-	7	2	mechanic	
348	TAN	Manufacturing and Assembly	607	TAN-607-2			Storage Pool Area	External Radiation	99	worl	-	3	, 17	pipefitter	
349	TAN	Manufacturing and Assembly	607	TAN-607-2			Storage Pool Area	External Radiation	99	Low	- ;	3	3	welder	:
350	TAN	Manufacturing and Assembly	607	TAN-607-2			Storage Pool Area	External Radiation	99	worl	-	'	2	technician	
117	TAN	Manufacturing and Assembly	607	TAN-607-1			Pipe Laundry	Chromium	=	Low		*	~	pipefitter	
118	TAN	Manufacturing and Assembly	607	TAN-607-1			Pipe Laundry	noise	12	1.ow		*	**	Decon Techs	
611	TAN	Manufacturing and Assembly	607	TAN-607-1			Pipe Laundry	noise	<u>ମ</u>	1.ow	-	~	••	pipefitter	
174	TAN	Manufacturing and Assembly	607	TAN-607-1			stainless steel shop	Chromium	28	worl	-	*	°.	pipefitter	
269	TAN	Manufacturing and Assembly	607	TAN-607-2			Hot Shop 101	Internal Radiation		worl	-	90 : : : :	•••	Decon Techs	;
<u></u> 300	TAN	Manufacturing and Assembly	607	TAN-607-2			x-ray cave	l.rad	53	Nor	[·]	20	20	quality assurance	
89	TAN	Manufacturing and Assembly	607	TAN-607-1			Decon Shop	Actore	ب م :	Medium	s	3	3) electrician	
\$	TAN	Manufacturing and Assembly	69	TAN-607-1			Decon Shop	Methylene Chloride	۲	Medium	S	, <mark>, ,</mark>	3	electrician	
97	TAN	Manufacturing and Assembly	607	TAN-607-1			Decon Shop	Lead	4	Medium	s :	~	2) mechanic	
86	TAN	Manufacturing and Assembly	667	1-209-NVJ.			Decon Shop	Lead	4	Medium	<u>s</u>	1 1	3 	Decon Techs	
123	TAN	Manufacturing and Assembly	607	TAN-607-1	02	8	Sandblast	l.cad	<u>د</u> ا	Medium			2) painer	
124	TAN	Manufacturing and Assembly	603	TAN-607-1	2	8	Sandblast	Lead	<u>.</u>	Nedium	<u>s</u>	-	<u> </u>	laborer	
125	IAN	Manufacturing and Assembly	601	TAN-607-1	2	2	Sandblast	Lead	<u></u>	Medium	<u>s</u>		≝ : 	D prechanic	
126	LVN	Manufacturing and Assembly	607	TAN-607-1	2	£	Sandblast	chronnium	4	Medium	~ ~	-t (<u> </u>	painter	
127	TAN	Manufacturing and Assembly	609	TAN-607-1	2 2	8	Sandblast	Chromium	4 1	Mcdium	<u> </u>		¥ 9) laborer	
147	TAN	Manufacturing and Assentity	209	TAN.607-1	2	6	Llinhhav	CHEOMIUM	± 2	Medium	• •	-		D mechanic	
148	TAN	Manufacturing and Assembly	209	TAN-607-1			Hichhav	Lead	: 2	Median	- vi		- 2		
149	TAN	Manufacturing and Assembly	607	TAN-607-1			linghbav	Lead	•	Mediun			: 9 	mechanie	
150	I'AN	Manufacturing and Assembly	607	TAN-607-1			Highbay	Lead	61	Medium	~		91) electrician	
152	NV.I.	Manufacturing and Assembly	607	TAN-607-1	8	92	1 fighbay	Beryllium		Medium	<u>s</u>		10) mechanic	
99 192	TAN	Manufacturing and Assembly	607	TAN-607-1			tool crib	Acetone	7	Medium	s.		2 	I tool crib attendent	
167	NV.L	Manufacturing and Assembly	607	TAN-607-1			tool crih	alcolol	7	Medium	s		≚ 	0 twol crib attendent	
691	TAN	Manufacturing and Assembly	607	TAN-607-1			stainless steel shop	Actime	26	Medium	s.		×) pipefiller	
170	TAN	Manufacturing and Assembly	603	TAN-607-1			stainless steel shop	Accione	36	Medium	Ś		¥) welder	
175	NV.I.	Namifacturing and Assembly	603	TAN-607-1	•		staintess steel slup	arc flashes	£.	Medium	~		З) welder	
176	1.AN	Manufacturing and Assembly	69	TAN-607-1			stainless steel shop	are flashes	£.	Medium	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	- i	¥) i pipefiter	
171	TAN	Manufacturing and Assembly	607	TAN-607-1		· .	stainless steel shop	arc flashes	ę.	Medium	<u>~</u>	-1 	≝) nechanic	
18	TAN V	Manufacturing and Assembly	607	TAN-607-1	7	æ :	carbon steet pipe she	t welding fumes	F	Medium	~		¥) pipefater	
<u>8</u>	TAN	Manufacturing and Assembly	607	TAN-607-1	7	æ	carbon steel pipe she	ap I mise	2	Nedium	~ ~	~ .	≍) pipefitter	
8	TAN	Manufacturing and Assembly	69	TAN-607-1			machine ship	Berylium	8	Medium		-1 	¥ 	D Experimental Machinist	
81	TAN	I Manufacturing and Assembly	609	TAN-607-1			machine shop	nickel	8	Medium	<u>~</u>	-1 ·	Ξ.	Experimental Machinist	
22	NVL	Manufacturing and Assembly	109	H-/09-NV1			Decon Shap		= :	Medium	<u> </u>		≍ : 	Decon Techs	
2	2	Nanutacturing and Assembly	20	H-/09-NV1		•	Decon Shop	Ē	<u> </u>	Meduan	<u> </u>		× 1	Decon Techs	
-	NVI	MARINACTURING AND ASSCINDED	(8)	11-/00-NIV1			date notati	MCCHC MCH	2	i Neoluli			=	I I PECON LECUS	

