SURVEILLANCE OF FORMER CONSTRUCTION WORKERS AT HANFORD:

A NEEDS ASSESSMENT

Submitted by
Center to Protect Workers' Rights

on behalf of
The Building and Construction Trades Dept., AFL-CIO
and
The Central Washington Building and Construction Trades Council

In Cooperation with
United Brotherhood of Carpenters
University of Cincinnati
Occupational Health Foundation
George Washington University
Zenith Administrators, Inc.
Duke University

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1. Introduction and Rationale

a. Specific Aims

The objective is to develop a notification, health evaluation (including medical screening) and intervention program for building trades workers who may have been exposed to health hazards as a result of prior work at Hanford. The specific aims for Phase I of this program are to:

- Identify and propose resolution to policy issues that surround this program.
- Conduct site needs assessment and develop a worker history risk characterization protocol as the basis to triage workers at risk.
- Develop notification protocol and related worker education materials.
- Develop a medical protocol.
- Develop programs and procedures for the determination of program eligibility and claims management, including coordination of benefits.
- Develop a data management, quality assurance and evaluation plan, including epidemiological analysis of the data.
- Develop an implementation plan for Phase II.

This program, proposed by the Center to Protect Workers' Rights (CPWR), which is the research and development arm of the Building and Construction Trades Department, AFL-CIO, in cooperation with the Central Washington Building and Construction Trades Council (CWBCTC), represents the target population at Hanford. This project has the support of all twelve building trade unions at Hanford. The work is being performed by a consortium consisting of CPWR and the Occupational Health Foundation (OHF), George Washington University (GWU), Duke University (Duke), Zenith Administrators, Inc. (Zenith), the United Brotherhood of Carpenters Health and Safety Fund (UBC) and the University of Cincinnati (UC).

The needs assessment presented here is part of Specific Aim 2.

b. Rationale for this Program

As will be described in more detail below, there are certain essential rationales that drive this program:

It is limited to building and construction workers. These workers are in a unique category within the DOE structure: their employment is temporary, they are employed by second, third and fourth tier subcontractors, and they move from work within the DOE facilities to work in general construction elsewhere.

We do not expect to find good data on these workers. Employment records, any health examination records and so on are likely to have been maintained by the subcontractors who employed these workers. Records of exposures that workers may have experienced are at best going to be highly variable in accuracy, and are not likely to identify the individual workers exposed.

We have proposed a public health program. Because we expected to be faced with a lack of good exposure data, we proposed a public health approach that would rely extensively on triaging of the workers who have worked at Hanford. This approach conforms to a model that we have used successfully in the past in similar types of programs, and is in some ways opportunistic: we do the best we can with the limited employment information available to us.

Our approach focuses on service delivery. Our main objective is to find those workers with significant exposures as a result of having worked at Hanford, and to provide them with a state-of-the-art health examination. The primary objective is not to engage in research. We will collect data as fully as possible, and use them to evaluate program quality, effectiveness and impact. We also hope to be able to conduct epidemiological analysis based on these data, but because of inherent limitations in our ability to establish population ascertainment, such analysis will be limited.

2. Need for Establishing Medical Evaluation and Notification

a. Medical Surveillance

Surveillance is the ongoing, systematic collection, analysis, and interpretation of health data essential to the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of those data to those who need it. In the occupational setting, the two distinct components of an effective surveillance program include monitoring of hazards in the workplace and monitoring of health effects of the workforce. To be effective, surveillance systems are best tailored to the specific disease or injury that is to be prevented. Linkage of data derived from health effects monitoring and hazard surveillance then defines areas for intervention. Effective surveillance must be directly linked to preventative action. Surveillance programs (secondary prevention) should be designed to support programs to control workplace hazards (primary prevention). Actions prompted by medical surveillance can be directed at workplace factors, at groups of workers, or at health interventions for an individual worker.

Historically, medical surveillance programs have most often been designed to protect the health of current workers in a certain industrial setting or experiencing a common exposure (Mintz, 1986). In this setting, "surveillance is essential to successful sustained public health intervention for the purposes of prevention" (Halperin, 1996). Data obtained through surveillance of the environment is used to establish quantitative levels of exposure, both day-to-day (average or real-time) and over time (cumulative), associated with specific industrial processes and work tasks, and with notation of the presence or absence of engineering controls and protective equipment. Data from ongoing environmental surveillance should drive interventions to reduce or eliminate exposures and ensure the use of protective devices. Sustained public health interventions for workers also are driven by medical surveillance data. These data are used to recognize new diseases caused by an exposure, and to advance the precision of quantitative risk assessment.

Medical surveillance activities justified by this needs assessment, however, are for former construction workers at DOE sites, and frequently are directed toward exposures incurred many years ago. With this cohort of workers, the concept of medical surveillance as a public health activity must put emphasis on different dimensions. Although the primary public health focus is still the need to reduce the frequency of work-related disease, the focus will be entirely on medical monitoring and risk communication, since the opportunity for hazard surveillance and workplace interventions for this cohort of workers no longer exists. Efforts of these surveillance programs can only be directed at the distal levels (biological monitoring, preclinical medical examination, diagnosis, therapy and rehabilitation) of the cascade of prevention described by Halperin. Data obtained through occupational histories and medical exams of former workers may be used to motivate interventions for current workers (hazardous waste cleanup at DOE sites or in energy related industry, or those exposed to specific hazards in other industries), but the primary goal of this medical surveillance program will be to direct interventions that will improve the health of individual construction workers.

Former construction workers at DOE sites are thought to have experienced exposures to a wide variety of toxic materials as well as ionizing radiation, at levels that would place them in populations at *increased risk* or at *high risk* (Samuels, 1986). As former employees of subcontractors, they no longer have access to occupational medicine physicians at the workplace and their primary care health providers often lack information on work-related disease, leading to incomplete diagnoses of medical conditions in a timely fashion. Secondary prevention interventions, which recognize disease at the preclinical stage, will decrease the rates of illness, disability or death related to workplace exposures. Specifically, the needs of these workers are to 1) develop an individual profile of past potential exposures, 2) identify disease at the pre-clinical stage (where possible), 3) diagnose clinical disease at an early stage, 4) assist the worker in identifying resources for further diagnosis and medical treatment, and 5) provide documentation necessary for obtaining compensation/benefits for work-related disease.

Individual occupational histories, linked to institutional histories, will be used to define potential exposure profiles for each worker. Tests of biological markers of exposure, where they are relevant many years post-exposure, will measure the more relevant internal exposure. Documentation of exposure profiles of individual workers will prevent unnecessary testing and reduce the volume of interventions necessitated by "false positive" test results. A graded response in conducting medical surveillance is necessary to conserve valuable resources (Samuels, 1986) required to deliver a medical monitoring program to a target population of former DOE workers. Evaluation of potential exposures will determine selection of appropriate screening tests for individual workers.

This linkage of work history and institutional history will provide each worker a written record of all of their work-related activities and potential exposures. Primary health care providers frequently are unaware of a patient's exposure history, and patients frequently are unable to specify exposures during history taking. A written record of exposures may improve the accuracy of diagnosis and selection of appropriate medical therapy. A worker needs to know the risks associated with the level of his/her exposures, to make informed decisions about future participation on medical monitoring and to develop an awareness of sentinel symptoms for which he/she should seek medical attention (Bayer, 1986). Former workers need to be informed that future occupational activities or home and leisure pursuits may increase levels of cumulative exposure to an agent where he/she already has achieved a level of increased risk (Millar, 1988).

Medical surveillance is most effective when the tests chosen have high specificity, reducing allocation of resources for repeat testing and communication of significance of "non-normal" test results. The screening test can not be an end in itself, but should be a means to direct the worker to additional diagnostic testing and medical treatment, if needed. Workers are more likely to comply with post-screening recommendations if implications of test results are explained in a manner that allows them to integrate the information. Workers also need assistance in identifying resources for tests and/or treatment.

b. History of Site

Ground was broken for the Hanford Engineering Works in March of 1943 by the Manhattan Engineering District (MED) of the Army Corps of Engineers (Gerber, 1992a,b). Although the vast majority of workers did not know the ultimate goal of their work, scientists at the Hanford site, along with those at Oak Ridge in Tennessee and Los Alamos in New Mexico, were to create an atomic bomb for use in World War II. It took only twenty-nine months from the time ground was broken for workers at Hanford to produce the plutonium that was used in the bomb dropped on Nagasaki, Japan in August of 1945.

In just over two years, at a cost of $230 million, approximately 50,000 construction workers working for the general contractor, DuPont, had transformed the 640 square mile desert site into the Hanford plutonium production complex and the government-owned town of Richland. They had built over 1,500 structures (not including housing), using 40,000 tons of structural steel, and 780,000 cubic yards of concrete. Other workers had laid 158 miles of railroad, 386 miles of roadway for automobiles, and hundreds of miles of fencing.

The original Hanford complex was made up of three areas: 100, 200, and 300. The 100 area included three reactors, also called piles, labeled B, D, and F, which were spread out along sixteen miles of the Columbia River's west bank. Also in the 100 area were water treatment plants and river pump houses, each of which was large enough to supply water to a city of 400,000 people, but were instead used to cool the reactors. Uranium fuel slugs were irradiated in the 100 area reactors, then "cooled," during which time their radioactivity partially decayed, and the slugs were then sent on to the 200 area.

The 200 area was made up of two chemical separations complexes: 200 East and 200 West. Each complex had large separations buildings which were officially named cells, but workers tended to refer to them either as canyons or as Queen Marys. Each of these cell buildings was 800 feet long, 65 feet wide, and 80 feet high, and contained forty concrete cells that were thickly shielded. Each complex also had plutonium bulk reduction or concentration buildings, and underground tank farms in which waste was stored.

The smallest of the Hanford areas was 300, which was located only ten miles from Richland. Work was conducted at the 300 area in fuel and equipment fabrication shops, research and development buildings, repair and maintenance areas, administrative office, construction personnel office, and various other facilities.

After completion of the bomb, two major changes in management occurred. In September of 1945, General Electric replaced DuPont as general contractor, and in January, 1947, the civilian-run Atomic Energy Commission (AEC) took over from the army's MED. Although for almost two years after the end of the war Hanford's future seemed uncertain, as some reactors were temporarily shut down and many workers left, by August of 1947, the two new management bodies announced that far from Hanford's usefulness being over with the end of the war, a new building expansion was to begin.

The huge building boom that lasted from 1947 to 1949 was the largest construction project yet undertaken during peace time, and at a cost of $350 million, was more expensive than all the construction from the war years. More growth spurts occurred during the Korean War, from 1950 to 1952, and again from 1953 to 1955, doubling the plutonium production facilities. During the postwar building booms five new reactors, DR, H, C, KE and KW were built, along with facilities for the REDOX and PUREX processes. Eighty-one more high-level waste-storage tanks were added, and Z-Plant (the Plutonium Finishing Plant) was added in the 200 West area. By early 1956, the Hanford site had eight reactors and five separations facilities, and in 1958 construction began on the N Reactor which, when completed in 1963, produced both plutonium and steam for electric power.

Since the late 1960s, the trend at Hanford has not been one of growth, but of downsizing. Due to decreased need, contamination and leaks, many of the Hanford's production facilities have been shut down, and most work at Hanford is currently devoted to cleaning up contamination created during the years of heavy production. In January 1987, the site's last remaining defense production reactor was shut down, and since then other production facilities and laboratories have been retired and are being cleaned up.

A list of the primary Hanford construction contractors is in Table 1.

Table 1
Major construction contractors at Hanford

Principal Construction Contractors:	
1943-1946	DuPont
1946-1953	General Electric
1953-1987	J.A. Jones
1987-1996	Kaiser Engineers Hanford
1994-present	Bechtel Hanford (Environmental Restoration)
1996-present	Flour-Daniels Northwest
Other Significant Contractors:	
	Blaw-Knox
	Valley Asbestos
	Vitro
	Jagger-Sroufe-Lord
	Thayn Construction

c. Special Issues for Construction Workers

Our project is limited to building and construction trade workers who have been employed mainly by subcontractors at DOE sites. The building trades have a long history of concern for their members on DOE sites, and have been pushing DOE and Congress to create health monitoring programs for these workers. Building and construction trades workers pose a number of unique challenges which cannot easily be addressed in general programs aimed mainly at permanent site production and management employees:

According to DOE, it is likely that the greatest risks to workers on its sites involve mainly the construction workers, including those who are involved in decommissioning, dismantling of facilities, and in maintenance or repair activities (O'Toole, 1994).

The building trades workers on DOE sites fall into two categories.

> The first consists of those with security clearances. They have tended to stay in mostly permanent employment at DOE sites, employed by the construction subcontractors.
>
> The second category consists of workers brought in temporarily and frequently for short periods of time to perform specific tasks. Many of them have repeat temporary employment at DOE sites, and may have been involved in similar civilian construction (e.g., nuclear power plants) or entirely different work between engagements on DOE sites, each of which may pose unique and important health risks. It is, therefore, much harder to determine the risk for these workers, especially the risk attributable to work on a particular site.

Because these workers were employed by hundreds of subcontractors, records of their employment or exposure histories on the sites may be virtually non-existent. Indeed, it has frequently been argued that DOE and its site M&O contractors sought to use subcontractor workers for the most dangerous tasks because they would not leave behind an easily traced paper trail.

Current building and construction trades workers are members of twelve different unions who have traditionally operated autonomously and separately from the industrial workers on site. They have had jurisdictional disputes over clean-up work creating a climate of conflict in recent years. Our consortium is in the unique position of being able to create programs that have the broad support of all the building trades unions who will be required to trace and notify the workers who have been employed in the past. At Hanford the CWBCTC, representing all the trades, is actively involved with this program.

3. Size of Construction Workers Target Populations (Since 1943)

The development of lists of construction workers with addresses and dates of employment at the Hanford site has been a challenge. In the past, the Department of Energy did not keep lists of construction employees hired through a construction contractor. While many workers received security clearances, it was reported to us that sometimes a truckload of construction workers came on site with the crew leader having the only security clearance.

Development of the size of the population of former construction workers can be approached in two basic and complementary ways:

1. Develop a list of workers' names through construction contractors, employment records, union records, e.g. dispatch cards, membership lists, pension records, and data tapes of records from DOE or its contractors.
2. Use traditional Outreach techniques (Tillet, Ringen, Schulte) to contact workers not on the lists described above, using radio, television, newspapers, union magazines, Internet, retirees' social events, etc.

a. Crude Estimate of Population Size

At this time it is possible to estimate the size of the target population. It is summarized in Table 2.

Table 2
Crude estimate of target population size

Before 1950	50,000
After 1950	59,000
Total	109,000

We have divided the population into two historical groups: before 1950 and after 1950. The reason for this is two-fold: first, there are no reliable or accessible sources of records on the population before 1950, and second, there were no unions in the sense we know them now before 1950.

b. Population before 1950

This number is derived from secondary (and probably tertiary) historical records (Gerber 1992). The bulk of this population was engaged in the war-time build-up of Hanford. At that time, because of the selective service draft of young men into the armed forces, most of the workers at Hanford were men above the age of 30. These men would today be over the age of 85. Even workers engaged during the second huge construction phase — from 1947-49 — would be very old today. Workers who were 30 years old in 1949, would today be 78 years old, and the average age of those who worked in construction at

Hanford in 1949, would be in their upper 80s. We do not expect that many of these workers are alive today, or that even if they were alive they would participate in this program, or that the program would be of significant value to them. Therefore, we do not plan to included this population in our phase II service delivery program.

c. Population after 1950

Since 1949, Building and Construction Trades (BCT) workers at the Hanford site are represented by 12 unions. Employees directly hired by site contractors and those employed by subcontractors are typically represented by different locals of the same international unions. We have estimated the total number of former BCT workers through examination of dispatch records, pension fund records, and union agent estimates. These records indicate that 58,750 workers had been employed at some time at Hanford. This number corresponds with Hanford Master Construction Data File, which was established in 1950, and is maintained by PNL. It contains 59,280 records. For workers employed at Hanford after 1950 who are deceased or cannot be located, will be combined with the group of workers who were employed at Hanford before 1950 into a category called "dead or lost." During this period there were three large construction booms:

Table 3
Age of workers during construction boom periods after 1950

1950-52	The youngest of these workers would today be 65 year of age; the average age of these workers today would be 80 years of age.
1953-55	The youngest age of these workers would today be 62 years, the average age would be 79 years.
1958-63	The youngest of these workers would today be about 55; the average age wold be 72 years.