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Job	machinist	Decon Techs	Decon Techs	Instrument Tech	Instrument Tech	quality assurance	quality assurance	quality assurance	quality assurance	sheet metal worker	mechanic	pipefitter	technician	laborer	technician	laborer	nechanic	welder	pipefitter	nechanic	welder	technician	pipefitter	mechanie	pipefatter	electrician	welder	laborer	mechanic	pipefitter	laborer	mechanic	pipetitier	tauca cu	DUMPHIA	electrician	laborer	mechanic	pipefuter	laborer	electrician	Decon Techs	haborer	Experimental Machinist	Experimental Machinist	laborer	laborer .	laborer	laborer	laborer .	Decon Techs	Decon Techs	Decon Leens t
DF	- -	9	2	9	2	2	0	2	9	10	0	0	10	9	10	01	01	91	2	01	9	9	01	50	20	20	30	30	20	20	2	2	88	5 5	9 9	2 2	8	2	2	۶.	2	2	2	2	2	2	2	2	8	2	8	R 9	50
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Exp	1.ow	Medium	Medium	Medium	Mcdium	Medium	Medium	Mcdium	Medium	Mcdium	Mcdium	Medium	Medium	Medium	Medium	Mediuna	Medium	High	ligh	ligh	High	lligh	lligh	High	l igh	High	۲ ۱۱ (kh	ug i	Hich	Hish Hish	High	lfigh	High	High H	High	High	High	High	light :	lhgh													
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Chemical/	TCE	Astustos	Acetone	Acetone	frcon	x-ray chemicals	sitver	iron oxide	maga glow	noise	Acetone	Acetone	Acetone	Acetone	Methylene Chloride	Lead	Lead	1.cad	Lead	TCE	TCE	TCE	ICE	TCE	Acetone	Acctone	Acetone	Methylene Chloride	Methytene Chloride	Nicinylene Chioride	External Padiation	Externel Rediation	lixternal Radiation	lleat	licat	Heat	licat	TCE	silica	Berythum	Chronium	31.31.	perchlorocthylene	Acctime	suxklard solvent	sodium hydroxide	Nitric Acid	turco 4518	Ruco 4527				
Process/	Entire Building	Decon Shop	Respirator Shop	Instrument Shop	Instrument Shop	x-ray area developing	x-ray area developing	quality assurance area	quality assurance area	sheet metal shop	Hot shop	hot shop	hot shop	hot shop	Hot Shop	Hot Shop	Hot Shop	1 lot Shop	Hot Shop	Hot Shop	Hot Shop	Ilot Shop	Hot Shop	Decon Shop	Decon Shop	Decon Shop	Decon Shop	Decon Shop	Decon Slup	Decon Shop	Decon Shop	Decon Shop	Decon Shop		Decon Stop	Decon Ship	Decon Shop	Pipe Laundry	Sandblast	llighbay	machine slup	decon Shap	Decon Shop	Decon Shop	Decon Shop	Decon Shop	Decon Ship	Decon Shop	Decon Shop				
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Map	CF-640	FAN-607-11	TAN-607-2	TAN-607-1	TAN KIT.	TAN-607-1	1-209-NVJ	TAN-607-1	1-/09-NV1	TAN-607-1	1-708-MAT	TAN-607-1	TAN-607-1	TAN-607-1	1-209-NV.L	1-708-UAT	1-209-NVJ	-1-209-NVJ.	H-209-NVJ.	II-209-NVJ	TAN-607-11	TAN-607-11	H-209-NVJ.	TAN-607-H	TAN-607-11	TAN-607-11																											
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	Entire Building		Decon Shop	Decon Shop	Dccon Shop	Hot Cell 109	Hot Cell 109	Llot Shop 101	Hot Shop 101	Weld Shop (Warm Shop)	Weld Shop (Warm Shop)	Weld Shop (Warm Shop)	Hot Shop	I lot Shop	Hot Shop	Hot Shop - Filter Room	Hat Shop - Filter Room	Hot Shop - Filter Room	Hot Shop - Filter Room	Highbay	llighbay	Highbay	Ilighbay	lighbay	stainless steel shop	stainless stocl shop	stainless steel shop	machine shop	Hot Shop 101	Weld Shop (Warm Shop)	Weld Shop (Warin Shop)	Decon Shop	Deceil Shop	Decon Shop	Decon Shop	Decon Shop	Sandblast	Sandblast	Sandblast	Highbay	Highbay	stainless steel shop	stainless steel shop	carbon steel pipe shop	carbon steel pipe shop	machine shop	Decon Shop	Decon Shop	Decon Shop	Decon Shop	Decon Shop	Decon Shan
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racuity	building Name	apid	deiv	Start	Stop	Process/	Chemical/	Dot	Exp	Rauk	Freq	DF	Job	Num
CFA	Old Machine Shop	640	CF-640	55	62	Entire Building	TCE	-	Low	-	2	5	machinist	91
TRA	Advandced Test Reactor	670	TR670-1B			cubicles	kad	11	low	-	2	~1	pipefuter	
TRA	Advandced Test Reactor	670	TR670-1B	-		cubicles	lead	17	low	-	2	5	HP Techs	
TRA	Advandced Test Reactor	670	TR670-1B			sample corridor	Nitric Acid	81	Nol	-	2	2	Reactor operator	
TRA	Advandced Test Reactor	670	TR670-1B			Ifeat Exchanger Area	External Radiation	61	Low	1	2	2	process operator	1 1
TRA	Advandced Test Reactor	670	TR670-1B			Heat Exchanger Arca	External Radiation	61	Low	1	2	2	mechanic	•
TRA	Advandced Test Reactor	670	TR670-1B			cubicles	External Radiation	20	Low	-	2	7	mechanic	:
TRA	Advandced Test Reactor	670	TR670-1B			cubicles	External Radiation	20	low	-	2	2	pipefitter	
TRA	Advandced Test Reactor	670	TR670-1B			cubicles	External Radiation	20	Low	-	2	2	process operator	
TRA	Advandced Test Reactor	670	TR670-1B			cubicles	External Radiation	20	Low	-	2	2	Reactor operator	
TRA	Advandced Test Reactor	670	TR670-1B			safety rod corridor	External Radiation	21	worl	-	2	2	mechanic	
TRA	Advandced Test Reactor	670	TR670-1B			safety rod corridor	External Radiation	21	Low	-	2	2	process operator	
TRA	Advandced Test Reactor	670	TR670-1B			safety rod corridor	External Radiation	21	Low	-	2	2	IIP Techs	
TRA	Advandced Test Reactor	670	TR670-2B			Pile Area	Acetone	23	Low	-	2	2	mechanic	
TRA	Advandced Test Reactor	670	TR670-2B			Pile Area	Vd1	23	Low	-	2	2	mechanic	
TRA	Advandced Test Reactor	670	TR670-2B		- Tompoortunation and a state	Pile Arca	lead	24	Luw	-	2	2	nechanic	
TRA	Advandced Test Reactor	670	TR670-2B			Bypass Demand Regeneration	sulfuric acid	25	Low	-	2	2	process operator	
TRA	Advandced Test Reactor	670	TR670-2B			Bypass Demand Regeneration	sodium hydroxide	25	Low	_	7	2	process operator	
TRA	Advandced Test Reactor	670	TR670-2B			Exhaust Blower Room	noise	26	low	-	3	2	mechanic	
TRA	Advandced Test Reactor	670	TR670-2B			Exhaust Blower Room	noise	56	low	-	2	2	process operator	
TRA	Advandced Test Reactor	670	TR670-2B			Exhaust Blower Room	noise	26	Low	-	64	~	Reactor operator	
TRA	Advandced Test Reactor	670	TR670-2B			Exhaust Blower Room	noise	26	how		~	3	HP Techs	
TRA	Advandced Test Reactor	670	TR670-3B			Rod Access Floor	External Radiation	27	Norl	-	5	3	process operator	
TRA	Advandced Test Reactor	670	TR670-3B			Rod Access Floor	Internal Radiation	27	worl	-	7	C 1	process operator	
TRA	Advandced Test Reactor	620	TR670-1F			Entire Building	Turco xx	4	worl	-	~	~	laborer	
TRA	Advanced Test Reactor	670	TR670-1F			Tank/Nozzłe Trench	welding fumes	-	Low	-	*	30	welder	
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TRA	Advandced Test Reactor	670	TR670-1F			Repair Area	welding fumes	٢	Norl	-	*	*0	welder	•
TRA	Advandced Test Reactor	670	TR670-1B			cubicles	lead	17	low	-	*	**	Reactor operator	-
TRA	Advandced Test Reactor	670	TR670-1F			Diesel Generator Pit	noise	4	High	0	-	2	mechanic	
TRA	Advandced Test Reactor	670	TR670-1F			Deisel Generator Pit	noise	4	lligh	2	4	40	process operator	
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Appendix B:

Risk Map Exposures

(Job Classification / Chemical) count of all exposure entries (high, medium and low)

Appendix B1: Matrix of Exposures by Facility Appendix B2: Matrix of Exposures by CFA Buildings Appendix B3: Matrix of Exposures by CPP Buildings Appendix B4: Matrix of Exposures by TRA Buildings Appendix B5: Matrix of Exposures by TAN Buildings

Appendix B1:

Matrix of Risk Mapping Exposures by Facility

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Table 1. Risk Map Exposures (All Facilities – CFA, CPP, TRA, TAN) Table 2. Risk Map Exposures (CFA) Table 3. Risk Map Exposures (CPP) Table 4. Risk Map Exposures (TRA) Table 5. Risk Map Exposures (TAN)

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Job Titles vs. Chemical/Agent (CPP Risk Map Data)

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Job Titles vs. Chemical/Agent (TAN Risk Map Data) 09/09/1998

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Job Titles vs. Chemical/Ager	(I KA KISK Map Uata)
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Job Titles vs. Chemical/Agent (CFA Bldg. 640 Risk Map Data)

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cutting fluid		1	
Acetone			
alcohol		-	-
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Lead	A REAL PROPERTY AND AND A REAL PROPERTY AND A	2	- ~
nickel			1
Nitric Acid	:	• • •	- : -
noise	-	•	- ~
TCE			1 -
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Job Titles vs. Chemical/Agent (CFA Bldg. 654 Risk Map Data)

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Appendix B3:

Risk Map Exposures for CPP Buildings

25 9 Grand Total pipefitter 0 2 r N Operator Job Titles vs. Chemical/Agent (CPP Bldg. 601 Risk Map Data) 2 Ö З ŝ N Instrument Tech mechanic 4 e 2 5 HP Techs G \mathfrak{c} \sim Helper CPP dol 601 Chromic Acid External Radiation sodium hydroxide Sulfuric Acid **Sadalidium Oxide** nternal Radiation cadmium Sulfate Ammon. Hydrox. **Mercuric Nitrate** Count of Exp **Boric Acid** Chemical/ Asbestos Nitric Acid Soda Ash Hexone Facility MIBK Bldg

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Turco 4502 Grand Total pvt_idB_chem_Job1

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Job Titles vs. Chemical/Agent (CPP Bldg. 630 Risk Map Data)

Facility	СРР			
Bldg	630			
Count of Exp	Job			
Chemical/	Instrument Tech	machinist	welder	Grand Total
Acetone			-	
cutting oils	-			- r
Lead		· -		
Mercury		_		
TCE	- -	•		
Uranium		: -		
welding fumes				
Zirconium	The second			
Grand Total	2	4	6	- α
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Job Titles vs. Chemical/Agent (CPP Bldg. 633 Risk Map Data)		
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Job Titles vs. Chemical/Agent (CPP Bldg. 601 Risk Map Data)