We can divide up the population that worked at Hanford after 1950 in three categories:

Steady employment. One data file (see Table 4) that we have obtained indicates that during the period 1950 to 1988 there were only 12, 953 new construction workers who were given both security clearances and radiation badges. For about 8,000 of these workers we also have duration of employment. Of these, only 1,500 had worked for more than five years in 1988; today we would expect this number to be substantially higher, thus suggesting that 25% of this core have worked more than 5 years. This would suggest that 5% of the total construction population may have worked more than five years.

Short-term new construction. Roughly 53,000 construction workers at Hanford after 1950 worked for short durations during the booms listed in Table 3.

Recent employment. Since 1990, between 1200 and 1800 BCT workers have been employed by the various prime maintenance and construction contractors, and most of these workers have been in full-time employment at Hanford.

Table 4
Employment based on workers' first hire date
Construction workers with security clearance and radiation badge information

Year	Frequency	Percent	Cumulative Number	Cumulative Percent
<1950	314	2.4	314	2.4
1950-1959	2567	19.8	2881	22.2
1960-1969	1966	15.2	4847	37.4
1970-1979	6578	50.8	11425	88.2

d. Summary of population size estimate

Although we will be examining a number of records in more detail in the months to come and during phase II, a reasonable estimate of the size of the population we can expect to serve would be:

Table 5
Summary of expected available population

	<1950	1950-60	1960-90	≥1990	Total
Total Size	50,000	36,000	19,000	4,000	109,000
Short-term		30,000	14,000	1,000	52,000
Long-term		6,000	5,000	2,600	16,000
Dead or lost	50,000	21,500	8,000	400	79,900
Available population	0	14,500	11,000	3,600	29,100

e. Location of Population

In order to conduct a surveillance program, the location of these workers must be known. If workers live in many states, the complexity of surveillance delivery is increased. While we have not yet been able to examine address records on all participants, we have examined the records of the Laborers' Local Union 348, one of the largest unions at Hanford, which indicates that the majority of working members and retirees live nearby.

Records of all *current* members of the Laborers' Local Union 348 were selected for analysis. Eight hundred records, including both working members and retirees, were examined and zip codes recorded. A geographical distribution was then determined by sorting records by zip codes and then plotting locations on a map of the Northwest region. A summary of this distribution is presented in Table 6. Eighty-eight percent of working members live within 80 miles of the tri-cities area, as do 76% of retirees. Most of the remaining members and retirees live elsewhere within Eastern Washington or in nearby areas of Oregon and Idaho. Retirees are somewhat more broadly dispersed within this region than working members and are more likely to live outside of the region (7% compared to 3%). Non-retired former members are likely to be more broadly dispersed than retirees since they are likely to have traveled in search of work.

Table 6
Residence Location (by zip code) of Membership List – Richland Area Laborers' Local Union 348

	Working Members number (percent)	Retirees number (percent)
Zone 1 Benton/Franklin Counties 10-mile radius	374 (60%)	75 (42%)
Zone 2 Grant, Yakima, Walla Walla Counties 80-mile radius	175 (28%)	61 (34%)
Zone 3 Grand Coullee Area 75 miles North of Zone 3	23 (4%)	7 (4%)
Zone 4 Eastern Washington, Idaho Eastern Oregon	30 (5%)	22 (12%)
Zone 5	20 (3%)	13 (7%)

Another sample of *former* Laborers' Local Union 348 members was drawn from dispatch records. Because current addresses and phone numbers were not available for this group, a search was conducted using telephone directories for the tri-cities area, Yakima, Moses Lake, and Spokane. Most of the small towns in the region are also covered by these directories. Twenty-five percent of those sought were matched by first and last name. Another 13% were matched by last name and first initial. Since the median age of this group (where ages were available) was greater than 60 years, many of these persons may no longer be living independently and therefore may not have a phone under their names. The geographical distribution of Laborers' Local Union 348 members is not likely to differ greatly from that of other building trades workers. Two-thirds of former workers are therefore likely to be found within the tri-cities area with other large populations located near mid-sized Eastern Washington regional towns, such as Yakima, Walla Walla, Moses Lake, and Hermiston, OR. Approximately 90% of all former workers are likely to be located in Eastern Washington and bordering areas in Idaho and Oregon. This estimate corresponds with the records of building trades pension funds that date from around 1960. Most retirees stay in the region.

Applying these findings to the available population information in Table 5, we anticipate the following distribution of population (Table 7):

Table 7
Geographic distribution of population

Population by Era	Available Population	Hanford Catchment Area	In Region Population	Outside Region
1950-59	14,500	8,000	5,100	1,400
1960-89	11,000	7,000	3,200	800
>90	3,600	2,700	750	150
Total	29,100	17,700	9,050	2,350

Note: Hanford catchment area is zone 1-2 in Table 6 (80 miles radius from Richland); region is zones 3-4 in Table 6; outside region is all other places.

These distributions generally agree with our experience from previous worker notification programs (Tillett, Ringen, Schulte, et.al., 1986)

f. Developing the List of Eligible Workers

We have identified several types of sources to assist in the development of a list of workers to which we are now gaining access. A description of these follows:

Data Sources

A number of electronic data sources are available that provide personal identifiers for former Hanford BCT workers as well as dates of employment, trade, date of birth and other information. No single data source provides a total record of former employees, but when combined they will provide a substantially complete master list. No source list, however, has been identified that provides identifiers for the large 1943-44 cohort of construction workers employed in the initial construction of the Hanford facilities.

We expect to use identified digital data source files as the primary framework for building a working data file. Identifier and address data developed from other sources will then need to be added to this working file. Union dispatch and pension records will provide an independent source of personal identifiers.

Although Unions are, in most cases, prohibited by their by-laws from sharing their mailing lists, union locals of the CWBCTC have committed to provide direct mailings to their membership and retiree lists. Union records are likely to be the only data sources for some sub-contractor employees.

Digital Sources

Currently we are analyzing two electronic sources of information on lists of construction workers from the Hanford Site. The first is a diskette we obtained from Donna Cragle, the Oak Ridge Institute for Science and Education, ORISE, which has specified fields, including: name, vital statistics, job title, badge information, employment information, department code, and demographic information (gender, race, birth date). We examined one of the files that contained over 8,600 employment records to ascertain the duration of employment. Seventeen percent, or 1,500 workers, had worked more than five years. This number of workers with at least 5 years of employment is likely increased since the data set was formulated in the late 1980s. Additionally, we have available on this data base vital status information on 29,332 construction workers, and in another file the names and social security numbers of 13,952 construction workers. Examination of Table 5 show that from the 1950s through 1989, almost 13,000 construction workers were hired.

Paper Sources

Paper originals of payroll, pension, and personnel records are maintained at the Records Holding Area (RHA) in Richland, WA and at the Federal Records Center (FRC) in Seattle. A complete review was conducted of the accession files maintained at RHA. Based upon content information, approximately 600 boxes of records containing personal identifiers of building and construction workers were identified by location and accession numbers. Accession files identified extensive record series available from Kaiser Engineers, J.A. Jones, Blau Knox, General Electric, DuPont, Vitro and Jagger- Stroufe-Lord. Although these records will contain a great deal of duplicate information we have learned from our previous review of records at Hanford and at Oak Ridge that several record sets must typically be accessed to create a complete file on any individual. Furthermore, it is usually necessary to utilize several types of records from different time periods to ensure a high level of confidence in the completeness of the list.

A listing of identified DOE records, by box accession number, appears in Appendix D.

Mortality Records

Several digital, microfiche and paper records exist that contain mortality data. These records will be accessed and deceased former workers will be removed from the active working file.

Other types of available records which would also help document the cohort of past construction employees are also at the FRC, Seattle. These include construction first aid reports and Medical X-ray, Construction. Documentation for these records includes only the date archived, not the date(s) during which the records were accumulated. One example is two boxes covering all employees who were treated (names beginning with A and ending with Z), archived in March 1958. It is likely that these records include the following: name of person treated, identifying number, work craft and location, activities which were being conducted when the injury occurred, and materials which contributed to the injury. It is also possible that the duration of employment of that worker at the time of injury is included.

g. Ability to Reach Workers through Outreach

The second method of reaching former workers will be through outreach techniques described above, i.e. through a local office that will coordinate radio, newspaper, etc. announcements, an 800 number and an office with a person in the community who will work with the local advisory committee to reach workers and retirees. The annual J. A. Jones reunion and picnic is an ideal location to introduce the program.

An important aspect of the needs assessment is to determine our ability to reach the target population. We have testing approaches under a separate DOE project for building trades workers at Oak Ridge.

These results indicate that developing as many sources of information as possible is important and then it requires a great deal of sorting and checking to verify information. For example, we developed a list of over 800 carpenters who had reportedly worked at the Oak Ridge Reservation. We attempted to test the validity of the list by sending a joint letter from the United Brotherhood of Carpenters (UBC)/University of Cincinnati (UC) to each of the 800 carpenters. We had developed this list from construction contractor records, union records, and tapes of construction worker records (Donna Cragle, ORISE). The UBC/UC newsletter was sent first class bulk mail with the assurance that those with improper addresses would be returned — about 20 were returned.

We proceeded to send the first questionnaires out with a letter requesting participation in the study. The results are shown in Table 8. We concluded that either few carpenters wanted to participate, or we had many wrong addresses and the post office only returned to us a portion of the undeliverable questionnaires.

Table 8
Returns (n=115) from Mailing 800 Initial Questionnaires - Oak Ridge Carpenters' Study

	Number
Number sent	156
Undeliverable	18
Never Worked at Oak Ridge	32
Death	7
Refused	2
Usable	56

We then sent out a double post card, first class (not bulk) with questions as to whether the individual had worked at Oak Ridge and whether they needed a questionnaire. The results of this test were revealing as shown in Table 9. First, half (379/750) never responded, either because of "mail overload" or again we had incorrect addresses and the post office did not return the mail. Of the cards that were returned because of incorrect addresses, we were able to look up 58% (116/200) on the World Wide Web phone books and resend. A large percentage, 31% (53/171) of final respondents never worked at the Oak Ridge site. We track information source on a database constructed by U.C. so we can take information from the most accurate list(s).

We have learned several lessons that will help us as we develop lists of former construction workers to use in a surveillance program:

- Check the addresses with the World Wide Web phone books (Tennessee went to street addresses from rural routes when 911 became available in the communities)
- Use a "tear off" postcard with a few questions as a source of first information.
- Plan for follow-up telephone calls.

Table 9
Results of Postcard Survey of Carpenters on Initial List — Oak Ridge

Postcards sent		750
Postcards with incorrect addresses returned by post office		200
Found on WWW & resent		116
Postcards returned by neither post office or intended recipient		379
Postcards returned		171
Deaths	30	
Never at Oak Ridge	49	
Refusals	7	
Needed a Questionnaire*	61	
Other	10	

4. Specific Hazards and Degree of Potential Exposures/Institutional History Books (100, 200, 300 areas and miscellaneous)

a. Specific Hazards

The rigorous material standards imposed on Nuclear site structures necessitated the use of a greater quantity of highly hazardous construction materials than is typical of civilian construction. At Hanford, asbestos, lead, stainless steel, nickel and epoxy-based paints were frequently used construction materials. Mercury, beryllium, and radioactive materials were also contaminants in maintenance, overhaul, and demolition environments. High noise levels, which are ubiquitous in construction work, were further increased at Hanford when work was performed within highly reflective enclosed areas such as reactor buildings and chemical purification "canyons". The complete spectrum of BCT worker exposures at nuclear sites, including Hanford, includes a wide variety of known hazards in undefined quantities.

The following exposures have been selected as posing a long-term health risk to former construction workers: asbestos, silica, welding fumes, beryllium, solvents, heavy metals (including cadmium, chromium and mercury), ionizing radiation, and noise.

The types of exposures to any potential hazard among construction workers is very dependent upon their trade and where they worked at the Reservation. For example, machinists would likely be directly exposed to a variety of machining fluids, while painters would not; however, painters are likely to conduct abrasive blasting as part of surface preparation, with possible exposure to silica, the pigments in the removed surface coatings and particulate from the underlying substrate (e.g., silica in cement or asbestos in transite). In addition, construction workers may be exposed to airborne and surface contamination related to the processes in areas where they come to provide the skills of their trade. For example, in an area where hexone is used as part of the PUREX process, exposure may occur to millwrights or carpenters working in the area as part of equipment repair activities.

Information on the types of direct exposures, by trade, in the early years of the Hanford operations has been collected and assembled into the Hazardous Exposure database (HEXFILE). The materials listed in the HEXFILE are direct exposures due to working with the substance listed. A summary of the contents of what is referred to as the "old Hex file" is shown in Table 10. The hazard rating score is a subjective ranking apparently assigned by those who developed the file. Values range from 0 (little or no hazard or potential for exposure) to 10 (highest value). The value assigned is linked to a specified area or building on the Site, and estimated dates for which the exposures may have occurred. These data are helpful in creating a profile of activities for each craft at Hanford, for review by Union leaders. In addition, the data will be integrated into the institutional history documents and compared with the results of reviewing our other references.

Even though the HEXFILE provides useful information, it does not even scratch the surface of potential exposures of former Hanford workers since industrial hygiene work performed by Hanford Environmental Health Foundation ,HEHF, (on which the HEXFILE is based) prior to the mid-1980's did little to quantify or even qualitatively describe construction and maintenance exposures. In addition, air monitoring results are not generally available for periods prior to the 1970's. Results were recorded as a percentage of a then current exposure limit and results truncated at 100% of the limit.

A preliminary review of the Hazardous Exposure database that contains the results of HEHF monitoring did show, however, a widespread incidence of asbestos exposures that exceeded 100% of the then current 2f/cc PEL. At a minimum, this data indicates that exposures to asbestos (with an unknown level of protection) at over 10 times the current PEL were relatively routine. Exposures of BCT workers are likely to have been significantly higher than 2f/cc when they, or coworkers, disrupted asbestos containing transite or lagging. Prior to, and in some cases, even after, 1980 it was likely that these exposures were not well controlled and/or adequate respiratory protection was not required.

Other overexposures documented in the HEX files include mercury (typically due to spills from laboratory or control instruments), beryllium, and lead. Exposures to non-construction materials would have been likely during overhaul, repair, and demolition of process and contaminant flow vessels and conduits (e.g. piping, ventilation ducts, tanks). It is not possible to determine, a priori, who was subject to these exposures. Worker interviews, combined with available contamination data, can shed considerable light on this matter. Early in Phase II, we will attempt to access the "new Hex file" and also consult with NIOSH researchers and our colleagues at the University of Washington to gain a better understanding of the exposure intensity data.

b. Institutional History Books

An integral part of our study of potential exposure history has been the creation of institutional history books, which contain information on the history of processes as well as physical structures. Using the evidence contained in sources listed below we have compiled information in a sophisticated Microsoft Access database. These have been printed in book form, with several hundred pages of information each for the 100, 200 and 300 areas, as well as miscellaneous buildings. For each building, these books tell dates of construction, renovations, additions, and demolition or shutdown; start dates, stop dates, and descriptions for each process within that building, as well as decommissioning of facilities or entire buildings; incidents, accidents, spills, and leaks, including the date of occurrence, type of hazard, and extent of contamination; and physical descriptions, including construction materials and distinguishing features. These books have helped us to catalogue documented (referenced in literature) potential hazards (based on professional judgment) in particular buildings or geographical areas, and thus identify significant buildings or other locations where significant exposures may have occurred.

Sample excerpts from these institutional histories are attached as Appendix A. Complete copies of these reports are available from Dr. Eula Bingham, Environmental Health Department, University of Cincinnati, Cincinnati, Ohio, 45267-0056.

c. Sources of Information

Several factors have made Hanford a site with a great deal of useful source material available for studying the history of processes and potential exposures for workers. Because Westinghouse Hanford has a site historian, a great deal of information on the history of Hanford's facilities and the processes that occurred in them is publicly available. Michele Gerber, PhD., has published a 300-page book on Hanford's history, with emphasis on problems of contamination. In her role as official historian for Hanford, Gerber has also written smaller histories of several of the major facilities and areas, which can be found both at the Hanford Public Reading Room (at Washington State University, tri-cities campus), and on Hanford's Internet home page.

Other factors are that Hanford is in the cleanup stage, and the local community and "downwinders" have been active in seeking answers about environmental and health concerns related to Hanford's activities. This has resulted in a proliferation of studies on dangerous practices at the site with detailed information about contamination. These studies have been useful for our research because of the analysis they offer, and also because the investigators who worked on them have had an amazing amount of primary documentation declassified under the Freedom of Information Act. These sources are available to the public in the Hanford Reading Room. Following are examples of the sources that have been most useful for creating the institutional history books and determining processes and possible exposures.

Michelle Gerber, On the Home Front: The Cold War Legacy of the Hanford Nuclear Site, Lincoln, NB: The University of Nebraska Press, 1992

Gerber's publications for Westinghouse Hanford:

"A Brief History of the T Plant Facility at the Hanford Site" (May 1994)
"Dramatic Change at T Plant" (April 1994)
"A Brief History of the PUREX and UO-3 Facilities" (November 1993)
"The Plutonium Production Story at the Hanford Site: Processes and Facilities History" (June 1996)
"Legend and Legacy: Fifty Years of Defense Production at the Hanford Site" (September 1992)
"Manhattan Project Buildings and Facilities at the Hanford Site: A Construction History" (September 1993)
"Past Practices Technical Characterization Study - 300 Area - Hanford Site" (December 1992)

"Hanford Site Development Plan," Richland: Richland Operations Office, May 1993

Building Inventories, compiled by AEC-GE Study Group for the Economic Development of Richland, 1964:

"Catalog of Hanford Buildings and Facilities: 100 Areas"
"Catalog of Hanford Buildings and Facilities: 200 Areas"
"Catalog of Hanford Buildings and Facilities: 300 Areas"
"Catalog of Hanford Buildings and Facilities: Miscellaneous"

"History of Operations (1 January 1944 to 20 March 1945)," (Richland: Hanford Engineer Works, no date but appears to be early postwar)

numerous reports of incidents and accidents, such as:

Final Radiation Incident Report for 231-Z Building, 2/18/72, personnel exposure to airborne plutonium contamination

Radiological Sciences Department Investigation, Radiation Incident Class I, No. 536-C, uncontrolled emission of ruptured materials from an irradiated uranium charge at the 105-H reactor building, 10/31/55

Investigation Report - Purex Plant Silver Reactor Incident, 2/27/58

Silver Nitrate Type Iodine Absorber Explosion, July 1958

Miscellaneous Documents available at Hanford Reading Room:

"Columbia River Pathway Dosimetry Report, 1944-1992," Prepared for the Technical Steering Panel and the Centers for Disease Control and Prevention (Richland: Battelle PNL, July 1994)

"Atmospheric Pathway Dosimetry Report, 1944-1994," Prepared for the Technical Steering Panel and the Centers for Disease Control and Prevention (Richland: Battelle PNL, October 1994)

"Project Hanford," (Richland: Richland Operations Office, November 1995)

"Old Hex File: Qualitative Assessment of Exposure 'Hazard' by Craft/Job Title," (Richland: September, 1976) (covers years 1944 - 1972)

Steven Blush and Thomas Heitman, "Train Wreck Along the River of Money: An Evaluation of the Hanford Cleanup," a report for the U.S. Senate Committee on Energy and Natural Resources (March 1995)

numerous reports of incidents and accidents, such as:

Final Radiation Incident Report for 231-Z Building, 2/18/72, personnel exposure to airborne plutonium contamination

Radiological Sciences Department Investigation, Radiation Incident Class I, No. 536-C, uncontrolled emission of ruptured materials from an irradiated uranium charge at the 105-H reactor building, 10/31/55

Investigation Report - Purex Plant Silver Reactor Incident, 2/27/58

Silver Nitrate Type Iodine Absorber Explosion, July 1958

In addition, we have collaborated with Dr. Steven Wing and Ms. Suzanne Wolf at the University of North Carolina (Chapel Hill) to access information abstracted by them for other DOE-supported studies. For example, the "Old HEXFILE" was obtained from UNC.

d. Data Still to be Reviewed

Several important sources are still being integrated into the Institutional History data base. These include the inventory of waste pits which has been obtained on microfiche and exposure data reportedly available through the DOE at Richland which has not been obtained. The "old HEX file" will be incorporated into the Institutional History and the "new HEX file" reviewed. Any film badge data for construction will be accessed through the DOE.

To date, we have been able to locate early site location maps developed during the years the Hanford site was being developed. It is hoped that DOE personnel can assist us in identifying sources of early site maps. These have been very useful in triggering recall of work areas by Carpenters in the NIOSH-funded project at Oak Ridge.

Additional data sources will be accessed as they become available through the DOE. We believe that data collection will provide documentation for exposures in routine, but previously unrecognized hazardous situations, and in non-routine activities. Thus, the understanding of the work activities of construction tradesmen will become more complete as the program is conducted.

Table 10
Exposures rated on a scale of 1 to 10
for various crafts at the Hanford Site

Craft	Potential Exposure	Hazard Rating
Asbestos Worker		
	asbestos	1 - 10
	cement	1 - 5
	fiberglass	1
	heat	1-6
	mineral wool	1
	noise	1-7
Carpenter		
	acetic acid fumes	1
	asbestos	1 - 3
	fabricating PVC/other plastics	1
	wood dust	0 - 3
	noise	1-3
	plexiglass cement	1
Cement masons		
	cement dust	1
	epoxy resins	1 - 2
	noise	1 - 3
Boilermakers		
	acetone	1
	aluminum	1
	asphalt	1
	asbestos	1 - 4
	bronzes	1
	carbon steel fumes	1
	carbon tetrachloride	1 - 7
	cast iron	1
	cement	1
	fly ash/soot	1
	heat	1 - 10
	inconel	1
	metal shavings	1
	stainless steel dust/fumes	1 - 3
	methyl ethyl ketone	1
	nickel	1
	noise	1 - 5
	perchloroethylene	1
	stoddard solvent	1
	titanium fumes	1
	trichloroethylene	1 - 3
	vanadium	1
	welding fumes	1 - 4

Electricians		
	acetone	1
	aerosol varnish	1
	aluminum	1
	asphalt	1
	asbestos	1 - 3
	carbon steel fumes	1
	copper	1
	cleaners/freons	1
	galvanized metals	1
	solder	1 - 2
	heat	1 - 6
	lead	1
	metal shavings	1
	noise	1 - 5
	perchloroethylene	1
	stainless steel fumes	1
	stoddard solvent	1
	trichloroethylene	1
Heavy Equipment		
	kerosene	1
Ironworkers		
	aluminum	1
	carbon steel fumes	1
	heat	1 - 10
	metal shavings	1
	naphtha	1
	noise	1 - 6
	perchloroethylene	1
	stainless steel fumes	1
	stoddard solvent	1
	welding fumes	1
Machinist		
	acetone	1
	aluminum	1
	beryllium	0 - 1
	carbon steel fumes	1
	copper	1
	metal fumes	1
	nickel	1
	cutting fluids	1
	stainless steel fumes	1
	stoddard solvent	1
	titanium fumes	1
	trichloroethylene	1
Millwrights		
	acetone	1

	aerosol spray cleaners	1
	aluminum	1
	carbon steel fumes	1
	cement dust	1
	machinery grout	1
	heat	1 - 6
	metal shavings	1
	stainless steel dust/fumes	1 - 3
	noise	1 - 6
	perchloroethylene	1
	stoddard solvent	1 - 3
	trichloroethylene	1
	welding fumes	1-3
Painters		
	asphalt	1
	paints/enamels	1 - 9
	thinners	1 - 5
	benzene	1
	methyl ethyl ketone	1 - 3
	neoprene/rubber coatings	1
	removers	1
	sandblasting	1 - 3
	stoddard solvent	1 - 3
	toluene	1
	trichloroethylene	1
	vinyl plastics	1
Plumbers/steam fitters		
	acetone	1
	aerosol spray cleaners	1
	asbestos	1 - 4
	carbon steel fumes	1
	copper	1
	welding fume	1 - 4
	heat	1 - 5
	lead	1 - 3
	metal shavings/buffing	1
	carbon steel dust	1 - 3
	nickel	1 - 3
	noise	1 - 6
	perchloroethylene	1
	plastics/cement	1
	stainless steel fumes	1 - 5
	stoddard solvent	1
	titanium fumes	1
	trichloroethylene	1
	welding fumes	1 - 3

Sheetmetal worker

acetone	1
aerosol spray cleaners	1
aluminum	1
asbestos	1
carbon steel fumes	1
cement/plastics	1
copper	1
metal filings/shavings	1
welding fumes	1
lead	1
noise	1
solder	1
stainless steel fumes	1
titanium fumes	1

Source: "Old HEXFILE", identified as HEXCREN (09/23/76), an historical, qualitative assessment of non-radiological hazards by job classification for the years 1944 through 1972.

5. Nature and Extent of Health Impacts/Determining Construction Workers at Significant Risk

a. Dates of Work

Based on other surveillance programs with which the team has been involved and an understanding of hiring practices at Hanford, it is believed that the duration of work is a key factor in determining whether a construction worker may have a significant risk of work-related illness or injury. From our experience, we believe that a guideline of 5 years of employment is initially appropriate and propose to use it in evaluating the numbers of persons who may be eligible for surveillance.

b. Interview Information

Duration of employment alone will not capture workers who may be at increased risk of disease due to an acute exposure (e.g., high-level radiation) or because of exposure to a severely toxic material (e.g., beryllium). Therefore, the occupational history interview will be constructed to elicit both duration of employment and potential exposure to specific hazards.

For exposures for which specific medical exam modules will be developed (see Appendix B), an instrument will be finalized to catalogue worker recall of duration of exposure (or activities likely to be associated with exposure), the first and last year of exposure, and an estimate of frequency of exposure. For example, an examination to evaluate the impact of asbestos exposure is proposed only if 1) 15 years has elapsed since first exposure and 2) a total of 5 years of exposure is documented. Each person who reports working with/near asbestos operations (e.g., pipefitters) will be queried as to determine 1) the first year of such activity, 2) the last year of such activity, and 3) and an estimate of how much of that elapsed time was associated with the exposure/activity.

We anticipate that some exposures may not be known, or for other reasons cannot be recalled. For example a carpenter working near beryllium machining is unlikely to have known of the hazardous potential exposure. In this case, we will rely on linking the institutional history document (location of potential exposures) and the work history report (of location). In this example, work in an area is a surrogate for potential exposure.

Draft occupational history survey instruments are shown in Appendix C.

c. Health Impacts

The goals of the medical surveillance program are to perform medical evaluations for specific exposure-related adverse effects and illnesses. For this program the following specific hazards have been selected:

asbestos
silica
welding fumes
beryllium
solvents
heavy metals (lead, cadmium, chromium, mercury)
ionizing radiation
noise

d. Nature of health impacts

Although the long-term effects of exposure to these agents is documented in Appendix B, the health impacts of each of the specific exposures described in the medical surveillance protocol are summarized below:

asbestos
- asbestosis
- pulmonary function decrements
- cancer

silica
- silicosis

welding
- chronic bronchitis
- asthmatic bronchitis
- chronic obstructive lung disease

beryllium

chronic beryllium disease

solvents

- liver and kidney dysfunction

heavy metals

- lead
  - elevated blood lead
  - CNS toxicity
  - peripheral neuropathy
  - renal insufficiency
- cadmium
  - altered renal function
- chromium
  - altered renal function
  - allergic dermatitis
  - lung cancer
- mercury
  - neuropsych abnormalities
- ionizing radiation
  - mutations
  - chromosomal damage
  - cancer

noise

- deafness

e. Example of an Assessment for Risk

In 1996, local Hanford area Carpenter Union leadership expressed concern about a perceived high lung cancer incidence among their membership. The Carpenters' Health and Safety Fund requested that Dr. Cynthia Robinson of NIOSH reanalyze the data from a recently completed PMR study on Carpenters. That reanalysis compared Eastern Washington and Western Washington Carpenters to the national norm. Eastern Washington carpenters (most with work experience at Hanford) were found to have a PMR of 190 for lung cancer while there was no significant excess in Western Washington. Nationally, carpenters had a PMR of 119 for lung cancer. While not definitive, this analysis is consistent with our belief that Hanford-related exposures have significantly increase lung cancer mortality among building trades workers.

Table 11
Typical Carpenter Interviews

ID	Age	Trade	Worker History Based on Interview	Years of Work	Potential
1114	67	Carpenter	X-10-2519 Steam Plant X-10-2013 Hospital-new construction Y-12-3017 removed asbestos, tiled sawed, ceiling transite work, scooped up Hg with hands	42	Asbestos Mercury
1501*	66	Carpenter	Y-12-9998 Ceiling work, UR, , PB, BE K-25-9201 Scaffolding for rad. Barrier, Pb, asb siding	41	Radiation , Uranium Asbestos
1278	53	Carpenter	Y-12-9212 Foundry-radiation contamination, built scaffolds Y-12 Equipment to foundry "hot" K-25 Told "clean", next day "rad"	9	Mercury Radiation
1001	50	Carpenter	X-10 New Construction	2.5	Asbestos

* This person died 2 days after interview from lung cancer.

6. Assessment of Phase II Service Delivery Need

Based on the needs assessment presented here, we have performed an initial calculation of service delivery volume that can be expected in Phase II.

a. Triage Design

The core of our approach is a triage design which is outlined in Figure 2. It can be summarized as follows:

Program eligibility. We will include all building and construction trades workers. These will be identified from record sources described earlier: DOE records, contractor records, union records, pension fund records, etc. We also will initiate outreach activities to encourage potential former workers to come forward. Based on the chronology of construction events at Hanford, we will then make an initial determination whether the persons contacted have been in a situation where they in any likelihood may have experienced hazardous exposures. The invitation to participate will clearly explain the nature of the program.

Occupational and exposure history. For those who agree to participate by signing an informed consent form, the first step is to conduct an in-depth occupational and exposure history interview. At that time we will also ask them whether they have had any symptoms or fears of illness due to their work at Hanford and we will ask them to sign a release of information for medical records from other health programs or examinations in which they may have participated. (We have found that at many DOE sites there have been several official and private screening programs of various kinds.) Based on this information we will make determinations about whether to include individuals in the medical examination portion of the program. At this time we have selected the following *tentative* criteria for inclusion in the program based on risk and ability of generally accepted medical tests to detect an adverse effects. This criteria can be found in Table 12.