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····	Facility	Bldg	Count of Exp	Chemical/	External Radiation	Hexone	Internal Radiation	Nitric Acid	Turco 4502	Grand Total	

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Appendix B4:

Risk Map Exposures for TRA Buildings

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Facility											5	ĥ
Chemical/	electrician	Hb Lechs	Instrument Tech	insulators	mechanic	bibetitter	process operator	reactor engineer	sponser engineer	utility operator	welder	Brand Total
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Asbestos											4	L
Beryllium		. 1				L	L .	L			ļ	4
cadmium		L			2		L	L			1	ε
chlorine		į					L	L				ς.
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Heat		L	L	Ĺ	្រ	L	: L			÷	Ļ! I	L s
Internal Radiation		-				:	:	1	:	;	ļ	3 8
Lead	ι	ε	L	L	ε	2	ε	L	L	L	Ļ	31
Mercury		L			ε		ε				Ļ!	8
nickel							L	L	1			2
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Job Titles vs. Chemical/Agent (TRA Bldg. 642 Risk Map Data)

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Appendix B5:

Risk Map Exposures for TAN Buildings

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Job Titles vs. Chemical/Agent (TAN Bldg. 633 Risk Map Data)

Facility	TAN	
Bldg	633	
Count of Exp	dob	
Chemical/	Decon Techs	Grand Total
Acetone	1	1
alcohot		
cadmium		• ~
External Radiation	4	4
gold		
halfnium		
H		• •
Internal Radiation	4	4
Lead	1	
Mercury	1	
Methylene Chloride		
nickel		• ; ~
Nitric Acid		
platinum		- - - -
silver	1	
sodium hydroxide		
stoddard solvent	-	· .
Sulfuric Acid		
TCE		
Grand Total	25	25
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	Appendix C:
	High Exposure Ranking Matrix
	(Job Classification / Chemical)
	Table 1. High Exposure Ranking (All Facilities – CFA, CPP, TRA, TAN) Table 2. High Exposure Ranking (CFA) Table 3. High Exposure Ranking (CPP) Table 4. High Exposure Ranking (TRA) Table 5. High Exposure Ranking (TAN)
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High Exposure Ranking (CFA, CPP, TRA, and TAN Risk Map Data) ſ

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Appendix D:

Average Dose Factor Matrix

(Job Classification / Chemical)

Table 1. Average Dose Factor (All Facilities – CFA, CPP, TRA, TAN) Table 2. Average Dose Factor (CFA) Table 3. Average Dose Factor (CPP) Table 4. Average Dose Factor (TRA) Table 5. Average Dose Factor (TAN)

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Average Dose Factor by Job Title	(CFA, CPP, TRA, and TAN Risk Map Data)
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- 1. Introduction
- 2. Demographic Breakdown
- 3. Report of Focus Group findings by topic

4. Observations

5. Recommendations

1. INTRODUCTION

Focus Groups-Description

In phase I, former INEEL workers are participating in risk mapping sessions to collect qualitative exposure data to determine exposures associated with buildings, processes and job classifications. Former workers are also filling out questionnaires about prior exposures, job histories, health concerns and current health care. However, neither of these vehicles can answer the type of indepth questions which are of tantamount importance in developing the best possible medical surveillance program. Therefore, focus group assessments of former workers were conducted in order to determine workers perceptions of their own and their co-workers occupational health risks, the desirability and expectations of medical surveillance and high risk notification and the accessibility and use of health care services for follow-up needs after the medical surveillance program. Focus groups, are group interviews comprised of 8-14 persons designed to gain an in-depth perspective on a narrow range of topics. Questions on the specific topic move from the general to the specific and in the group discussion which follows, a wide range of responses can be elicited. Focus groups are an excellent way to fill in the gaps left by the risk mapping and the questionnaires.

Worker-investigators (OSHEC's) conducted both the risk mapping and the focus group sessions. For the focus groups, a standardized moderator guide was developed with assistance from the OSHEC's who also received training on the methods for properly conducting a focus group. Instruction to them included how to set the tone for the group, how to facilitate, how to remain neutral and avoid leading questions and how to create a respectful atmosphere. While one OSHEC moderated the session, another acted as the scribe. It was particularly valuable to have the OSHEC's to moderate the focus groups. Their status as current workers and their expanded expertise in occupational safety and health and in training methodology greatly enhanced the discussions. They were extremely respected and credible and garnered a high degree of respect from the participants.

Focus group format

Two focus groups were held on June 22, 1998 at the OCAW union hall in Idaho Falls, Idaho which represents the workers at INEEL. Both groups, moderated by OSHEC Gaylon Hanson and scribed by Dan Koste were 1 ½ to 2 hours in length and in both sessions the moderator followed the standard moderator guide (see Appendix A). All participants received a participant information sheet and signed informed consent forms, read aloud to the group. Each signature was witnessed by Sylvia Kieding, OCAW Health and Safety Coordinator. The participants were assured that all aspects of their participation in the project would remain confidential. They were then asked to consent to the audio taping of the sessions. The tape was turned on after people introduced themselves and every effort was made to protect participants identities during the taping.

3. DEMOGRAPHIC MAKE-UP

The morning focus group was comprised of 13 former workers, both hourly and salaried, chosen by the project team and by active OCAW retirees, led by James Colvin, for their knowledge of the INEEL facility based on many years of experience. This group also participated in the risk mapping session held on a date prior to the focus groups. The afternoon focus group was comprised of 10 former

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workers, both hourly and salaried, who were randomly selected and who had not previously participated in a risk mapping session.

Demographic Category	Expert group - AM	Random group PM	Total - both groups
Gender	13 male	9 male, 1 female	22 male, 1 female
Age (average)	67.3 years	67.2 years	67.2 years - total
Median	65	65	65
Years at DOE -INEEL site	32.2 years	25.1 years	29.1 years- total
Hourly employee	11	3	14
Salaried employee	2	7	9
Reason for leaving INEEL			
-Retirement	2	5	7
-Early retirement	6	5	11
-Voluntary separation package	2	0	2
-Other Off-the-job injury/ill "No longer do the work"	2	0	3
Race	White - 12, Asian - 1	White - 10	White - 22, Asian - 1
Marital Status	Married - 13	Married - 10	Married - 23
Educational Level			
-Some high school or less	2	0	2
Demographic Category	Expert group - AM	Random group PM	Total - both groups
-High school graduate	5	2	7
-Some college or advanced vocational training	4	4	8
-College degree	0	0	0

DEMOGRAPHIC BREAKDOWN

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-some post college graduate	1	1	2
-Graduate degree	1	2	3
-no answer	0	1	1
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- \$10,001 - \$20,000	3	2	5
-\$20,001 - \$30,000	6	1	7
-\$30,001 - \$40,000	1	3	4
-\$40,001 - \$50,000	2	1	3
-\$50,001 - \$70,000	1	1	2
-over \$70,000	0	1	1
-no answer	0	1	1
Religion			
-Protestant	4	4	8
-Other: Mormon	7	4	11
-Other: Own, None or no answer	2	2	4

Job Titles - Morning session: welders, press operators, machinist, mechanic, administrative, trainer, nuclear engineer, planner/estimator, utility operator, utility coordinator

- Afternoon session: engineers, reactor engineer, scientific specialist, RN, engineering

technician, pipe fitter, industrial safety engineer, medical technologist, industrial hygienist

3. REPORT OF FOCUS GROUP FINDINGS BY TOPIC

The following is a breakdown of responses to questions posed by the moderator. Every effort was made to have the report follow the topics exactly as they appeared in the moderator guide. However, for continuity sake, responses to questions 2-4 of topic I, can be found under topic II in this report. These findings are based on responses by both focus groups taken together. Within each topic, the findings are broken up into the major themes that were being expressed by a number of the people in both groups.

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TOPIC I: HEALTH CONCERNS - PERCEPTION OF OCCUPATIONAL HEALTH RISKS

Questions: Participants were asked if they think they are personally at risk for an occupationally-related health problem and they are asked to rate that risk (1-10). They were also asked their perceptions of risks faced by co-workers.

THEMES

1. Participants believe a serious health risk exists for them because of unsafe conditions in the industry in the early years (ie. 20 years ago).

The major concerns raised by the participants were:

- <u>Radiation</u> Participants said they witnessed and often participated in extremely unsafe practices. Workers were forced to perform unsafe acts with "hot" material or witnessed radioactive material being disposed of improperly. Finally, workers were very concerned that the radiation badges were not accurate and not properly processed. They also felt they didn't receive enough information about how much radiation they received if the badge exceeded the limit. Workers reported being sent by management into extremely "hot" areas considered very dangerous, but were removed after short periods. Workers believed they received massive doses of radiation during those periods. Also, workers sometimes did not wear their radiation badges to avoid exceeding their radiation limit. Once the limit was exceeded, they were moved to other less desirable jobs.
- <u>Lead</u> In order to protect themselves against what they perceived to be excessive radiation levels, the workers would fashion their own lead shielding by cutting or burning lead into whatever size protections were needed. They were exposed to lead fumes and lead dust rather extensively and often in confined spaces yet wore no respirators or gloves.

Asbestos - Many participants were required to rip out asbestos with no protection.

Beryllium - Work was done inside the reactor by hand, using beryllium.

- Mercury Large amounts were used in the processes and workers were exposed sometimes, without protection
- <u>Chemicals</u> Regular use of unidentified chemicals was reported. Floors were cleaned for example with trichloroethane. Also mentioned were chromates and nitric acid.
- Other: Cadmium, Chromium, Noise, Heat Stress, Second hand smoke.

The major health concern expressed by the participants was cancer. They particularly mentioned bone cancer, leukemia and thyroid cancer. Unusual, difficult to diagnose radiation related problems are a fear, for example, one man suffers from monoclonal gammopathy an unusual cell problem. They often mentioned fear that the radiation seeped into or otherwise penetrated their bones and joints. Health concerns for themselves and co-workers based on the above exposures are illustrated by the following quotes.

"We used to get a lot of stuff in from Rocky Flats, from the Burial grounds, ...you had leaking barrels coming in from there, so you didn't know what kind of chemicals you were exposed to really."

"The worst thing that worries me is that they used to send us out to that cutting facility, CPP, and put us in that lead cask and put us down there, and never tell us how much radiation we got...they just say you're burned out."

"In my 40 years I was exposed to radioactive dust which probably had some radium in it."

"I'm a real living type instrument. About 1990, they decided I had a "monoclonal gammopathy" of undetermined significance...the books at the hospital say that one of the things that can give you this is radiation. It leads to bone cancer is what it does. There's a lot of guys that I know at the site had cancer of some kind. What happens is that there is one cell that just keeps cloning itself over and over and over and it pushes out other cells. So, I have a weakness in upper respiratory because of that."

"We were always using lead, every day we were handling lead. It was a shielding medium and we used it. Go in mold it around a piece of hot equipment, and you were always exposed to radiation, chemicals, mercury."

"When you had a "hot" sample or piece of equipment, you just built a lead barricade, stuck your arms around it and worked at it."

"As a chemist I know, there was radiation exposure and asbestos exposure - there was a lot of that and there was a lot of lead - those were the major ones."

"I can remember days we waded in asbestos to our knees."

2. In the early years, the management/government responsible for the facility did not do enough to protect the workers.

Most participants believed that it was only natural that as time passed, more was learned about the dangers of the hazards with which they worked and that things improved gradually as a result of education and more stringent regulation. However, there was a real sense that the employer did whatever he felt he could get away with, often putting them a tremendous risk. They felt they were the guinea pigs regularly being put into situations which were obviously dangerous.

"Radiation monitoring, for example a film badge, I feel they were not all that accurate. ... If you didn't process a film badge accurately you could get erroneous readings. When we were using those we could have got far more exposure than we thought we were getting. We never got exact amounts."

"Over the long haul you could have gotten more or less radiation exposure than was put on your permanent record."

"Many situations were very poorly handled."

"We never had an HP."

"They weren't too conscious or careful 20 years ago"

"Until the last 10 years, never any protection against asbestos either"

"We were told to wear our dosimeters on our chests immediately under our lead aprons, which only covered us from our knees to our neck and open in the back. I told the health physicist to put lead apron on outside for more accurate reading or less instead of the exposure to legs, arms and back. That was one of my concerns for years."

"My biggest concern as an hp was the insulators and welders, they stuck them in the most horrible places for long periods of time. We didn't have a lot of them, 2 or 3 guys got stuck with the "hot" jobs consistently because they had

to be done accurately and quickly. They picked up a lot of exposure."

"We participated in the learning curve."

"Sometimes there was mercury everywhere - during the fabrication of one reactor, they really screwed up."

3. Participants felt angry that physicians at the facility inadequately cared for their occupationally related health concerns.

The focus group participants, as most Americans, have a basic trust for physicians and an expectation that they will be cared for. The fact that the physicians at INEEL seemed to have no interest in or understanding of the special occupationally related health concerns which they faced working in such obviously dangerous conditions, made the participants feel angry and betrayed. The group agreed that perhaps if these doctors had done their jobs better, they wouldn't feel as worried about their health today.

"You know I went out there in '54 and everything was a little bit on the inadequate side out there in the abilities of the doctors there and everything else at that time. One time I blacked out and fell down the steps and they hauled me to the dispensary, they checked me over and saw that I had been in the lead shop. They told me I had lead poisoning, see ya. Later, I blacked out again, they took a blood count on me, told me I had lead poisoning. A third time I went down, they took a blood sample and hauled me to town to take my appendix out, it was about to rupture."

"My feeling was, the only doctors they hired there were the ones who couldn't hold a business of their own."

"Medical after the SL1 accident, was just a - something should have been instituted for a long term study to see if there is something down the road that was going to occur. But this never happened, they just - life went on and we forgot about that."

"I was just so tired all the time, and cold, the last 2 years I worked there. I was taking my physicals there at the plant as they required there at central. Three years after I left there I found out I had a thyroid count of 2.3. The local doctor said, "aren't you tired", (I thought I'd found God). I said yes, I'd been that way for a long time. I feel better now than I have in 18 years. It might not have been caused by the plant, it might have been a natural thing, but why the hell didn't they find it."

"They never kept track of your medical radiation exposure to add it to the other totals."

"Not sure if asbestos ever bothered me, they never gave me a test"

"As a medical person, in the beginning we were exposed because when radiation patients would come down, we didn't have a real standard operating procedure as to how to wash them and how to protect ourselves."

"In medical - standard operating procedures were written up after we found a hazard - to cover our butts."

"He's an industrial health care person (plant doctor), he should know what's going on in the work area."

4. Former workers expressed concern for new workers and want them cared for.

Former workers feel strongly that prevention efforts should be undertaken for current workers. Again, while they feel conditions have improved, much more can and should be done in the area of prevention and especially in terms of better medical care for the current workers.

"They give you a physical at central - for us guys here, we're all washed up, but there's people out there right now that they might be able to help. If the union is interested in saving them, they ought to have some sort of a test to give to some of these suspect victims."

"For these workers today, there should be closer monitoring and monitoring of airborne exposures and stuff like that."

"This will benefit those coming up more than it will us who have been there and done it. You got to look at what can we do for the new guys that are coming in."

5. Participants felt that this program is raising workers' awareness about these issues.

Many focus group members felt that the focus groups, risk mapping and eventual health program are all helping to raise the awareness of the former workers about their exposures and their potential health problems. Many expressed a new found desire for more information.

"If the doctor knows what you have been exposed to he can help. But unless they know to look for specific things, they can miss it. But we often don't remember to tell him because it was part of the daily work."

"This group or your other groups might like to know, I would like to know what the latency period is for (things we were exposed to)...asbestos, beryllium, cadmium."

"We'd like to know, how long these things ... how long does some of this stay in your body and how much does your body wash it out?"

TOPIC II: HEALTH CARE DELIVERY/UTILIZATION ISSUES

Questions:

- 1. Participants were asked about their current needs and current medical programs. What health services they currently receive and where they receive these services.
- 2. Participants were also asked if they would participate in a health program, what they would like to see in the program and where/how would they like to see the program administered?
- 3. Finally, they were asked if they saw any roadblocks to participation in a health program.

THEMES - CURRENT MEDICAL CARE

1. Former workers are generally conscientious about current medical care despite insurance limitations.

Focus group participants currently follow basic preventive health regimens. Most were diligent about regular physicals and about following up on any unusual health symptoms. Those that don't have regular physicals are under the care of a physician for an ongoing health problem. Most expressed annoyance at the restrictions and problems associated with insurance coverage, particularly Medicare, but most successfully worked around whatever problems they encountered. "Medicare pays for part of it and what they don't pay my supplement does, if Medicare approves it."

"The biggest problem we notice is that if you just go in for a physical they won't cover it but if you go in, say you got an ailment, well, they'll give you an examination for that particular ailment and then Medicare would cover it."

2. Focus groups expressed trust and a preference for their personal physicians/distrust of occupational physicians.

Most participants rely on their primary physicians for their basic health needs and feel satisfied as far as it goes. If they are in need of specialty care they head to bigger medical facilities either in Idaho or in Salt Lake City, Utah. Occupational physicians in the community are not trusted by the participants because they see them as too company oriented, whether they worked at INEEL or not.