Table 12
***Tentative* criteria for inclusion in medical program**

Five years or more of employment at Hanford
Fifteen years or more since first employment at Hanford
40 years of age or more
Unless:
There have been significant exposures to specified hazards, e.g., radiation, asbestos, silica, mercury, beryllium, lead, cadmium, etc.
There is medical indication of need
The worker expresses a strong fear or concern about his or her health.

Basic medical examination. Individuals who meet the criteria will be invited to receive the core medical examination. The examinations will be carried out under contract by community physicians selected by us. This will be initiated by a second informed consent request, where all aspects of the medical examinations and use of data will be explained in detail, as well as the individual's legal rights. At that time, based on the exposure history or medical indication, the person may also be referred for additional, risk specific examinations. Those who are tested positive will be referred to their medical providers (or assisted in finding an appropriate medical provider) for follow-up care, and will once again be given information on their legal rights.

Surveillance. For those individuals who have suspicious medical findings, the examining physicians' opinion indicates need, or if there are exposure findings warranting this, it is our plan that a longer-term program of ongoing monitoring will be established. DOE, however, has not made a determination about the need for, or authority to, support such a program.

Each step in this triage will be designed with carefully developed quality control and reporting mechanisms. We will also interview participants for satisfaction.

b. Preliminary estimate of need

Based on information that we have obtained, we estimate that our program will be required to meet the following needs:

Table 13
Preliminary estimate of need

Population to be served:		
Total population (Table 2)		109,000
Dead or lost to follow up (Table 5)		79,900
Available population (Table 5)		29,100
	In Area	Dispersed
Eligible population (Table 7)	17,700	11,400
Decline participation	30%	50%
Participating population	5,800	5,700
Eligible for Medical surveillance	50%	50%
Examined population	2,900	2,700

*Best Estimate

Based on the information in Table 13, we have estimated the volume of services that will need to be delivered in Phase II, assuming that Phase II will last 4 years.

Table 14
Estimate of Phase II service delivery (Per year for 4 years)

Population tracing[1]	15,000
Searching for death certificates[2]	7,500
Invitations to participate/follow-up[3]	7,500
Interviews conducted[4]	3,000
Follow up to collect medical records[5]	750
Medical exams conducted[6]	1,500
Follow-up telephone interviews to determine satisfaction[7]	3,000

[1] We will trace 15,000 workers per year, totaling 60,000 workers in 4 years, which is the total number of eligible dead or lost population plus the total available population (see Table 5).
[2] We assume that we will need to search ½ of the population traced for death certificates.
[3] We assume that we will invite ½ of the population traced to participate (the rest will be dead or lost , or not eligible).
[4] We assume that 60% of the workers invited will decline to participate, and thus we will interview 40% of the workers invited.
[5] We assume that 1/4 of the workers interviewed will have medical records which will need to be collected.
[6] We assume that ½ of the workers interviewed will decline to participate further or will not be eligible to participate, and thus we will conduct exams on ½ of the workers interviewed.
[7] We may decide to interview only a sample of this population.

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Appendix A

Excerpts from Institutional History Documents

100 Area

200 Area

300 Area

Miscellaneous

AREA 100
SELECTED BUILDINGS

Hanford Reservation
Richland, Washington

Prepared under the direction of
Dr. Eula Bingham and Dr. Carol Rice
June, 1997

Grant: Sub UBC/DOE

Report of Building Number: *105-D*

Building Name: Reactor Building

Area: 100 **Construction Year:** 1944 **Closure Year:** 1967

Construction Type: Similar to building 105-B except minor variations in layout.

Size: Offices 1762 sqft; Shops 3275 sqft, Work 28,832 sqft; Storage 3845 sqft; Laboratory 380 sqft; Common 15,573 sqft.

Unique Features: See building 105 B.

Renovations:

Function

Year	Function
	Reactor D building

Processes in the Building

From Year	To Year	Process
1949		April; Reactor-D is put to the "Incremental Test Program" to increase the energy to 300MW. (WHC-MR-0521, Rev 0)

Hazards : U-235, Pu-238

Inferred Hazards: other radionuclides, graphite dust, EMF, welding fumes

References

GEH-26434- 100: Catalog of Hanford Buildings and Facilities 100 Areas; Construction Data.

Report of Building Number: *105-N*

Building Name: Reactor Building

Area: 100 **Construction Year:** 1959 **Closure Year:**

Construction Type: Reinforced concrete and structural steel building with channeled steel siding. The reactor is contained within a reinforced concrete enclosure which serves as a confinement zone capable of withstanding moderate pressures.

Size: 452 x 259 ft with stepped roof to 70 ft; 183 x 70 ft basin and transfer area extend west at southwest corner; Offices 5030 sqft; shops 10,870 sqft; Storage 3180 sqft; Common 5030 sqft; Process, Operating and fuel storage 140,000 sqft.

Unique Features: One side of the confinement enclosure (i.e. rear) is shared with the 109-N heat exchanger building. Three track railroad spur enters irratiateed fuel storage and transfer wing. Also 1734-N building, 900 sqft in area is used for storing gas bottles. A 900.000 gal chemical waste storage tank for decontamination ssolutions, crib and tile feild.

Renovations:

Processes in the Building

From Year	To Year	Process
1964	1986	N-reactor operation. (WHC-MR-0521, Rev 0)
1965	1967	Co-product demonstration in which tritium was produced in the reactor fromspecial lithium-aluminium fuel elements. (WHC-MR-0521, Rev 0)
1966		Production of steam for generating electricity. (WHC-MR-0521, Rev 0)
1971		Ordered closed for defence production but continued producing electricity. (WHC-MR-0521, Rev 0)
1986		April; Ordered to stand-down mode. (WHC-MR-0521, Rev 0)
1988		February; Cold-standby. (WHC-MR-0521, Rev 0)

Hazards : U-235, Pu-238

Inferred Hazards: other radionuclides, graphite dust, EMF, welding fumes

References

GEH-26434- 100: Catalog of Hanford Buildings and Facilities 100 Areas; Construction Data.

Report of Building Number: *107-B*

Building Name: Effluent Water Retention Basin

Area: 100 **Construction Year:** 1943 **Closure Year:**

Construction Type: A reinforced concrete structure divided into two sections with a central flume running the length of the basin.

Size: 230 x 467 ft; 12 mil gallon capacity; Gate house area 650 sqft.

Unique Features: Sluice gates permit use of each of the sections alternatively. Small wooden structures house the instruments and controls for the gates and valves.

Renovations:

Function

Year	Function
	Effluent water retention Basin

Hazards : Potential radioactive uranium and other nuclear reactor by-products such as P-32, Zn-65, Cr- 51, Fe-59 and As-76. Also Sodium-dichromate added during reactor influent treatment to prevent corrosion.

Inferred Hazards: biohazards

References

GEH-26434- 100: Catalog of Hanford Buildings and Facilities 100 Areas; Construction Data.

Report of Building Number: *117-B*

Building Name: Exhaust Air Filter Building

Area: 100 **Construction Year:** 1943 **Closure Year:** 1979

Construction Type: A reinforced concrete structure almost completely below grade.

Size: 56 x 39 x 35 ft

Unique Features: The building consists of two identical filter cells with operating gallery in between. Each filter cell contains two filter banks in series; the first of the "absolute" type capable of removing 99.95% of 0.3micron particles; the second, of activated carbon.

Renovations:

Function

Year	Function
	Exhaust air filteration for Reactor-B

Hazards :

Inferred Hazards: mercury, EMF

References

GEH-26434- 100: Catalog of Hanford Buildings and Facilities 100 Areas: Construction Data.

Report of Building Number: *1722-B*

Building Name: Paintshop and Riggers Loft

Area: 100 **Construction Year:** **Closure Year:**

Construction Type: Single story frame structure on concrete foundation with concrete floor, asbestos shake siding, and flat wooden roof with built-up felt and gravel surface.

Size: 40 x 30 x 15 ft

Unique Features: A concrete block wall divides into two equal sized rooms.

Renovations:

Function

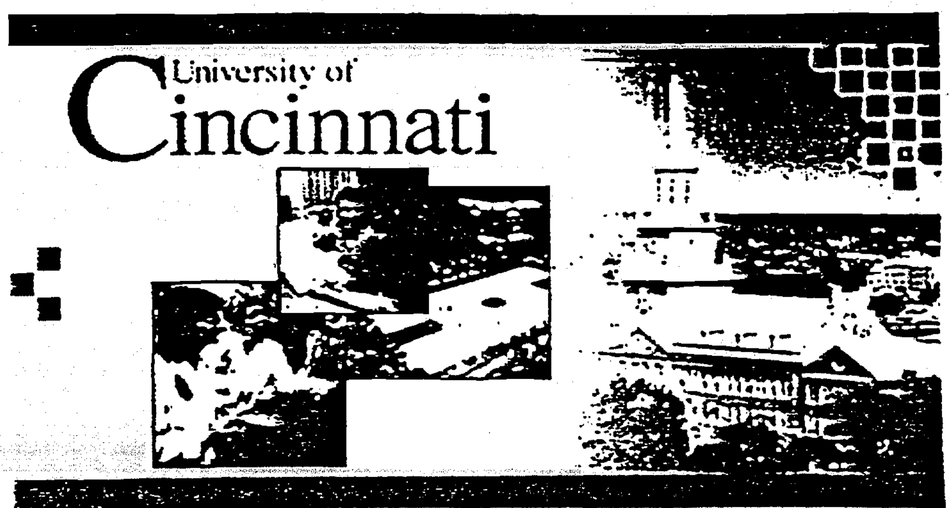
Year	Function
	Paintshop and riggers loft

Hazards : asbestos

Inferred Hazards: paint pigments and solvents, silica, degreasing agents, welding fumes

References

GEH-26434- 100: Catalog of Hanford Buildings and Facilities 100 Areas; Construction Data.



AREA 200
SELECTED BUILDINGS

Hanford Reservation
Richland, Washington

Prepared under the direction of
Dr. Eula Bingham and Dr. Carol Rice
June, 1997

Grant: Sub UBC/DOE

Report of Building Number: *202-A*

Building Name: PUREX Processing Plant

Area: 200 **Construction Year:** 1956 **Closure Year:** 1992

Construction Type: The original PUREX Plant was a concrete rectangle. The shielding capacity of the concrete was designed so that personnel in non-regulated service areas would not receive radiation in excess of 0.1 millirem per hour. The canyon is heavily shielded concrete and contained 11 cells designated A through H, J, K and L. Each cell was 14 feet wide, 42.5 feet deep, and 39.5 feet deep from floor to underside of the reinforced concrete cover blocks.

Size: 1005 x 199 x 64 ft high; Total area 189,000sqft.

Unique Features: Master and slave cranes of various capacities. Railroad spur and tunnel to the east of the building for bringing casks. Vacuum cleaning system to remove dust from the canyon deck. Water fog fire protection system for the canyon in all process cells. Equipment disposal facility to remove failed equipment. Nitric acid recovery system. 3750 KVA substation services the Purex facility. Other unique features included: an irradiated fuel element storage basin, located within a separations facility; a railroad tunnel that permitted unloading of contaminated cask cars without compromising the ventilation system; and a "soft wall" at the east end of the building consisting of concrete blocks and grout that could be removed for the installation of an additional crane or to enlarge the building at a future date. In the ventilation system, an initial glass wool filter was chosen instead of the sand filters used at earlier HW processing plants. The overall ventilation system was also designed to have three times the capacity of the REDOX system so that air of considerable force could enter the cells when cover blocks were removed and prevent the escape of contaminated particles from the cells into the canyon area.

Renovations:

Function

Year	Function
1955	After the PUREX Plant was completed in April, "Cold" runs(tests with unirradiated materials) were initiated in late of the year.
1956	Hot startup(work with radioactive substances) commenced in January of the year.
1972	The PUREX Plant entered a temporary shutdown period that lasted 11 years.
1983	The PUREX Plant reopened.
1992	A final closure order was issued by DOE in December.

Processes in the Building

From Year	To Year	Process
1955		January; Commences "hot" startup and operation. (WHC-MR-0521, Rev 0)

1958		Recovery of neptunium-237. Continuous recovery started in 1962. (WHC-MR-0521, Rev 0)
1962		Plant modified to permit the continuous recovery of Np-237 without interfering normal plutonium recovery operations. (WHC-MR-0435)
1965		System reconfigured to operate at a capacity factor of 4.0 or 33 MTU/d. (WHC-MR-0521, Rev 0)
1966		Zirflex process emplaced to process N-reactor fuel. (WHC-MR-0521, Rev 0)
1972	1983	Plant shut down. (WHC-MR-0435)
1972	1983	Plant closed for clean up and other associated modifications. (WHC-MR-0521, Rev 0)
1988		Closed for six weeks for safety violation and also closed for a year due to technical and safety difficulties. (WHC-MR-0521, Rev 0)
1988		February; Final stand by order. (WHC-MR-0521, Rev 0)

Contamination/Acciden

Year	Accident
1956	An instrument line leading to the L-6 tank (part of the final plutonium decontamination cycle) release about 20 gallons of plutonium-bearing solution into the west end of the P&O gallery. Liquid contamination was spread through the chemical sewer drain, the canyon lobby, the P&O gallery, and into R-Cell. Airborne contamination was drawn by exhaust fans throughout the P&O gallery, other 202-A Building locations and into the environment. So many coats of sealant paint were applied to the immediate area of the spill in the west end of the P&O gallery that the area became known as the White Room. In 1957, a shielding wall and a separate ventilation system were installed to isolate the White Room, and the area remains a radiation zone today. (WHC-MR-0437)
1958	The bottom portion of the silver reactor filter in A-Cell exploded. The huge filters, 8-foot-thick beds of packing material coated with silver nitrate, absorbed and reacted with the radioiodine in the dissolver offgases. Once saturated, they regenerated with an ammonium hydroxide flush. It was presumed that the 1958 uncontrolled reaction(explosion) occurred when unstable products formed in the ammonia-silver salts mixture. Although there was little detectable spread of contamination to other portions of the PUREX building and none to the environment, cleanup and repair were difficult because the fillter was located in a heavily shielded, inaccessible area. (WHC-MR-0437)
1964	First-cycle acid waste from the PUREX Plant accidentally was discharged to the cooling water swamp southeast of the 202-A Building. An estimated 10,000 curies (Ci) of mixed fission products (primarily Zr/Nb-95, Ce-141/144, and Ru-103/106) were released and settled in the mud and algae. Corrective action included killing the algae, covering the contaminated ditch area that flowed to the swamp with backfill, and digging partial new ditch/swamp areas. (WHC-MR-0437)

1965 A sudden release of steam from high-level waste storage tank 241-A-105 caused contamination of tank instrumentation and a nearby construction ditch. The contamination cleaned up readily, but probes showed that a large area of the steel tank liner bottom had bulged upward as much as 8.5 feet, creating a void capable of holding up to 85,000 gallons. It was surmised that a leak in the liner had caused water to accumulate, and that the temperature differential between the water and the hot tank sludge had caused the buckling. The tank continued to hold wastes until April 1967, but no new wastes were added and recirculator flow and surveillance were increased. In 1967, when liquid level fluctuations began to occur, the tank was taken out of service. All liquids were pumped out, and as much sludge as possible was removed in sluicing campaigns in the early 1970's. The remaining sludge still produced enough heat on a regular basis that cooking water needed to be sprinkled into the tank for several years until it was fully stabilized in 1978. Since that time no wastes have been added to the tank. (WHC-MR-0437)

1967 High-level contamination escaped from a shielded sample carrier and spread onto the clothing of an operator. Because it was not detected for 44 minutes, low-level contamination was spread by the employee into nonradiation zones. The incident was considered serious because of operationg procedure violations rather than to the extent of contamination spread. Another incident of operator contamination, accompanied by the spread of low-level contamination in areas of the 202-A Building, took place in June 1968. Radioactive liquid was sprayed onto an operator's coveralls during the removal of a broken pipette tip from the F-26 sample riser. This incident did not involve the violation of work procedures. (WHC-MR-0437)

1982 A dilute nitric acid solution was misrouted during a routine transfer, and a 2500-gallon spill occurred. Radioactivity was spread to various areas normally occupied by operations personnel. However, because the plant was not operating, the personnel exposures were limited. Loss of configuration control and poor tracking were blamed for the incident. (WHC-MR-0437)

1986 A leak occurred at a pipe fitting downstream from a plutonium nitrate product solution strorage tank, and solution dripped to the floor of the containment glovebox. A temporary transfer of solution to another tank was made, without entering the change into the formal documentation and configuration control procedures. Although a blank was installed in the piping to prevent inadvertent and subsequent transfer of the solution to a non favorable environment and the leak was repaired, the episode revealed several violations in proper documentation and control. (WHC-MR-0437)

Hazards : Airborne plutonium, plutonium, neptunium-237 , ruthurfordium, cesium, nitric acid, ammonium fluoride, ammonium nitrate, iodine-131, silver nitrate, ammonium hydroxide, plutonium nitrate

Inferred Hazards: EMF, asbestos, hexane, other radionuclides

References

GEH-26434-200: Catalog of Hanford Buildings and Facilities 200 Areas; Construction Data.

WHC-MR-0521, Rev 0: The Plutonium Production Story at the Hanford Site: Process and Facilities Hist

WHC-MR-0435: Hanford Site. An Anthology of Early Histories

WHC-MR-0437: A Brief History of the PUREX and UO3 Facilities

Report of Building Number: *211-T*

Building Name: Tank Farms.

Area: 200 **Construction Year:** 1943 **Closure Year:**

Construction Type: Nine vertical, stainless steel storage tanks that held acids (nitric, phosphoric, and formic). Six horizontal tanks, stainless steel tanks held the full-strength, concentrated nitric acid. Three additional steel tanks held caustic solution (sodium hydroxide), one steel tank held sulfuric acid, another tank on scales held anhydrous hydrofluoric acid, and a small expansion tank was provided as a spare, to provide for overflow and preventthe rupture of other tanks.

Size: Not described.

Unique Features: Not described.

Renovations:

Function

Year	Function
1943	To store and supply fresh chemicals to T Plant. (WHC-MR-0452, ADDENDUM 1)

Processes in the Building

From Year	To Year	Process
1944		To store and supply fresh chemicals to T plant. (WHC-MR-0452)

Contamination/Acciden

Year	Accident
1947	In December, an operator received contamination on his hands and clothing while rodding a vent pipe in the new crib No. 2 near the 361-T Tank. (WHC-MR-0452)

Hazards : Nitric, phosphoric, formic, anhydrous hydrofluoric, and sulfuric acids. Sodium hydroxide.(WHC-MR-0452, ADDENDUM 1)

Inferred Hazards: welding fumes, EMF

References

WHC-MR-0452, ADDENDUM 1: A Brief History of the T Plant Facility at the Hanford Site.

Report of Building Number: *221-T*

Building Name: Canyon Building

Area: 200 **Construction Year:** 1943 **Closure Year:**

Construction Type: Reinforced concrete building, components varying in thickness from 3 ft to 8 ft depending on the required shielding for the original process.

Size: 85 ft x 875 ft 6 in.; height 102 ft.

Unique Features: The pipe gallery is split into sections by the railroad tunnel. Its overhead clearances are restricted by the various piping. All cells have process equipment in place, and the cell-block covers control radiation and contamination by acting as a lid to each cell. The railroad enters the building below grade level, and dirt has been piled up outside of the building on both sides of the track for shielding.

Renovations: Portions of the building are currently being used for decontamination of process equipment. Currently, the head-end section is being converted for use in Reactor Contaminant Test Program.

Function

Year	Function
1944	Radiochemical processing.
1958	The facility replaced U Plant as HW's central decontamination plant. (WHC-MR-0452, ADDENDUM 1)
1964	A Burst Test Containment Facility was installed in the head end of T Plant, thus providing a place to conduct trials in the explosive degradation of irradiated fuel elements. (WHC-MR-0452, ADDENDUM 1)
1993	Waste inspections and repackaging. The facility stepped up to accept, open, sample, and repackage over 200 drums containing unknown wastes from the Tank Farms. (WHC-MR-0452, ADDENDUM 1)

Processes in the Building

From Year	To Year	Process
1944		December 26. hot processing begins. (WHC-MR-0452)
1944		Actual runs using process solutions began on december 6, and the first batch of irradiated fuel rods from B Reactor was processed on December 26 and 27. (WHC-MR-0452)
1944		Bismuth phosphate (BiPO4) process. (WHC-MR-0452)
1944		Wind dispersion tests with oil fog (SO2) begun. (WHC-MR-0452)
1944	1945	To schedule dissolver operations when atmospheric conditions are conductive to maximum dispersion hourly and 12-hour dissolving forecasts were phoned to T plant, begining with the cold runs in November. (WHC-MR-0452)

1944		During November and early December, chemical runs, and then practice runs using cold (unirradiated) slugs having defective aluminum jackets (covers), were made. (WHC-MR-0452)
1944	1952	Chemical processing operations. (WHC-MR-0452)
1945		In February, a group of 60 qualified men was allowed to participate in processing active uranium. (WHC-MR-0452)
1945		January 13. the semiworks was placed on cold standby, and all personnel were transfered to the 321 Seperations buildings. (WHC-MR-0452)
1945		February 12, the hot semiworks were reactivated in T plant to conduct tests in which scavengers were omitted from the by-product step and ammonium silicofluoride was used in the product step. (WHC-MR-0452)
1945		In March, process improvement trials and personnel were transfered to the 321 Building. (WHC-MR-0452)
1945		A sharp increase in metal activity, increased dissolving frequency, and the change to warmer spring weather resulted in increase in atmospheric contamination. (WHC-MR-0452)
1945		Between June and December, the number of fuel charges being processed at T and B plants rose from 22 to 77. (WHC-MR-0452)
1945		In March. early changes. due to the unavailibility of potassium hydroxide containing only 0.005% iron impurity, included the relaxation of process specifications for this chemical to allow for 0.005% iron impurity. (WHC-MR-0452, ADDENDUM 1)
1945		In February, elimination of potassium carbonate from the separation process. (WHC-MR-0452, ADDENDUM 1)
1945		By september 1, process modification enabled the T Plant to complete the processing of a charge in just 20 hours. (WHC-MR-0452)
1945		By mid-1945, free nitric acid concentration was reduced to obtain an increase in the specific gravity of dissolver solution. (WHC-MR-0452, ADDENDUM 1)
1945		The meteorology team switched to a single, daily (24 hour) dissolving forecast. (WHC-MR-0452)
1946		Much experimentation was done in T Plant to lower further the quantities of phosphoric acid required in the product precipitation steps of extraction and decontamination. (WHC-MR-0452, ADDENDUM 1)
1947		The semiworks was decontaminated and closed. (WHC-MR-0452)
1949		The original equipment was removed to prepare the space for use as a separations facility for radioactive lanthanum. (WHC-MR-0452)
1950		Iodine removal filters installed at the canyon dissolver cells in 1950. (WHC-MR-0521, Rev 0) Initial reports prepared in January and February 1951 placed the filters efficiency rate for iodine-131 removal at 99.9%. By late July. H.I. monitors reported that the silver reactor filters were easily saturated and failing. (WHC-MR-0452, ADDENDUM 1)

1951		T Plant did add mercury, silver, potassium, and/or sodium, to the metal dissolving solution to help keep iodine in solution and to provide added means of emission control. (WHC-MR-0452, ADDENDUM 1)
1955		Newly generated, first-cycle T plant wastes were settled with chemical additives, and the supernatant was discharged to the 216-T-26 crib. (WHC-MR-0452)
1956		March 20, Plant shut down for processing. (WHC-MR-0521, Rev 0) 10 days later, washes of the processing equipment and cells with a 60% nitric acid solution began. (WHC-MR-0452)
1956	1963	Instruments and other equipment, as well as some piping, were removed from the facility and buried as contaminated waste. (WHC-MR-0452, ADDENDUM 1)
1958		The facility replaced U Plant as HW's central decontamination plant. (WHC-MR-0452)
1978		In the late 1970's, the T Plant rail entry tunnel and pool cell were used to receive, unload, and disassemble high-exposure, irradiated fuel from the shippingport (Pennsylvania) power reactor. (WHC-MR-0452, ADDENDUM 1)
1983		The T Plant rail entry tunnel was used to receive and transload (into overpack burial containers) zeolite beds encased in stainless steel liners and loaded with Cs-137 from the Three Mile Island (Pennsylvania) power reactor. (WHC-MR-0452, ADDENDUM 1)
1992		The cleanup and cleanout of 2706-T Decontamination Annex began. (WHC-MR-0452)

Contamination/Acciden

Year	Accident
1945	As a result of the dissolving practices and quantities of irradiated material processed through T and B plants, at least 345,000 Ci of iodine-131 were released to the atmosphere. (WHC-MR-0452, ADSDENDUM 1)
1945	In autumn, radiation levels in the exhaust fans measured at the inspection plates on the electrical fans housing reached 8,000 mr/hr. As a result, the fences around the fans were moved outward, and an earth barricade was placed inside the fence to shield personnel working near the north boundary. (WHC-MR-0452)
1945	March 11, a "suckback" in the steam jetting lines caused higher than normal radiation levels in the Pipe Gallery and in the Operating Gallery. (WHC-MR-0452)
1945	June 27, Vapor condensate from a process tank backed into a solution addition line in the Operating Gallery and caused levels in that area to exceed tolerance limits. (WHC-MR-0452)
1945	January 5, the bowl of the centrifuge in section 16 jammed against some dip tubes when it was run backwards. The centrifuge was replaced via remote operations, partially decontaminated in a spare cell, and then burried in 1954. (WHC-MR-0452)
1946	An additional 76,000 Ci of iodine-131 were released to the atmosphere. (WHC-MR-0452, ADDENDUM 1)

1946 After one and one-half years of operation, failure of centrifuges, skimmers, dip tubes, transfer jets, asbestos gasket, piping lines because of corrosion, and piping jackets leaks became more common. (WHC-MR-0452)

1946 In February, a "trombone" containing a high-level product sample was being carried to the 222-T Laboratory when it fell to the ground and spilled highly active solution. (WHC-MR-0452)

1946 In March, a maintenance man. the ground. a crane, and diversion box were sprayed with first cycle waste solution during an attempt to open and free a plugged tie-line from Section 5 of T Plant. (WHC-MR-0452)

1946 In April, a faulty vent valve on the Cell 3 to 5 Right gang valve asembly allowed fumes containing radioiodine and nitrous oxide from dissolver Cell 5 to back up into the Operating Gallery. (WHC-MR-0452)

1947 In December, an operator received contamination on his hands and clothing while "rodding" a vent pipe in the new crib No. 2 near the 361-T Tank. (WHC-MR-0452, ADDENDUM 1)

1949 In May, dust blowbacks from improperly sealed burial boxes contaminated equipment burial grounds outside T plant and spread contamination to several pieces of equipment being used in and near the burial area. (WHC-MR-0452)

1949 In December. nearly 8,000 Ci of iodine-131 escaped in a two-day period. This event. known as the Green Run, boosted the 1949 emission level to approximately 12,000 Ci. Effects of the Green Run on contamination levels on regional vegetation in rainwater and mud, and in other environmental media were dramatic. Readings in the city of Kennewick were 107.3 micro Ci/kg, over 1000 times the (then) tolerable limit of 0.1 micro Ci/kg. Other neighboring cities had significant readings too. (WHC-MR-0452, ADDENDUM 1)

1952 In November, a large area of ground around the 155-TX diversion box catch tank, six vehicles. two air compressors, a hydrocrane, and various electrical equipment were contaminated during the transfer of a high acidic, off-standard solution out of this tank. (WHC-MR-0452)

1953 In May, two chemical trainees, using improper procedures. dropped and spilled a supernate sample from the 241-TX Tank Farm on the 200 West Area railroad crossing on 22nd Street between Bridgeport and Camden Streets. (WHC-MR-0452)

1953 On July 3 and 4, a 4-ft-diameter hole caved in over the old 5-6 Cell drainage waste line between T Plant and the 222-T Laboratory. Liquid flow about 200 ft long from the ruptured 5-6 line was visible along the ground just north of and over the 154-TX diversion box, located between the two buildings. Gross ground contamination occured over this wide area. The cause of pipe rupture was unknown. (WHC-MR-0452)

1953 In the summer and autumn, Diversion box catch tank leaks, as well as leaks from 242-T Evaporator steam coils, caused ground contamination spreads, and continued into the spring of 1954. (WHC-MR-0452)

1953 In November and December, High winds during solid waste burial operations, complicated in one case by the dropping of a burial box and in another case by leaving contaminated materials out overnight while the necessary burial equipment was obtained, brought contamination spreads in large areas north and west of T Plant. (WHC-MR-0452)

1953 In March, a chemical reaction in 155-TX catch tank resulted in another spread in ground contamination. (WHC-MR-0452)

1954 In January, two employees and a large area of ground were contaminated during the cleanout of pump and sluice pits in the 241-TX farm. (WHC-MR-0452)

1955 A spike in the amount of I-131 released from the stacks due to malfunctions in the dissolvers in Cell 3 through 5 Right. (WHC-MR-0452)

1955 In late December, several thousand gallons of first-cycle waste accumulated on the ground between T Plant and the 224-T Building, as a result of a ruptured underground line. (WHC-MR-0452)

1956 By the time of shut down of T plant as processing facility, in the early 1956, approximately 87,285 Ci of beta emmitters and 7,840.83 g of plutonium had been discharged in liquid wastes sent to the ground in the various T plant trenches, cribs, swamps, and reserve wells. Unknown amounts of radionuclides had been disposed to the T, TX, and TY tank farms. (WHC-MR-0452)

Hazards : Plutonium, uranium, phosphoric acid, nitric acid, metal chromates, Iodine-131 and other radioactive by-products of the extraction process. Non-specific airborne radioactive contamination throughout the building. Sodium hydroxide, sodium phosphate, boric acid, versene, sodium dichromate, sodium tartrate. sodium citrate, 1,1,1-trichloroethane, perchloroethylene, oxalic acid, phosphates, nitric acid-ferrous ammonium sulfate combinations, potassium permanganate,

Inferred Hazards: EMF, welding fumes, asbestos, PAHs, contaminated soils

References

GEH-26434- 200: Catalog of Hanford Buildings and Facilities 200 Areas; Construction Data.

WHC-MR-0452: A Brief History of T Plant Facility at the Hanford Site.

WHC-MR-0452, ADDENDUM 1: A Brief History of the T Plant Facility at the Hanford Site.

Report of Building Number: *284-E*

Building Name: Power House

Area: 200 **Construction Year:** **Closure Year:**

Construction Type: A five-story steel frame concrete block structure with reinforced concrete foundation and precast concrete roof with built-up gravel surface.

Size: 68000 sqft total area.

Unique Features: Contains auxiliary equipment such as emergency generator, boiler treatment, feed pumps, ash pits, draft fans, controls, stokers and coal bunkers, and 250 ft stacks.

Renovations:

Function

Year	Function
	Power house

Hazards : coal, fly ash

Inferred Hazards: silica, asbestos, chromates, EMF, mercury, noise

References

GEH-26434- 200: Catalog of Hanford Buildings and Facilities 200 Areas: Construction Data.