"I'm completely satisfied with my doctors, but it isn't like going to the Mayo Clinic."

"We have 1 board certified occupational medicine doctor in town and he used to work for the company",

"We feel pretty comfortable with medical community in Idaho Falls."

3. Personal physicians do not have enough information about occupationally related illnesses.

Focus group participants like and trust their personal physicians but virtually all the former workers reported that they had never been tested for illnesses or health effects related to their employment in the nuclear industry. However, they mostly feel that this is due to a lack of knowledge on the part of the primary physician. They don't blame their physicians or feel angry, they mostly feel resigned to the fact that very few physicians have the necessary expertise.

"Maybe 2 or 3 of these guys got the same condition and they don't even know it, and if their general numbers stay the same, maybe they'll die and nobody will know the difference. If they were looking at that, maybe they could be saved."

"I don't think you're going to find any of these things we're talking about in a general physical with anybody."

THEMES- HEALTH PROGRAM DESIGN

1. There was a positive feeling toward participating in a health program.

Focus group participants expressed very positive feelings about participating in a health program and felt co-workers would feel the same way.

2. Testing for specific occupational exposures is crucial.

Former workers should receive any specific tests which exist for exposures they may have had for example lead, beryllium and mercury. Everyone should have hearing tests, eye tests for welders, specifically should be performed. Also, any part of the body they could have been adversely affected by these exposures should be examined like the liver, the kidneys and the bones. Complete blood screenings looking for particular exposures and respiratory testing should be done as well. They see this as being in addition to their yearly physicals.

"We should have some kind of physical that will look at our former exposures that we have all had. We need a specific physical to address what we've been exposed to, not what the general fella or lady walking down the street has been exposed to ... specific to our former job occupations."

3. Primary care physicians should administer the health program, but they need education on occupational exposures.

In keeping with their positive views about their primary physicians, they would feel most comfortable having them run this health program. They would trust their physicians to refer them to other specialists or facilities as needed. But while the former workers trust their physicians, they do not currently feel they have all the training necessary to conduct this program. They would like to see an appropriate training program for physicians to bring them up to speed on handling occupational exposures.

"I would think that if these guys just went to their doctor like they're saying to get their physical and they would mention to him about a special test, he may not be aware of it and that could be a problem. But just ask him for it and he'll give it to you. My doctor learned about this thing I have by reading books and calling other doctors."

"We all want doctors who are conversant with what happens to people with chemical exposures."

4. Education about occupational exposures should be provided to the former workers.

They themselves also wish to be educated so they can monitor and control their own care. Questions came up consistently about whether or not a particular exposure was actually hazardous, how it would enter the body, what the latency period would be for illness and what type of health problems would be associated with particular exposures.

"I have acute adult lymphoblastic leukemia. My doctor says this could come from radiation. I am convinced it was not from my on the job exposure, but my wife is convinced it was."

5. The health program should be ongoing and comprehensive.

The program should be long term to benefit all the former workers as long as they need it, since so little care was given to them while they were working. Also, they want a health program that treats them as well as diagnoses their conditions.

6. Travel is not a roadblock.

The participants felt strongly that they would be willing to travel long distances to take advantage of this program.

"For any medical purpose, many have to travel. You have to decide, how much is your health worth". "I'd travel 50 miles for a free physical, wouldn't you".

"We rode the buses back and forth, what difference would one trip make one day a year."

6. Participants want the health program to portray the nuclear power industry in a positive light.

Those in the focus groups believe that the industry has vastly improved and that this program should emphasize that it will address health concerns which came out of past exposures. They worry that if the program is not conducted with a positive spin, it will be used to criticize the industry, the work they do and their jobs.

"They (the community) squalled about the shipment of the (nuclear) waste going through the site and the state and everything, and that bothers everybody. Yet they had this train derail the other day had 30,000 gallons of formaldehyde. There's a lot of that stuff goes out on the trains and trucks every day, that's much more dangerous than anything comes out of the site."

"When you start these things, whether you're going to start monitoring people or physicals or what, to put a positive spin on why you're doing it. That's been the hard part with atomic energy all the way."

"Hopefully, one of the things that I like about this program is that ...you got the people here who are on the job and you're not going to get a lot of theoretical B.S. There are some people here in the state who make a living as I see it bashing the INEEL and talking about hypothetical exposure to this and that. One of the benefits that's going to come out of this is OCAW is going to be able to say to anybody, we know what exposures there are. And you podiatrists and other feather merchants, we aren't going to have to listen to you anymore."

THEMES - ROADBLOCKS

1. Cost is always a concern.

Given they are on fixed incomes and given the limitations of Medicare, the participants do not want the program to be costly, and feel it should be adequately covered by insurance or preferably be free. They would not want excessive cost to stand in the way of success.

"The problem with us retirees, of course, we don't get a free physical, Medicare won't cover it".

"Lets give a little attention to us now and not take it out of our measly retirement. These tests cost big bucks....20% is 20%."

2. Denial by former workers that they may have a health problem.

There was a general sense that many people just don't want to know if they have a serious health problem and getting them to participate may be difficult.

Moderator reported conversation with one former worker who chose not to participate saying, "I haven't had a physical for 9 years and I'm doing fine, I'm doing okay".

"You've always got a few people for reasons I don't understand who say, I guess I don't want to know."

3. Former workers may distrust the program if it is being run by INEEL or DOE.

Focus group members felt strongly that this program must clearly be run by OCAW. Most former workers wouldn't trust a program run by INEEL or the DOE or one they incorrectly perceived was being run by INEEL or the company. They felt the company and the DOE failed to care about their health while they were being exposed and failed to care for any medical needs that may have arisen as a result of exposures.

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"I'd like somebody other than DOE hired physicians to give us the physical - you need an independent."

"We need somebody non-biased, that would be the biggest thing."

4. Participants worry that when the program finally gets set up it will be too late for them

Former workers feel their unique health needs have gone uncared for so long that many of them will die before they have the opportunity to participate in this program.

"Most of us are going to be gone before this is implemented."

"I called a gentleman for risk mapping and he said, you're 30 years too late."

TOPIC III - OUTREACH/ACCESS AND HEALTH EDUCATION INFORMATION, RESOURCES

Question: What are the best ways to reach former workers and how do they currently receive health education information?

Best ways to reach former workers:

- 1. INEEL retirees newsletter reaches 500 out of 3,000 retirees
- 2. Retiree clubs
- 3. Telephone calls based on personnel lists, union lists or telephone books
- 4. OCAW newspaper
- 5. Area newspapers
- 6. Letters
- 7. AARP chapter
- 8. Public Service Announcements

Current health information:

- 1. Reading material in doctors offices 5. Internet
- 2. Magazines

3. Television

- 6. Information available at the Pharmacy
- 7. Mail from advertisers

8. Friend in the medical profession

4. AARP

4. OBSERVATIONS

The use of the focus group method in this needs assessment facilitated by OCAW workerinvestigators has created a meaningful body of information which very likely could not be obtained in any other manner. This discussion with former workers at the INEEL facility with an average age of 67.2 years and an average number of years working on the site of 29.1 years has created an tremendous wealth of information about a site where exposure data is virtually non-existent. The memories captured here are from notes taken at the focus groups by the report's author, the flipchart notes taken by the scribe and from the audio taping done at both groups. It has been noted that there is a lack of available information about early exposures of these workers, some of whom were hired when the facility opened in 1949. But, discussion with the group revealed the extreme security measures taken by the contractors and by the government to protect this dangerous and unusual facility. The INEEL is the country's premier experimental nuclear energy facility conducting experiments with nuclear power that are replicated nowhere else in the U.S. The INEEL also contains the largest stockpile of weapons grade plutonium in the entire world. This helps to explain why it may have been so difficult in the past to uncover the necessary information about worker exposures. And, therefore, why it was so essential to hear directly from the workers about their years at INEEL.

This report accurately reveals the responses the focus group participants had to the questions posed. There was a basic similarity of themes in the experienced group in the morning and the random group in the afternoon and any important themes, even if they only emerged out of one group, were reported. However, underlying the basic responses there existed a contradiction that emerged over and over. That is the contradiction between their anger and distrust of INEEL management and DOE for allowing the blatantly unsafe conditions they reported, and their core belief that nuclear energy is safe and their resultant desire to protect the good name of INEEL. As older former (mostly retired) workers, they resolved this contradiction by saying that times have changed and the terrible conditions they faced many year ago have been eradicated. However, it is unclear whether they feel this adequately clears up the contradiction because they still expressed concern for current workers and strongly wanted the union to take action to protect them. Given the anti-nuclear sentiment existing in many circles in this country, they seem to feel it prudent to handle internal site problems quietly, while refusing to bash nuclear power in public.

Despite the wide range of educational backgrounds reported by the participants, the group was clearly made up of very smart and sharp people. It seemed obvious that working in such a dangerous and technically challenging environment requires a smart and curious worker able to understand and operate in a highly technical and exacting work situation. They were proud of their abilities and their hard work and felt that were making a real contribution even though they were often misunderstood by the general public.

Most discussions inevitably returned to the strong belief that they were as they said "guinea pigs" and "ahead of the learning curve". And while they could accept that they worked in a dangerous industry made especially so by the experimental nature of the work being performed there, they could not accept that those responsible for their safety and the safety at the facility in general either let them down, or just plain didn't care enough to take even the minimum safety precautions dictated by common sense and human decency. And while they believe management should have cared for them and should be taking care of them now as well, given their many years of loyalty, they just don't trust INEEL or DOE enough to let them run a health program. They trust OCAW and this seemed true even of those non-union

personnel who participated in the focus groups. The quote below sums up this very basic overall feeling that most of the participants shared.

"We did this yes to earn a living, but the employer had a responsibility to protect us even way back when and did not do this, so we're kind of the guinea pigs now. And I'm saying that its gone on long enough. Lets have a little attention given to us before we're upstairs or downstairs, where ever we're going. Lets give a little attention to us now and not take it out of our measly retirement to have to follow this health screening...I feel it is partly the responsibility of our former employer whether it be a contractor, DOE, the Atomic Energy Commission or whatever. We gave our best years to the contractor or to the United States government. Now how about turning around here a little bit and taking care of us folks."

5. RECOMMENDATIONS

In conclusion, the results of the focus groups comprised of the former nuclear workers at the INEEL facility in Idaho have produced the following recommendations:

The need exists for a medical surveillance program.

Focus group members clearly report significant concern about occupationally related health symptoms and diseases based on exposures while working at the INEEL facility.

♦ The medical program must clearly be run by OCAW.

Distrust of their employers and of the DOE would prevent the former workers participating in the focus groups from becoming involved in a health program run by either entity. Outreach about the program should make it perfectly clear who is conducting the program.

The medical surveillance program must be set up in a manner that does not portray the nuclear power industry in a negative light.

Despite distrust of INEEL management and DOE, no one wants to see attacks on the nuclear power industry.

♦The program should begin as soon as possible, given the advanced ages of the eligible participants.

♦Local community primary care physicians are the first choice for providing the medical care required by this program.

An education program must be developed for the community physicians to teach them about occupational exposures.

♦The medical program should diagnose and treat the former workers and follow them as long as needed to complete their care.

They understand that not all former workers with all diseases will be able to be selected for this program, but they would like to see complete care for those who are involved from beginning to end. They would also like to see the program run for long enough to reach all the eligible former workers.

♦Keep costs low. Participants will travel.

Location of the program is not important, but keeping costs low is crucial.

An education program should also be set up for the former workers.

They expressed a desire to be actively involved in their own care starting with a basic understanding of occupational disease.

♦Outreach is best accomplished through the INEEL retirees newsletter, retiree clubs, personal telephone calls and the OCAW newspaper. Secondarily, area newspapers, letters, the AARP chapter and public service announcements.





QUESTIONNAIRE SURVEY RESULTS

Section VII

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Appendix A: Questionnaire Steven Markowitz MD Queens College City University of New York

Health and Exposure Questionnaire Survey

<u>Methods</u>

In order to obtain exposure and limited health information from a broad cross-section of the former workforce at INEEL, a questionnaire was developed and sent to a random sample of 1,000 retired and terminated INEEL workers. The base population from which this sample was drawn included a total of 5,154 workers, consisting of 2,140 retirees who currently receive pension from Lockheed-Martin; 2,709 workers terminated by Lockheed-Martin since 1994 (when Lockheed-Martin became the site contractor); and 305 retirees who currently receive pension from Argonne West.

In order to ensure adequate representation from the retirees who had left INEEL in the 1960's and 1970's, we stratified the list of Lockheed-Martin retirees by decade of retirement. We selected all of the retirees on the Lockheed-Martin retiree list from the 1960's and the 1970's (n = 120) and 480 of the 2,020 Lockheed-Martin retirees from the 1980's and the 1990's. This represented a 24% random sample of the retirees from the 1980's and the 1990's. In addition, we randomly selected 300 (11%) of the 2709 workers who had been terminated from INEEL from 1994 to the present. Finally, we randomly selected 100 (33%) of the 305 Argonne retirees. Hence, we weighted the sample in favor of retirees (versus terminated workers), especially the earlier INEEL retirees and in favor of the Argonne West retirees. This weighting was done in order to ensure that we had maximum information from the group that was likely to have had the most employment during early calendar years of INEEL operation and also probably the highest duration of employment and exposure. This corresponds to the group that is *a priori* most likely at risk for occupational disease due to employment at INEEL. Since the overall number of retirees at Argonne West was limited, we over-sampled from that group in order to ensure an adequate number of questionnaire responses.

A seven-page questionnaire was developed (Appendix A) that requested information on demographic status; history of job title, exposures, and job locations at INEEL; health concerns; current health care; and interest in screening and education. A check list of 35 specific exposures were included in the questionnaire. The questionnaire was approved by the Institutional Review Boards of LMTCO and Queens College of the City University of New York. A copy of the questionnaire was sent to the selected 1,000 individuals with a cover letter signed by Robert Wages (OCAW International President); the local OCAW union president at INEEL; and Steven Markowitz, MD. A second mailing of the same questionnaire with a slightly revised cover letter was sent to non-respondents approximately 6 weeks after the first mailing. Addressed stamped return envelopes were included in each mailing. The questionnaires were sent by first class U.S. mail in order that the letters with incorrect addresses would be returned to the project office.

We report here the preliminary findings from the returned completed questionnaires. We have recently received approval from the Institutional Review Boards of LMTCO at INEEL and Queens College to place telephone calls to former workers who have not responded to either of the mailings of the questionnaire. This will be done later in October in order to improve the response rate and to provide further information about correctness of the current address list that we have for former INEEL workers.

<u>Results</u>

Of the 1,000 questionnaires sent, 62 (6%) were returned by the U.S. Postal Service due to an incorrect address. Of the remaining 938 individuals, we received 450 (48%) completed questionnaires. There were 7 questionnaires returned from family members of former INEEL workers indicating that the workers had died.

Section Apple Systems

Table 1 provides some basic information about the individuals who responded to the questionnaires. Most (80%) of the respondents were retirees, either from INEEL or Argonne West. The remaining 20% received were questionnaires from terminated INEEL workers. The response rate from the retirees (366/700, or 52%) was better than from the terminated workers (90/300, or 30%). Most (85%) of the Argonne West retirees to whom we sent questionnaires (n=100) returned a completed questionnaire, which was considerably better than the response rate from the INEEL retirees (282/600, or 47%).

Two-thirds of respondents were between ages 60 and 79, with the remaining one-third was evenly divided between workers aged 59 or less, or aged 80 and over. 99% (362/366) of the retirees were aged 50 and over. Interestingly, 54% (49/90) of the terminated workers were also aged 50 years and over. Over one-half of the retirees (n=216, or 59%) retired in the 1900's; an additional 91 respondents (25%) retired in the 1980's. Roughly one-fifth of the retirees retired prior to 1980.

Three-quarters (77%) of the respondents live in Idaho. An additional 10% (n=47) of the respondents lived in states that border Idaho, including Montana, Wyoming, Nevada, Utah, Oregon, and Washington. Other states with five or more respondents included Arizona (9), California (9), Colorado (5), and Texas (5).

Of note is that only 27% (n=111) of respondents had been members of OCAW. Information about membership in other unions at the facility was not requested.

Table 2 lists the exposures and their reported frequencies on the completed questionnaires. External radiation exposure was reported by almost one-half of the respondents (45%, n=205). One-fifth of respondents reported exposure to acetone, asbestos, and noise. Additional common exposures, defined as greater than or equal to 10% of respondents reporting exposure, were internal radiation, acids (i.e. - nitric, sulfuric, hydrofluoric, and hydrochloric); cutting oils; welding fumes; mercury; and carbon tetrachloride. Cadmium exposure was reported by 8% of respondents. Beryllium exposure was reported by 7% of respondents. Additional details regarding prevalence of reported exposure to individual agents is provided in Table 3.