Report of Building Number: *291-T*

Building Name: Vent Stack and Control House

Area: 200 **Construction Year:** 1943 **Closure Year:**

Construction Type: The blower house has reinforced concrete foundation and floors, concrete block walls, and a flat concrete slab roof covered with built-up asphalt gravel.

Size: Stack 13 ft 10 in dia., 200 ft height. Control house 17 ft 6 in. x 18 ft 10 in. x 17 ft 8 in.; Total area 330 sqft.

Unique Features: Equipped with two electrically driven exhaust fans.

Renovations: None.

Function

Year	Function
1943	Vent stack and control

Processes in the Building

From Year	To Year	Process
1943		To exhaust process gases from the 221-T Building. (WHC-MR-0452)
1946		In spring, lead shielding was installed around the emergency steam fan to prevent an intolerable radiation condition in the fan house, should the emergency fan be operated. (WHC-MR-0452)
1948		On October 15, sand filters installation was completed at T Plant. (WHC-MR-0452. ADDENDUM 1)
1948		By March, the fans and duct work had been replaced. (WHC-MR-0452, ADDENDUM 1)
1950		Equipment to measure humidity levels was installed. (WHC-MR-0452, ADDENDUM 1)

Contamination/Acciden

Year	Accident
1947	Specks were found near the stacks contained some I-131, Ce-144, Sr-90, Yttrium. Ru-106, Cs-137, and the carbon, iron, silicon and hydrogen components of the resin paints used in World War II to coat the inside of 291-T and 291-B stacks, fans and duct work. (WHC-MR-0452)

Hazards : Iodine-131, Cesium-144 and 137, Srontium-90, yttrium, Ru-106 and carbon, silica, iron, silicon and hydrogen components of resin paints used in WW II

Inferred Hazards: EMF, asbestos, noise

References

GEH-26434- 200: Catalog of Hanford Buildings and Facilities 200 Areas; Construction Data.

AREA 300
SELECTED BUILDINGS

Hanford Reservation
Richland, Washington

Prepared under the direction of
Dr. Eula Bingham and Dr. Carol Rice
June, 1997

Grant: Sub UBC/DOE

Report of Building Number: *0307*

Building Name: Retention Basins and Trenches.

Area: 300 **Construction Year:** 1953 **Closure Year:**

Construction Type: It consisted of four basins, two trenches, and a set of pumping controls.

Size: Basins 50,000-gal each.

Unique Features:

Renovations:

Function

Year	Function
1953	Liquid process wastes that had the potential to be contaminated were disposed to the RPS and routed to the 307 Basins for sampling. (WHC-MR-0388)

Contamination/Acciden

Year	Accident
1965	In September, a large disposal of low-level radioactive light water coolant from an accident at the PRTR occured. Sheer waste volumes overwhelmed the capacity of tanker trucks to carry the coolant to the 200 Areas, and it was disposed to the soil near the present site of the 3763 Building. (WHC-MR-0388)
1967	The capacity of the 340 facilities was overwhelmed by a promethium-147 contamination incident in the 325 Building. 150,000 gal of waste containing about 250 mCi of promethium-147 were released to the 300 Area Process Ponds. (WHC-MR-0388)
1969	Contaminated mixed waste leaked from the Retention Basin waste lines over long duration and was discovered in December, 1969. Nearby soils were grossly contaminated with ruthenium-103/106, cesium-144, promethium-147, strontium-90, cesium-137, and rare earths with complexing agents. Promethium-147 was the most significant contaminant, present to the extent of 800 Ci in 70 cubic yd of soil that was removed to the 200 Area. (WHC-MR-0388)

Hazards : Low-level radioactive light water coolant, promethium-147, ruthenium-103/106, strontium-90, cesium-137, rare earth with complexing agents. (WHC-MR-0388)

Inferred Hazards: other radionuclides

References

WHC-MR-0388: Past Practices Technical Characterization Study - 300 Area - Hanford Site

Report of Building Number: *0321*

Building Name: Cold Chemical Semi-works and Annex.

Area: 300 **Construction Year:** 1944 **Closure Year:** 1988

Construction Type: Rectangular one story building with a full basement. Framework is reinforced concrete and bolted steel. Roof is reinforced concrete finished with 20 year tar and gravel. Exterior walls are concrete and concrete block with fixed sash windows. Floors and interior partitions are concrete. Some rooms have tiled floors.

Size: 122' x 87'8" x 24'; office 1499sqft; work area 15,580sqft; shop 3,551sqft; storage 180sqft; common 2445sqft; total area 23,255sqft(combined with 321-A)

Unique Features: Heating is accomplished by coils in fresh air systems and by space heaters. Cooling is by evaporative units. Both the main building and the annex have 3 ton bridge cranes as well as smaller hoists.

Renovations:

Function

Year	Function
1944	Pilot scale plant for testing chemical "process improvements" using unirradiated or low-activity sbstances. (WHC-MR-0388)
1968	Pilot testing of waste vetrification processes. (WHC-MR-0388)

Processes in the Building

From Year	To Year	Process
1945	1946	By September 1, process modification to complete the processing of a charge in just 20 hours. reduction in waste volumes, recovery of additional product from wastes. (WHC-MR-0452)
1947	1949	Testing with higher activity radiochemical solutions was initiated and continued until C plant, a "hot semi-works" facility, was constructed in the 200 East Area. (WHC-MR-0440)
1948		A process was developed in which some of the uranium bearing solutions were slurried into sodium diuranate and shipped offsite. (WHC-MR-0388)
1948		Much new equipment was added to the building to run pilot scale tests for the development of the REDOX process. (WHC-MR-0388)
1950	1955	Pilot scale tests for the PUREX and RECUPLEX processes were conducted using low-activity solutions. (WHC-MR-0388)
1950	1960	Attempting to produce uranium-233 from thorium. Pilot-scale developmental tests for extraction of high-heat isotopes from high-level nuclear waste were conducted using tracer-level waste solutions. Among isotopes extracted were strontium-90. cesium-137, cerium-144, promethium-147, and neptunium-237. (WHC-MR-0440) (WHC-MR-0388)

1977	1979	A cold hydraulic core mock-up for the development of the Fast Flux Test Facility was installed. (WHC-MR-0440) (WHC-MR-0388)

Contamination/Acciden

Year	Accident
1946	A general cleanup of the building revealed radioactive material in lead sink traps of cold areas and maximum readings of 50,000 d/m in other building locations. (WHC-MR-0388)
1947	During January and February, a total of nearly 800 micro g of plutonium was flushed from the inside of process lines and tanks in the 321 Building. (WHC-MR-0388)
1947	In September, a spike in pond contamination readings resulting from a large release of uranyl nitrate hexahydrate (UNH) from the 321 building. (WHC-MR-0440) (WHC-MR-0388)
1948	Plutonium contamination in the concrete of sampling boxes in cold areas of the canyon was revealed, and readings up to 45,000 d/m (alpha) were discovered in sludge inside tank 1-AU. (WHC-MR-0388)
1949	On January 23, a large explosion of a hexon/nitric acid mixture known as IAX occurred in E-Cell on the "graveyard" shift (midnight to 8:00 a.m.), when a spark from an electric motor arced through the air and touched off the IAX. The explosion spread uranium powder and solution throughout the canyon. Some chemicals and process solutions splattered and spilled in the aqueous makeup room. An entire drum of uranyl nitrate hexahydrate flew through the air on the back dock, spilling its contents. (WHC-MR-0388)
1957	In May, an explosion and resultant fire occurred in dissolver vessel A-5, in A-Cell. The vessel contained enriched (0.95% uranium 235) uranyl nitrate solution. (WHC-MR-0388)
1962	In January, concentrator AQ-7 experienced an overpressization and sprayed uranyl nitrate hexahydrate as far as the roof of 3706 Building. (WHC-MR-0388)
1964	A release of iodine-131 both within the building and out of the stack occurred during a chlorine gas-scrubbing experiment. Then, contamination spread around the floor and various tanks of A-Cell that same year. (WHC-MR-0388)
1988	Exterior contamination survey of the building found several areas of fixed contamination, including flaking exterior paint chips reading 150,000 d/m beta/gamma and 25,000 d/m alpha, attributed to "pre PUREX R&D radiological chemical separation operations". (WHC-MR-0388)
1991	Loose, smearable contamination was found during a routine survey of the building's interior attributed to "residual" remains from past operations. (WHC-MR-0388)

Hazards : Acids (nitric, phosphoric, hydrofluoric, oxalic), bismuth nitrate, sodium dichromate, potassium permanganate, lanthanum and sodium fluorides, ammonium fluosilicate, peroxide, sodium hydroxide, sodium diuranate, methyl isobutyl ketone, aluminum nitrate, ferrosulfamate, mercury, resins, tri-butyl phosphate, normal paraffin hydrocarbon, amonium fluoride, carbon tetrachloride, trace isotopes of plutonium, uranium, thorium, strontium, cesium, cerium, promethium, neptunium, uranyl nitrate hexahydrate. (WHC-MR-0388)

Inferred Hazards: asbestos, noise, welding fumes, EMF

References

WHC-MR-0388: Past Practices Technical Characterization Study - 300 Area - Hanford Site.

GEH-26434-300: Catalog of Hanford Buildings and Facilities 300 Areas; Construction Data.

WHC-MR-0440: Multiple Missions, 300 Area in Hanford Site History.

Report of Building Number: *0327*

Building Name: Radiometallurgy Building.

Area: 300 **Construction Year:** 1953 **Closure Year:**

Construction Type: Building is roughly cruciform and has one story and basement. Additions are on grade. Framework is welded steel. Parapeted roof is slightly sloped steel deck topped with Class II 20yr tar and gravel finish. Exterior walls are fluted steel insulated panels. Fixed windows protected by storm sashes and shade screens extend across front. First floor is reinforced concrete or steel decking covered with concrete finished with sheet vinyl. Metal movable partitions are decontaminable type in that a minimum crack exists at joints. Suspended ceilings are perforated metal pans backed with Fiberglas pads.

Size: 215' x 140' maximum height 32'; office 1300sqft; lab 6049sqft; work area 1811sqft; storage 2079sqft; common 12,117sqft; total area 23,356sqft

Unique Features: The main laboratory contains cells of meehanite cast iron which are arranged along the long axis of the room. Spaced symmerically about the sides and top are 140 access holes. (7 1/4 in. in diameter). These holes provide for plugs with utilities, windows, manipulators and instruments as well as general access. Steel plugs fill unused holes. Walls and tops can be removed for decontamination or to install or remove equipment. There are also two lead cells, a burst test facility, and a decontamination chamber. Cells are served by a 20 and 15 ton capacity bridge crane. Two large water basins are available for storage of radioactive material. Main heating and ventilation system has two supply fans in the main building basement and one in the west additon second floor equipment room. Two exhaust fans from the main building and two exhaust fans from the cells and hoods are located in the basement. One of each pair of fans runs while the other is in standby. Utility services include hot, cold and deionized water; laboratory and contaminated drains; vacuum; compressed air, steam, propane; inert gas; and spare gas. Breathing quality air is distributed from a water seal compressor unit. The electrical system provides 440, 208, 110Vac, 25, and 125Vdc emergency power with backup by the powerhouse steam turbine is available for essential use. Isolated circuits are provided for instruments. Patch panels provide electrical and instrument flexibility in the cells. The building has a 10,000 lb electric elevator.

Renovations:

Function

Year	Function
1953	To house the examining and testing of irradiated materials, particularly fuel elements and fuel cladding materials from and for the HW production reactor. (WHC-MR-0440) (WHC-MR-0388)
1957	In the late 1950s and early 1960s, missions conducted included the establishment of specifications for N Reactor fuel rods and process tubes, the conduct of destructive examination (DE) and NDE to evaluate the performance of these rods and tubes after N Reactor startup in 1963, and the examination of various isotope combinations and capsules. (WHC-MR-0440)

1970	Special Environmental Radiometallurgical Facility, a large hot cell with a controlled atmosphere of inert nitrogen. (WHC-MR-0440)

Contamination/Acciden

Year	Accident
1954	In December, a waste transfer brought readings of 9 r/h, including 4 r/h at 4 ft from the waste itself and 5 r/h at 18 in. from the "load lugger" that transported the waste to the newly opened 300 North Burial Ground. (WHC-MR-0388)
1954	In September, three contamination events producing readings of 80,000 c/m in the building's canyon resulted from sample transfers.
1955	In February, two Class I and one Class II radiation incidents resulting from drain line leaks occurred. Attempts to plug the leaking drain line resulted in splashes and spills of radioactive materials reading 250 r/h on the floor below the cell. (WHC-MR-0388)
1956	After one E-Cell filter failure, H.I. Division monitors reported airborne contamination. An estimated 6 to 40 millicuries of fission products were released. (WHC-MR-0388)
1956	On two occasions, leaks from the cut-off cell produced "puddles" reading up to 5 r/h in the canyon. (WHC-MR-0388)
1956	A waste transfer produced airborne radiation readings in the canyon of 4.6 x 10^(-8) micro Ci/cc. (WHC-MR-0388)
1957	The transfer of ruptured fuel element slug from its shipping cask produced canyon air readings of 4.1 x 10^(-8) micro Ci/cc. Both air conditions were well above HW tolerance limits. (WHC-MR-0388)
1959	In October, a chemical explosion and fire occurred in E-Cell during the processing of an irradiated stainless steel capsule containing sodium-potassium. (WHC-MR-0388)
1960	Tantalum-182 and chromium-51 were spread on the bed of a truck arriving from 100-C Reactor. (WHC-MR-0388)
1960	Routine H.I. Division surveys of the 327 Building canyon frequently found surface spot contamination readings of 20 to 30 r/h. (WHC-MR-0388)
1961	Early that year, a ruptured fuel element in a leaking container spread contamination of up to 4.5 r/h on an incoming truck and up to 200 mr/h on the ground at the 327 Building truck loading area. (WHC-MR-0388)
1961	A waste line leak produced reading of 110 r/h. (WHC-MR-0388)
1963	A manipulator removed from A-Cell and placed in the "PRTR Room" produced readings of 350 r/h on floors and flat surfaces in that room. (WHC-MR-0388)
1963	A waste line leak produced reading of 100 r/h in the basement. (WHC-MR-0388)
1965	A criticality alarm sounded in the building when it was subjected to a radiation flash exposure as an N Reactor fuel element was being pulled out of a cask. (WHC-MR-0388)
1966	A drill bit was blown out through a steel port in the side of A-Cell as the result of strong internal gas pressure from an irradiated lithium-aluminate target fuel element. (WHC-MR-0388)

1967 In March and April, destructive analysis performed on some of the irradiated neptunium-aluminum fuel targets resulted in discharges of over 40 mCi (iodine-131) from the building's stacks. In April and May, over 300 mCi (iodine-131) was released as the result of DE work on PRTR fuels, and in August another 88 mCi (iodine-131) was discharged as a consequence of other fuel examinations. (WHC-MR-0388)

1968 Mercury used in the fission gas sampling apparatus ran out onto the canyon floor from a disconnected sample line leading out of A-Cell.

1972 Contamination spread in and and around the building that resulted from sample transfer. (WHC-MR-0388)

1973 Contamination spread in and and around the building that resulted from sample transfer. (2 events) (WHC-MR-0388)

1973 Both A-Cell and C-Cell drain lines backed up into the 327 Canyon in a hydrostatic test of the underground waste system. (WHC-MR-0388)

1973 Minor sodium-potassium explosion occurred in F-Cell. (WHC-MR-0388)

1974 Contamination spread in and and around the building that resulted from sample transfer. (2 events) (WHC-MR-0388)

1974 Minor sodium-potassium explosion occurred in F-Cell. (WHC-MR-0388)

1976 In January, sodium-patassium explosion occured in F-Cell. (WHC-MR-0440)

1976 In January, a powerful hydrogen explosion took place in F-Cell. The explosion destroyed the RLWS drain where it occurred and blew the drain contents out through cell ports and splattered them in the canyon and onto the outside walls of nearby cells. The resultant heat in F-Cell also melted and fused several equipment pieces. (WHC-MR-0388)

1979 The radioactive waste sump leading to the RLWS backed up into the 327 Building basement. (WHC-MR-0388)

1979 Contamination spread in and and around the building that resulted from sample transfer. (WHC-MR-0388)

1986 In February, a serious explosion occurred in SERF Cell. Ethanol in the cell's atmosphere ignited when an electric vacuum cleaner was turned on during cell decontamination operations. The cell's entire atmosphere, as well as the glovebox that made up the interface between the regular and nitrogen atmospheres, blew up, driving one cell plug far across the canyon and distending two others. Plutonium and other fission products were spread around the canyon to varying degrees, and the cleanup required 7 months. (WHC-MR-0388)

1986 In February, a serious explosion took place in SERF Cell, when ethanol in the cell atmosphere ignited as an electric vacuum cleaner was turned on during cell decontamination operations. One cell plug blew out, allowing plutonium and other fission products in the cell to be spread around the canyon to varying degrees. The cleanup from that explosion required seven months. (WHC-MR-0440)

1990 Cesium-137 waste from transfer operations out of D-Cell spread contamination in the 327 Canyon. (WHC-MR-0388)

Hazards : Extremely high-activity wastes. Uranium, plutonium, gamma-emitting isotopes, neptunium-aluminum, iodine-131, tantalum-182, chromium-51, cesium-137, mercury, sodium-potassium, ethanol, irradiated lithium-aluminate, hydrogen. (WHC-MR-0388)

Report of Building Number: *3711*

Building Name: J.A. Jones, Construction Shop.

Area: 300 **Construction Year:** **Closure Year:**

Construction Type: Metal frame with corrugated aluminum siding and roof. Foundation is concrete block and floor is concrete.

Size: 40 x 80 ft; total area 3200 sqft.

Unique Features: Heat is provided by steam space heaters and cooling with forced air water evaporation equipment.

Renovations:

Hazards :

Inferred Hazards: asbestos, machining fluids, degreasers, welding fumes, EMF, noise, exhaust fumes

References

GEH-26434- 300: Catalog of Hanford Buildings and Facilities 300 Areas; Construction Data.

Appendix B

Draft Medical Surveillance Protocol

Appendix B: Medical Surveillance Protocol
Draft for Review and Comment

a. Goals of medical surveillance program
   1. Perform medical surveillance for specific exposure-related adverse effects and illnesses, as specified under Public Law 3162.
   2. Create a database which may be used to prevent adverse health outcomes from specific exposures encountered in DOE facilities.
   3. Create a database that will be useful for quality assurance and program evaluation.

b. Basic structure of medical surveillance program
   1. A construction worker must have worked a minimum of five years at DOE facilities to be eligible for an examination, unless entry into the program is triggered by site specific exposure data or one of the substance-specific criteria below.
   2. All eligible workers will undergo a core examination consisting of medical history, physical examination, and laboratory tests.
   3. All eligible workers will complete an exposure questionnaire prior to examination. This questionnaire will be compared to a job-exposure matrix to help determine possible significant exposures. Such significant exposures (eg., lead, asbestos, external radiation) will trigger additional testing modules to be scheduled at the time of the general surveillance examination.
   4. Additional modules may also be triggered by specific findings on medical history and physical examination. Examples might include a history of lung cancer, or findings of peripheral neuropathy or interstitial lung disease.
   5. Findings from the examination and laboratory evaluation will be given verbally to the worker at the time of the exam (to the extent that results are available) and conveyed in writing when testing is completed. A set of risk communication materials will be developed to try to standardize interpretation of tests.
   6. Quality assurance activities will be incorporated at all levels of the process.

c. Core examination
   1. Complete medical and occupational history.
   2. Physical examination, with particular emphasis on skin, lung, musculoskeletal and neurological systems.
   3. CBC with differential, electrolytes, BUN, Glucose, AST, ALT, Alkaline phosphatase, bilirubin.

d. Specific Modules
   1. Asbestos

      Chest x-ray and spirometry for workers over 40 years old with >15 years since first exposure and at least 5 years exposure at DOE facilities

Rationale for Five Year Duration, 15 Year Latency

Data from medical examinations of construction trades gives us a basis for establishing these entry criteria. Among sheet metal workers with 25 years of work in construction and 25 years of latency, 31% had some asbestos-related disease on chest x-ray. Of this 31%, one third (11% of the total group) had evidence of parenchymal disease, and 2/3 had pleural disease only. This prevalence was lower in younger men with 25 years in the trade (Welch et al 1994). Similar rates of disease have been reported for electricians (Hodgson 1988), plumbers and pipefitters (Sprince 1985), and for construction workers in general (Kilburn 1989), with higher prevalence rates for insulators (Kennedy 1991, a reference from Selikoff).

Based on this data, 5 years of exposure and 20 years of latency would be expected to result in a 10-15% prevalence of asbestos-related changes, primarily pleural disease. This is a reasonable target for medical surveillance.

2. Silica

Chest x-ray and spirometry for workers over 40 years old with 5 years of exposure in listed occupations, plus 15 years since first exposure.

Occupations: sandblasting, rock drilling, concrete removal and demolition work, bridge, railroad and road construction, tunnel construction, concrete or granite cutting. (Removal/disposal of silica filter material could pose a special hazard at Hanford.)

Occupational exposure to silica occurs in the construction industry among workers employed in concrete removal and demolition work, bridge and road and railroad construction, tunnel construction, concrete or granite cutting, drilling, sanding, and grinding. The highest exposure jobs are in sandblasting and rock drilling. More than 1/3 of the respirable crystalline silica compliance measurements taken at construction sites exceeded the prevailing exposure limit (p. 325 in STAR). There are no prevalence rates from the US for silicosis in construction workers, but in China 84% of a group of tunnel construction workers had silicosis on chest x-ray (p. 326, STAR).

Most forms of silicosis develop slowly, and require years of exposure and a long latency. The disease can progress after cessation of exposure as well. Given the scant data on prevalence of silicosis in construction workers in particular, it is reasonable to use the dose and latency as for asbestos, and to target the higher risk occupations and tasks.

3. Welding

Welding can cause a chronic bronchitis, asthmatic bronchitis, and possibly cause chronic obstructive lung disease. We are recommending that surveillance for welding-related lung disease be triggered after an initial history and physical examination, to target surveillance a those with clinical disease. Abnormal lung function in the absence of cough or wheeze would not be attributable to welding as the exposure, so lung function screening in the absence of symptoms is not indicated where exposure has ended. .

4. Beryllium

Lymphocyte proliferation test and chest x-ray **are recommended** for any worker identified as exposed by our exposure matrix, even if they do not meet the five year general entry criteria. After one year this data will be re-evaluated and the protocol adjusted.

Rationale

DOE's current beryllium protocol at Rocky Flats and Y-12 at Oak Ridge is finding chronic beryllium disease in former workers, including those for whom an initial exposure assessment would have classified them as unexposed. A draft DOE document (Medical Evaluations for Former DOE Workers - a Working Paper, March 1995, Office of Health Studies, p. 10) states that self-identification of beryllium exposed workers is an appropriate step for initial screening. We will include those for whom we think a significant exposure may have taken place, and use the results of the LPT and chest x-ray to refine the protocol.

5. Solvents

a. Surveillance for liver and kidney function is included in the core.
b. Exposure to a range of chlorinated solvents alone would require five years of exposure if exposure ceased more than 1 year before examination.
c. If exposure is on-going, enroll in surveillance if the estimated solvent exposure is above the action limit.
d. Neuropsych testing if suggested by history and physical exam.

e. EMG/NCVs if suggested by history and physical exam.

Rationale for requiring five years of exposure for remote exposures:

Acute exposure to a range of solvents can cause heptatotoxicity, generally manifest as an elevation in liver transaminases. It is generally agreed that most of this inflammation ceases after exposure stops (Harrison 1990). In some cases and with some solvents, on-going exposure with resultant on-going inflammation can lead to a permanent injury. This permanent injury is a chronic hepatitis or cirrhosis. The examination is designed to find those with permanent injury from remote exposures.

It has been reported that 5-7% of workers without occupational hepatoxin exposures will have elevations of liver function tests (Hodgson 1989, Wright 1988), and it is well known that many other substances and medical conditions can cause such elevations. These tests are not specific for occupational exposures, nor diagnostic of liver disease. Because exposures in construction are hard to characterize, we have chosen a five year dose as a reasonable one.

6. Heavy Metals

a. Lead

1. blood lead level, ZPP in workers with five years of known or presumed exposure to lead through high risk tasks and exposure within the last year. High risk tasks are included in demolition of metal structures: sandblasting, burning, cutting or welding on steel structures coated with lead paint. These high risk tasks are expected to be found among ironworkers, painters and laborers, and possibly among sheet metal workers, welders and boilermakers.
2. attention to neurological system on medical history and physical examination in anyone exposed to lead.
3. for initial group of 100 workers who have had substantial exposure to lead in the past but have not been exposed within the past year, add challenge testing with DMSO. This, in combination with the lead levels on workers with more recent exposures, will allow re-assessment of the criteria for entry into this specific module.

Rationale for requiring five years of exposure for blood lead testing

In adults exposed to lead in an occupational setting, we can expect to find both an increased body burden of lead and residual health effects after exposure stops, if that lead exposure was of sufficient magnitude and duration. The health effects we could detect from remote exposures are:

- CNS toxicity, manifest as memory loss, mood instability, and impairment of psychomotor testing
- peripheral neurophathy
- renal insufficiency

Construction workers who demolish metal structures are at risk for overt, symptomatic lead poisoning caused by extremely high burst of lead exposure (Landrigan 1982, NIOSH 1991, Osorio 1995). Lead paint coating these structures becomes airborne during sandblasting, rivet removal, and similar tasks, and airborne exposure can reach tens of thousands of ug/M3 (Sokas 1997). Sustained, prolonged exposure such as that found in classic lead industries is not usually found in construction work, and blood lead levels return to "normal" within a month of cessation of exposure as lead moves into long term storage compartments in bone and is excreted.

In laborers and ironworkers who were not performing lead work at the time of the survey, the median whole blood lead was 7 ug/dl, with a range of 2-30 ug/dl (Sokas 1997). Workers who had worked in demolition, burned paint and metal, or welded outdoors had higher levels (mean of 8.6 vs. 6.8 ug/dl). This study was undertaken in a state which has regulated lead exposure in construction since 1984, so these levels may not be representative of all construction workers. They do suggest that sustained elevation of blood lead levels will be uncommon after cessation of exposure. Because of this we are initially requiring five years of work in tasks or occupations with known or likely lead exposure. This entry criteria may be adjusted based on the findings of the first year of surveillance.

Rationale for requiring exposure within the past year

Blood lead levels represent acute and recent exposures most accurately. Over time after exposure has ceased, the lead transfers into long term compartments in bone and other organs. This body burden is to some degree in equilibrium with the blood lead, but as the lead is stored in larger compartments the amounts in circulation decreased. Assessment of body burden due to remote exposures would require challenge testing or x-ray fluorescence.

Challenge testing is added as a refinement of the exposure assessment for 100 initial examinations of lead workers. If these challenge tests do not show significant body burden of lead in workers whom we have assessed to be at risk we will re-adjust our exposure assessment and re-adjust the criteria for entry into the lead module. This will mean that the lead levels done after the initial phase will be more specifically targeted to the at-risk group of workers.

b. Cadmium

1. Attention to neurological exam on medical history and physical examination in any one exposed to cadmium.
2. For an initial group of 100 workers who have had substantial exposure to cadmium appropriate biomarkers will be used: urinary beta-2-microglobulin or retinol binding protein, followed by metallothionein if beta-2-microglobulin (or retinol binding protein) is elevated.

Rationale for requiring five years of exposure for cadmium testing

Following exposure to cadmium, kidney cadmium increase progressively up to a critical level and then kidney dysfunction develops. Depending on the susceptibility of the individual, this critical level of cadmium is 215-385 ppm (Roels 1981). Our goal for this program is to find workers with health effects from prior exposures, and so we will choose to monitor those whose renal burden of cadmium is in this range, and use a marker of effect that is sensitive to the earliest changes in renal function induced by cadmium.

c. Chromium

for any history of exposure:

- Renal function testing is included in the basic examination
- Attention on physical examination to skin for any worker with chromium exposure, looking for allergic dermatitis
- risk communication about risk of lung cancer

d. Mercury

1. Attention to neurological and psychological responses on medical history and physical examinations in any one exposed to mercury.

2. For an initial group of 100 workers who have had substantial exposure to mercury, EMG/Nerve Conduction Velocity (NCV) will be considered.

   - neuropsych testing if suggested by history and physical exam
   - EMG/Nerve Conduction Velocity (NCV) if suggested by history and physical exam

e. Ionizing Radiation

External and Internal Radiation

Construction workers could have been exposed to various forms of external radiation from contamination sources and process activity releases, including beta radiation to the skin and gamma ray, and possibly neutron exposures would come from film badeges and historical records and reports. Internal exposure could also have taken place to a variety of radio-isotopes including those of uranium as well as various fission products by inhalation and ingestion. The two primary biomonitoring methods for internal exposure are whole body gamma ray counting and urinary radioactivity, gross or speciated according to the type of isotope. Biomonitoring methods for radiation damage, e.g., mutations, chromosomal damage and micronuclei in blood cells. The major concern with the late effects of ionizing radiation is cancer, of which many types are induced, none of which are unique to radiation.

Sufficient time has passed to allow for radioactive decay and excretion of internally deposited isotopes so that exposure biomonitoring is not indicated other than in cases of exceptionally high exposure.

Our strategy therefore is to rely on film badge records, when available, and the history of unusual radiation exposure, accidental or in decontamination operations, to identify individuals who might require special studies for radiation injury and enrollment in a monitoring program for cancer.

7. Noise

audiometry as triggered by history and physical exam, not included as a routine part of the examination

We are recommending that hearing surveillance be triggered after an initial history and physical examination, to target surveillance at those with clinically significant hearing loss. Workers with asymptomatic hearing loss do not need to take any action; surveillance is not indicated in the setting where exposure has ceased and screening results would not trigger any action.

8. Quality Assurance Activities

   a. History and Physical Examination
      - ongoing chart review for incorporation of all information
   b. Laboratory Evaluation
      - ongoing data query for known associations (ie, hematocrit and hemoglobin levels and sex, FEV1 and sex, height and age, FEV1 % predicted and smoking) (Olson et al., 1991)
   c. Risk Communications
      - post exam random sample survey

Appendix C

Occupational History Survey Instrument
(Currently being used for NIOSH - supported project)

Occupational History
Carpenter Task Checklist

University of Cincinnati - Department of Environmental Health

PHASE I - OCCUPATIONAL HISTORY DATA COLLECTION
OAK RIDGE PROJECT
Data Recording - Telephone Interview

Name: ____

Date: ____________________ **Interviewer Name:** ___________________

Start Time: __________

1. On the questionnaire you mailed back to us that you did most of your work at _____ (X-10, Y-12, or K-25).
   Do you work at ______ (X-10, Y-12, or K-25) now?

CURRENT OR LAST JOB:

Now, I would like you to think about your current/last job at _______(X-10, Y-12, or K-25). I have some questions about this job. By job I mean work on one project in one location.

Specific questions:

1. Are/were you working in a specific location? Where? (If in or around a building)

   What was the number of that building? ____________

   Did you work inside the building or on the outside? What was the name of the outside zone?