We also examined how many respondents reported exposure to at least one of the following agents: asbestos, acids (nitric, sulfuric, hydrofluoric, and hydrochloric), beryllium, mercury, chromium, cadmium, nickel, welding fumes, benzene, cutting oils, carbon tetrachloride, trichloroethylene, and trichloroethane. Over one-third (36%) of the respondents reported exposure to at least one of these agents. This percentage increases to 40% if noise is added to the list of exposures. Note that radiation and lead are not included on this list. (Lead was inadvertantly omitted from the questionnaire.) Over one-half of questionnaire respondents reported exposure to at least three of the agents on the above-cited list.

Table 3 provides the breakdown of questionnaire respondents by facility at INEEL. One-third or more respondents reported having worked at CFA, TRA, ICCP, or TAN. An additional one-quarter of respondents reported working at IF. Of note is that individuals usually worked at more than one facility at INEEL so that the exposures occurred over multiple sites.

Table 4 provides a breakdown of the most common exposures by facility for the five most common facilities where respondents worked. Most of the targeted exposures occurred at multiple sites, though more chemical exposures were reported at ICPP than elsewhere.

We also obtained information about job titles that respondents had over their careers at INEEL. Over 300 job titles have been cited. We are currently aggregating these job titles in order to better characterize common exposures among similar job titles.

Table 5 provides information on health status and health care of respondents. Most respondents reported to be in fine health. Over three-quarters (385, or 84%) reported that their health was good or excellent. Only 28 respondents (6%) indicated that their health was poor. Three-quarters of the respondents reported that they had seen a physician during the 12 months prior to completing the questionnaire (n=348, or 76%). Only 15 respondents, or 3%, reported that they had last seen a physician more than 3 years previously. Three-quarters of respondents reported that they have periodic checkups when they are not ill. Indeed, 90% of these respondents who report having regular checkups had a checkup during the 12 months prior to completing the questionnaire (n=392, or 86%). Only 3%, or 15 individuals, responding to the questionnaire, reported that they did not have health insurance. The remaining 47 respondents, or 10%, wrote that they were "unsure" whether they had health insurance.

Table 6 provides data on additional issues related to the need for medical screening. When asked whether they were concerned that their health might have been affected by working at INEEL, 40% (n=164) reported that they were somewhat or very concerned about this issue. The remaining 60% (n=248) reported that they were not concerned that their health was affected by working at INEEL. Indeed, most respondents (292, or 72%) reported that they did not believe that their health is currently affected by having worked at INEEL. One-fifth of workers (n=82, 20%) reported that they did believe that their health had been affected, and an additional 30 workers (7.4%) were unsure about this issue.

The majority of the respondents were interested in participating in a medical screening if offered. Nearly 60% of respondents (n=242, or 59%) stated that they were somewhat to very interested in participating in a screening.

The majority of respondents reported that their personal physician knew that they had worked at INEEL (Table 6). 62% (n=244) reported this belief, whereas, 35% (n=138) reported that they did not believe that their physician was aware of their previous work at INEEL. However, when asked if their personal physicians were aware of their specific exposures that they had had at INEEL, the vast majority (295, or 78%) reported that they did not believe that their physician was aware of the specific exposures that they had had at INEEL. Only 21% (80) respondents believe that their physicians did know of the particular exposures that they had worked at the plant.

 Table 1

 Respondents Employment Status and Age

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Employment Status	<u>NO. OF</u> <u>Respondents</u>	<u>%</u>
Retired		80.3%
Terminated	90	19.7%
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Argonne West	85	18.6%
Lockheed-Martin (or predecessor)	395	81.4%
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30-49	32	7.0%
50-59	34	7.5%
50-69 70 70	185	40.6%
70-79	112	24.6%
	UU	1 3.2 70
<u>Retire Year</u>		na an an an an an an an an an an an an a
Pre-1980	39	10.7%
1980-1989	91	24.9%
1990+	177	48.4%
Retired Due to Disability		
i Agrandy Million a landal mga anna isrgan an anga bartit. Yesi I	29	7.9%
10	291	79.5%
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	45 Reconcernent for the concernent of the Salah Reconcernent for the second state	12.3%
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es	91	24.9%
	238	65.2%
Insure	2	0.5%
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Table 2

Most Commonly Reported Exposures

	<u>No. of Respondents</u>	
Chemicals and Agents	Reporting Exposure	<u>%</u>
External Radiation	205	44.9%
Acetone	97	21.2%
Noise	92	20.1%
Asbestos	91	19.9%
Internal Radiation	65	14.2%
Nitric Acid	60	13.1%
Cutting Oils	59	12.9%
Welding Fumes	57	12.5%
Sulfuric Acid (Battery Acid)	57	12.3%
Mercury	52	11.4%
Carbon Tetrachloride	51	11.2%
Hydrofluoric Acid (HF)	46	10.1%
Hydrochloric Acid (HCL)	45	9.8%
Heat	41	9.0%
Paint or Paint Thinners	40	8.8%
Cadmium	37	8.1%
Dusts (Wood, Coal, Fibers)	35	7.7%
Beryllium	33	7.2%
Trichloroethane	33	7.2%
Other	32	7.0%
Sodium Hydroxide	30	6.6%
Chlorine	29	6.3%
Copper	29	6.3%
Freon	29	6.3%
Benzene	26	5.8%
Chlorinated Solvents	24	5.3%
Chromium or Chromic Acid	24	5.3%
Methyl Ethyl Ketone (MEK)	24	5.3%
Repetitive Motion, Vibration	22	4.8%
Nickel	15	3.3%
Silica	15	3.3%
Fluorine	12	2.6%
Methylene Chloride	11	2.4%
Arsenic	5	1.1%
Acrylonitrile	4	0.9%
Phosgene	4	0.9%

 Table 3

 Respondents' Work Sites

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1. Annual States		an an an an an an an an an an an an an a	ng talah seri dakeran baran Bahar Palan seri dak	ne vezeta de la constante de la seconda de la constante de la constante de la constante de la constante de la Constante de la constante de la c		
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÷.,	.		TRA*	180	39.5% 37.7%	
			ICPP*	171	37.5%	
2	March 13	nen en seneren en en en en en en en en en en en en e	TAN*	146	32.0%	
		an an an an an an an an an an an an an a	IF*	118	25.9%	
	Rend No. 4	aan baar maana ka ay san ah ahaan ah ah ah ah ah ah ah ah ah ah ah ah ah	AW*	85	18.6%	
			ARA*	56	12.3%	
2				50	11.6%	
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	Good	179	48.9%	40	44.4%		
	Fair	53	14.5%	6	6.7%		
	Poor	25	6.8%	3	3.3%		
	N/A	33	9.0%	8	8.9%		
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	Within past 12 months	289	79.0%	60	66.7%		
and a state of the second state of the	Within past 1-3 years	34	9.3%	13	14.4%		
	> 3 years ago	7	1.9%	8	8.9%		
	N/A	36	9.8%	9	10.0%		
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	Yes	294	80.3%	56	62.2%		
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· · · · · · · · · ·	N/A	33	9.0%	. 9	10.0%		
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	Within past 12 months	229	62.0%	41 8	40.0 %		
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 Table 5

 Questionnaire Responses: Health Status and Care

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Table 6

Questionnaire Responses: Health Concerns Related to INEEL Employment and Medical Screening

	Retire	T	Terminated			
	No. of		No. of			
	<u>Respondents</u>	<u>%</u>	Respondent	<u>%</u>		
Level of Health Concern						
Very Concerned	35	9.6%	6	6.7%		
Somewhat Concerned	90	24.6%	33	36.7%		
Not Concerned	205	56.0%	45	50.0%		
Unsure	2	0.5%	. 0	0.0%		
N/A	34	9.3%	6	6.7%		
Believe Health Affected						
Yes	61	16.7%	21	22.2%		
No	238	65.0%	56	62.3%		
Unsure	24	6.6%	6	6.7%		
N/A	43	11.7%	7	7.8%		
Screening Interest						
Very Interested	72	19.7%	20	22.2%		
Somewhat Interested	119	32.5%	33	36.7%		
Not Interested	138	37.7%	29	32.2%		
Unsure	2	0.5%	1	1.1%		
N/A	35	9.6%	7	7.8%		
Physician Aware of INEEL Work						
Yes	196	53.6%	49	54.4%		
No	112	30.6%	27	30.0%		
Unsure	9	2.5%	3	3.3%		
N/A	49	13.4%	11	12.2%		
Physician Aware of INEEL Exposures						
Yes	67	18.3%	13	14.4%		
No	232	63.4%	65	72.2%		
Unsure	2	0.5%	0	0.0%		
N/A	65	17.8%	12	13.3%		

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3. Ho	w many DOE facilities of	did vou work at?		year						
	Name the DOE sites wh	here you worked oth	er than INEEL:	number	、					
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				and a second second second second second second second second second second second second second second second						

4. We wish to learn more about your specific history of work at INEEL. Please complete all columns in the following table. <u>Please begin the table with the first job</u> that you had at INEEL and <u>continue with each job</u> until you stopped work at INEEL.

We are especially interested in your work in any of the following sites at INEEL:

- Idaho Chemical Processing Plant (ICPP)
- Test Area North (TAN)
- Test Reactor Area (TRA)
- Central Facilities Area (CFA)
- Argonne West (AW)
- Radioactive Waste Management Complex (RWMC)
- Auxiliary Reactor Area (ARA)

Please list your INEEL jobs in chronological order, beginning with your first job:

	<u>Building(s)</u>	<u>Years Worked</u> Year started Year ended	Comments
	<u> </u>		
Second Site			
Job Title	<u>Building(s)</u>	Years Worked Year started Year ended	Comments
hird Site			
Job Title	Building(s)	Years Worked Year started Year ended	Comments

4. Please continue to list details about additional INEEL sites where you worked:

	rourth Site	<u> </u>		
	Job Title	<u>Building(s)</u>	Years Worked Year started Year ended	<u>Comments</u>
an an an ann an an Ann Ann Ann Ann Ann A				
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un en al gala de la companya en 1995 a la companya en la companya en la companya en la companya en la companya en la companya en la companya en la c	Fifth Site			
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an an 1917 - Hard Harassa n an Santa 1917 - Harassan Angeleta	Sixth Site			t an an an a
	Job Title	Building(s)	Years Worked Year started Year ended	<u>Comments</u>
		·		
and a sector of a sector of a sector of a sector of a sector of a sector of a sector of a sector of a sector of	×+++			
(1) A set of the se				

5. Please complete the following table based on your work experience at INEEL. If you were exposed to the agent listed in the first column, please fill in the columns to the right. If not, you can leave those columns blank.

Chemical/Agent	Facility(s) where exposure occurred	Building(s) where exposure occurred	Calendar years when	E (ch	xposure Level leck one)	
Acetone	~ .		exposed		Med Lo	<u>w</u>
Acrylonitrile	الم المحمد المحمد المحمد المحمد المحمد المحمد المحمد المحمد المحمد المحمد المحمد المحمد المحمد المحمد المحمد ال					
Arsenic						,
Asbestos						
Benzene						
Beryllium						-
Cadmium						- -
Carbon Tetrachloride						-
Chlorine						-
Chlorinated Solvents						
Chromium or Chromic Acid						<u> </u> _
Copper						1
Cutting Oils						-
Dusts (Wood, coal, fibers)						
Fluorine						
Freon						
Heat					_	.
Hydrochloric Acid (HCL)						
Hydrofluoric Acid (HF)						 .'

		Chemical/Agent	Facility(s) where exposure occurred	Building(s) where exposure occurred	Calendar years when exposed	Exposure level (check one) High Med Low		
Bre y		Mercury				1		
	an an an an an an an an an an an an an a	Methyl Ethyl Ketone (MEK)				<u> </u>	+	+
		Methylene Chloride				<u> </u>		
		Noise				 	┼──	<u> </u>
	n an an an an an an an an an an an an an	Nickel					<u> </u>	<u> </u>
	e z maline, edukoma presents	Nitric Acid	and the second second second second second second second second second second second second second second second			<u> </u>		<u> </u>
in the second se		Paint or Paint Thinners						<u> </u>
		Phosgene						
-		Radiation, external						
an the second se	n an an the second problem and the second pro	gamma, x-ray, neutron						-
		Radiation ,internal exposure						
		Repetitive motion, Vibrations						
in a s	la an galar shi a lan fa faran. A kala masangalarin makari A	Silica		e de la companya de la companya de la companya de la companya de la companya de la companya de la companya de l				
1000 - 1000 1000 - 1000 1000 - 1000 1000 - 1000	anta Carego e coloradore 1990 - Carego e coloradore 1990 - Carego e construido 1990 - Carego e construido	Sodium Hydroxide			an an air an an an an an an an an an an an an an			
	a traj la j	Sulfuric Acid (Battery Acid)						
		Trichloroethane						
		Welding Fumes						
		Other (List Below)						
		1.					-+	
		2.						
		3					<u> </u>	

HEALTH CONCERNS

- 6. How would you rate your health overall? (Check one)
 - Excellent Excellent
 - 🗖 Good

🗀 Fair

🗖 Poor

7. When was the last time you saw a physician? (Check one)

Within the last 12 months

Within the last 1-3 years

☐ More than 3 years ago

□ Never

8. Do you have a personal physician? (Check one)

□ Yes □ No

9. Do you have examinations when you are not feeling ill (an annual or regular check-up)?

□ No

🗀 Yes

- 9a. If yes, when was the last time you saw your personal doctor when you were not sick annual or regular check-up)? (check one)

Within past 12 months

☐ 1-2 years ago

more than 2 years ago

10. Do you have health insurance?

Yes No

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	and a second second second second second second second second second second second second second second second A second second second second second second second second second second second second second second second secon
	11. How would you describe your level of concern about whether your health has been affected by the working conditions at INEEL?
	Very concerned
#. /	Somewhat concerned
	☐ Not concerned
	12. Do you believe that your health currently or in the future will be affected by having worked at INEEL?
	TYes No
	13. How would you describe your interest in participating in a medical screening program to screen for health conditions that might be caused by exposures that you had while you worked at INEEL?
i Pere Barri	☐ Very interested ☐ Somewhat interested ☐ Not interested
	14. Does your personal physician know that you used to work at INEEL?
gr a ref	TYes No
	15. Have you informed your personal physician about the chemical, radiation or other exposures that you had as an employee of INEEL?
	Yes No
giane,	16. Were you a member of OCAW union when you worked at INEEL?
	TYes No
4 177	a server a server a server a server server server server server server a server a server server server server s The server server server server server server server server server server server server server server server se
i i i i i i i i i i i i i i i i i i i	
	THANK YOU FOR COMPLETING THE QUESTIONNAIRE. PLEASE PLACE IT IN THE ATTACHED STAMPED ENVELOPE AND SEND IT TO US.
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Section VIII

Community and Health Inventories at INEEL

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Sylvia Kieding OCAW International Union

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<u>Community inventories at INEEL</u>

J.C. Colvin, the retiree member of the OCAW site team, conducted inventories of area health care facilities, providers, and resources within a 70-mile radius of Idaho Falls. The inventories are a representative sample rather than a complete listing of resources. They were conducted to provide information to be used in the planning for the medical testing and risk notification envisioned for Phase II of the project.

Facility inventory

The facility inventory contains a list of four regional medical centers and seven clinics. Three clinics were rated "favorable" based on the retiree's personal experience or reports from friends. These include the Snake River Heart and Lung Clinic in Idaho Falls; the Family Emergency Center, a community clinic with walk-in care in Idaho Falls; and the Family Emergency Center West in Idaho Falls. There is a pulmonary clinic in Pocatello accessible to retirees and former workers rated neutral.

The Community Care Clinic in Idaho Falls is rated neutral, based on lack of experience or reports about the facility.

There are four hospitals listed, and the Bannock Regional Medical Center in Idaho Falls is the only one rated "favorable". It has departments of occupational medicine, neurology, pulmonary medicine, and internal medicine. Other hospitals listed include the Eastern Idaho Regional Medical Center and the Pocatello Regional Medical Center (both of which has the same departments as Bannock), and the Madison Memorial Hospital in Rexburg, which is in an outlying area to the north of Idaho Falls and contains only pulmonary medicine and internal medicine.

Clinics selected as geographically accessible to the most retirees were the Family Emergency Center East and the Pocatello Pulmonary Clinic.

<u>Health care provider inventory</u>

There were fifteen provider inventories completed. Most of the physicians had offices either next to the Eastern Idaho Regional Medical Center or the Pocatello Regional Medical Center. The list contained one urologist rated neutral, one internal medicine specialist, neutral; two cardiologists rated favorable; three oncologists, neutral; four neurologists, neutral; and four pulmonary medicine specialists rated neutral. No occupational medicine physicians were included, because they are considered to be too close to the contractor. There are four occupational physicians listed in the Idaho Falls telephone directory.

<u>Community resources inventory</u>

Four community associations were contacted as possible outreach for informing the community and former workers about the program. These include the INEEL Retired Employees Association, the Veterans of Foreign Wars (VFW), the Elks Lodge, and the American Heart Association in Pocatello. Only the VFW and the INEEL Retired Employees Association were receptive when contacted. Both of these have monthly meetings and issue
quarterly newsletters. The Elks and American Heart Association appeared non-receptive to publicizing and proposed program, and Colvin thought it was because they are intimidated by INEEL. There is a PBS television station broadcasting out of Pocatello, which will put out public interest bulletins. There is a news and information radio station, which can be used for disseminating program information.

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