2. Tell me a little about what you do at your current job (did at your last job) at___ __________. By asking this general question, you have some information to use to assess the necessity of rephrasing or reordering the questions below.

3. **When did you start this job?** (Try to obtain month and year. If they cannot recall the month, try to get year.)

(If finished with this assignment:) **When were you finished with this job?**

Now I'm going to ask you some very specific questions about where you are/were working. Answer as best you can. If you are not reasonably sure of the answer, don't guess. As you ask these questions, keep reminding the carpenter that you are asking about his/her current or last job, not his/her experience through all jobs at (X-10, Y-12 or K-25).

4. (If inside a building) **On this job at Building _______ in what area are/were you working?**

   Is this near any piece(s) of equipment?

5. Do you know or suspect that there were hazardous materials such as asbestos, lead or mercury in the area in which you are working/worked? (If YES ask specifically about lead, asbestos and mercury-mention each substance. Also ask specifically if there were any other substances.)

6. What were the steps that you took in doing this remodeling/new installation? (Probe to obtain as many job tasks as possible.)

   ____

   ____

   ____

   ____

   ____

   ____

7. During this assignment, how many total hours per week do/did you spend at the Oak Ridge Reservation? Does/did this include travel time?

3. Did you ever have to be decontaminated? (If YES,) What was this for? Where had you worked? When?

Were there other carpenters working with you who also had to be decontaminated at that time? (If YES,) Who?

Did you know of other carpenters who had to be decontaminated at other times? What was this for? When did this occur? Who?

4. Did you ever work with equipment that then had to be decontaminated? (If YES) What equipment? When?

COMPLETION OF INTERVIEW:

After administering the set of questions for each job at Oak Ridge, ask the carpenter if he/she would like to add any additional information about any work assignment.

Do you have any other information about any of your jobs that you think I should know about?

Thank you for participating in this interview. As I mentioned earlier, the information you have given me will be used create a more complete history of the work done by carpenters Oak Ridge. Thank you for your time. (Have a nice evening.)

Finish time: ____________________

4. Go back to the list of tasks that carpenters may do. Think about ALL OF THE TIMES you have worked in or around this building (location). Look at each task on the list and, as I read it, tell me if you have done this task at ____________ (building or location). Remember, I am asking you about ALL OF THE TIMES that you worked at Building ____________. (Use a list of carpenter tasks and check frequency. Do not go back and add information to the answers to previous questions.)

5. Did you know or suspect that there were hazardous materials such as asbestos, lead or mercury in the area of Building ______ ? (If YES, ask specifically about lead, asbestos and mercury, or any other materials mentioned.)

6. While you worked around Building ______, did you use:

   Paper dust mask?

   Respirator with rubber or plastic mask?

   Gloves made of cloth or leather?

   Gloves made of rubber-like material?

GENERAL QUESTIONS:
I have just four more questions. These questions refer to the ENTIRE TIME YOU WORKED at the Oak Ridge reservation, at ANY ONE OF THE THREE PLANTS.

1. Do/did you wear a radiation badge?

   (If YES,) When (month and year) did you first wear a radiation badge?

   Did you wear a radiation badge on all of your assignments after that date?

2. Were you ever involved in a major fire? By "involved" we mean being in a smoke filled area during a fire or helping to fight a fire. (If YES,) Where (what building or area)? When?

   Any other fires?

OAK RIDGE WORK HISTORY PROJECT

Name: ______________________________

Study ID: _ _ _ _

CARPENTER TASKS

LAST	FIRST	OTHER	Construction
☐	☐	☐	building with wood (other than scaffold)
☐	☐	☐	building scaffolds
☐	☐	☐	carpenter shop
☐	☐	☐	erecting towers
☐	☐	☐	fabricating covers/enclosures
☐	☐	☐	fabricating wooden parts
☐	☐	☐	hanging doors/cutting door openings
☐	☐	☐	hanging suspended ceilings
☐	☐	☐	installing equipment
☐	☐	☐	installing drywall
☐	☐	☐	laying floor tile/repairing floors
☐	☐	☐	roof surfacing/repairs
☐	☐	☐	setting forms
☐	☐	☐	shoring activities
☐	☐	☐	soil drilling
☐	☐	☐	supporting other crafts
☐	☐	☐	work with wet cement
☐	☐	☐	work with dry cement

Demolition/Removal

☐	☐	☐	dismantling equipment
☐	☐	☐	removing asbestos insulation/transite
☐	☐	☐	removing ceiling tile or panels
☐	☐	☐	removing fiberglass
☐	☐	☐	removing pipe
☐	☐	☐	removing siding
☐	☐	☐	removing and wrecking forms
☐	☐	☐	ripping masonite/wall board
☐	☐	☐	stripping walls/ceilings/floors

☐ ☐ ☐ Welding

☐ ☐ ☐ Pile Driving

Support Activities

☐	☐	☐	expediting materials
☐	☐	☐	issuing construction supplies
☐	☐	☐	issuing protective clothing; cleanup of change house
☐	☐	☐	ladder safety inspections
☐	☐	☐	attending meetings
☐	☐	☐	sign-up and orientation
☐	☐	☐	security delay

8. **Do/Did you use:**

Paper dust mask?

Respirator with rubber or plastic mask?

Gloves made of cloth or leather?

Gloves made of rubber-like material?

9. **Have you worked in or around this building (area) at other times? When? About how many jobs have you been on int this building/in this area?**

10. We have sent you a list of tasks that carpenters may do. Think about ALL OF THE TIMES that you have worked in or around this building (location). Look at each task on the list and, as I read it, tell me if you have done this task at__________ (building or location). Remember, now I am asking you about ALL OF THE TIMES that you have worked at this building/in this area.
(Use a copy of the task list to check off tasks and frequency.)

As you go through the list of tasks, the carpenter may remember additional tasks that he performed on this job. DO NOT GO BACK TO EARLIER QUESTIONS AN RECORD ADDITIONAL INFORMATION.

FIRST JOB:

The next step of the interview process will be to focus on the first job of the carpenter at Oak Ridge.

Now, could you please think back to your first assignment at ______________ (X-10, Y-12 or K-25).

1. Where was your first job? What was the number of that building/location of that outside area?

   Did you work inside the building or on the outside?

2. Tell me a little about what you did at this job at Building __________.

3. When did you start this job? (Try to obtain month and year. If they cannot recall the month, try to get year.)

   When were you finished with this job?

Now I'm going to ask you some very specific questions about where you were working. Answer as best you can. If you are not reasonably sure of the answer, don't guess. As you ask these questions, keep reminding the carpenter that you are asking about his/her first job, not his/her experience through all jobs at (X-10, Y-12 or K-25).

4. (If inside a building) In what area were you working?

   By which piece(s) of equipment?

5. Do you know or suspect that there were hazardous materials such as asbestos, lead or mercury in the area in which you are working/worked? (If YES ask specifically about lead, asbestos and mercury-mention each substance. Ask specifically if there were any other substances.)

6. What were the steps that <u>you</u> took in doing this remodeling/new installation? (Probe to obtain as many job tasks as possible.)

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7. During this assignment, how many total hours per week did you spend at the Oak Ridge Reservation? Did this include travel time?

8. Did you use:

Paper dust mask?

Respirator with rubber or plastic mask?

Gloves made of cloth or leather?

Gloves made of rubber-like material?

(If the location of the first job was different from the location of the current or last job, ask Questions #9 and #10. If the same building or outside area was the focus of both the last job and the first job, skip Questions #9 and # 10 and go to the next section.

9. Have you worked in or around this building (area) at other times? When? About how many jobs have you been on in this building/in this area?

10. Go back to the list of tasks that carpenters may do. Think about all of the times that you have worked in or around this building (location). Look at each task on the list and, as I read it, tell me if you have done this task at______________ (building or location). (Use a copy of the task list to check off tasks and frequency.) DO NOT GO BACK TO PREVIOUS QUESTIONS and record additional information.

OTHER JOBS:

1. **Think of your other jobs at ____________ (X-10. Y-12, K-25). Try to remember the buildings in which you worked. I'll write them down as you name them.** (After each building is mentioned, ask for building number. If they cannot remember exact building numbers, ask the carpenter to give us his/her "best guess".)

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2. At __________, were there any other locations that you worked at that were not buildings?

Using the list of "Locations of Special Interest" at ____________ (X-10, Y-12, K-25), check off any that the carpenter has mentioned.

X-10	Y-12	K-25
#1-3026-C	#1-9201-01	#1-305-1
#2-3042	#2-9202	#2-402-3
#3-3503	#3-9204-04	#3-502-1
#4-3505	#4-9419-1	#4-601-5
#5-3508	#5-9998	#5-1025D
#6-3592		
#7-7503		
#8-7810		

Using the random number table, randomly select one of the buildings mentioned by the carpenter (consult protocol for exact instructions).

I would like to ask you about one other location of work at ____________ (X-10, Y-12, or K-25), Building __________ (or a non-building location). These questions will refer to all the jobs you had at Building ______________.

3. **What kind of jobs did you have at this building (location)? Tell me about the jobs that took the longest.**
Record information about these jobs.

Job #1 ______________________________

In what area were you working?

By what piece(s) of equipment?

Job #2 ______________________________

In what area were you working?

By what piece(s) of equipment?

Job #3 ______________________________

In what area were you working?

By what piece(s) of equipment?

Job #4 ______________________________

In what area were you working?

By what piece(s) of equipment?

Job #5 ______________________________

In what area were you working?

By what piece(s) of equipment?

Job #6 ______________________________

In what area were you working?

By what piece(s) of equipment?

University of Cincinnati - Department of Environmental Health

PROTOCOL FOR PHASE II - OCCUPATIONAL HISTORY DATA COLLECTION
OAK RIDGE PROJECT
In-Person Interview

Objective: Following the phone interview, each carpenter will be interviewed a second time. Some carpenters will attend an information presentation (verbal history, maps, diagrams, and pictures) immediately prior to this second interview. The interview will focus on the same site (X-10, Y-12, or K-25) as the first interview. During this in-person interview, we will ask for information about the last or current job reported at the phone interview, the first job, and one other building or work area. The worker will be asked about work tasks, protective practices, and equipment. At the end of the interview, the interviewer will ask the carpenter to designate work locations by writing X's on a map and to fill out a questionnaire about memory recall methods.

INTERVIEW QUESTIONS:

Hello. My name is ________________________ and I am working with the UBC Work History Project for carpenters who worked at the Oak Ridge Reservation. (I am the same person who interviewed you over the phone.)

If in Group A or Group C (Information Presentation):

> Before we go to another room for my interview of you, I'd like to ask you about the portals you used to enter the site. Look at the large map we have here, and then check off the portal you used.
>
> Give carpenter one-page questionnaire with portals question.

Use a prepared interview recording form. Confirm the carpenter's name and DOB. <u>Write in the start time of the interview.</u>

When we interviewed you over the phone, we discussed your work at _______ (X-10, Y-12, or K-25). Today I am going to ask you the same questions, to see if you now remember more details about your work at Oak Ridge DOE sites.

Do you work at ______ (X-10, Y-12, or K-25) now?

<u>CURRENT OR LAST JOB:</u>
At the time of your phone interview, you told us that your current or last job (X-10, Y-12, or K-25) was at________. I am going to ask you again about that job.

A job will be defined as "work on one project in one location". If the carpenter moves on to a new location (new building or different construction project), that will be considered a new job. Asking about the start date of the job may precipitate questions about the operational definition of a "job", and allow the interviewer to clarify. The carpenter may still be working on this job, or may not, if retired or at a non-Oak Ridge assignment.

Specific questions:

1. **Did you work inside the building or on the outside? (If on the outside) What was the name or number of that outside zone?**

2. **Tell me about what you are doing/did on your current/last job at______________.** By asking this general question, you have some information to use to assess the necessity of rephrasing or reordering the questions below.

3. **When did you start this job?** (Try to obtain month and year. If they cannot recall the month, try to get year.) (If finished with this assignment:) **When were you finished with this job?**

Now I'm going to ask you some very specific questions about the work you are doing/did on this job. Answer as best you can. If you are not reasonably sure of the answer, don't guess.

As you ask these questions, keep reminding the carpenter that you are asking about his/her recent job, not his/her experience through all jobs at (X-10, Y-12 or K-25).

4. (If working inside a building) **On this job at ____________ (building number) in what area are/were you working? Is this near any piece(s) of equipment?**

5. **Do you know or suspect that there were hazardous materials such as asbestos, lead or mercury in the area in which you are working/worked?** (If YES ask specifically about lead, asbestos and mercury-mention each substance. Ask specifically if there were any other substances.)

6. **What were the steps that you took in doing this remodeling/new installation?** (Probe to obtain as many job tasks as possible.)
   Write in job tasks (on lines on the recording instrument) as they are mentioned by the worker in response to question 6.

7. **During this assignment, how many total hours per week do/did you spend at the Oak Ridge Reservation? Does/did this include travel time?** In answering this question the carpenter should include lunch break and other breaks (if this time was spent at the Oak Ridge reservation) but should not include travel time.

8. Do/Did you use:
   Paper dust mask?
   Respirator with rubber or plastic mask?
   Gloves made of cloth or leather?
   Gloves made of rubber-like material?

9. Have you worked in or around this building (area) at other times in the past? When? Approximately how many jobs have you been on in this building/in this area?

10. Here is a list of tasks that carpenters may do. Think about ALL OF THE TIMES that you have worked in or around this building (location). Look at each task on the list and, as I read it, tell me if you have done this task at__________ (building or location). Remember, now I am asking you about ALL OF THE TIMES that you have worked at this building/in this area.

FIRST JOB:

The next step of the interview process will be to focus on the first job of the carpenter at Oak Ridge.

When we interviewed you on the phone, we asked you questions about your first assignment at ________________ (X-10, Y-12 or K-25), which was at ________________. I'm going to ask you those questions again.

1. Did you work inside that building or on the outside?

Ask the same set of questions as you asked for the current or most recent job (Questions 2-8) and record the information in the same manner. If the location (building) of the first job is different from the location of the current/last job, ask Questions #9 and #10. In the unusual circumstance that both first and last jobs were at the same location, skip over #9 and #10.

OTHER JOBS:

1. Think of your other jobs at ___________ (X-10, Y-12, or K-25). Try to remember the buildings in which you worked. I'll write them down as you name them. (After each building is mentioned, ask for building number. If they cannot remember exact building numbers, ask the carpenter to give us his/her best guess.)

2. At ________ (X-10, Y-12, or K-25), were there any other locations that you worked at that were not buildings? Where were these?

3. **I would like to ask you about one other location of work at ________ (X-10, Y-12, or K-25), Building ________. I'm asking you about all of the different times that you worked at Building ________.**

What kind of jobs did you have at this building, (location)? (For each job mentioned) In what area were you working? By what piece(s) of equipment? Record the information about each job on page 8. Write a short description of the job on the line, and then write in the area or piece of equipment.

4. Go back to the list of tasks that carpenters may do. Think about ALL OF THE TIMES that you have worked in or around this building (location). Look at each task on the list and, as I read it, tell me if you have done this task at ________ (building or location).

5. Did you know or suspect that there were hazardous materials such as asbestos, lead or mercury in the area in which you worked? (If YES, ask specifically about lead, asbestos and mercury, or any other materials mentioned.)

6. Do/Did you use:
   - Paper dust mask?
   - Respirator with rubber or plastic mask?
   - Gloves made of cloth or leather?
   - Gloves made of rubber-like material?

GENERAL QUESTIONS:

I have just four more questions. These questions refer to the ENTIRE TIME THAT YOU WORKED AT THE OAK RIDGE RESERVATION, at any one of the three plants.

1. Do/did you wear a radiation badge? (If YES,) When (month and year) did you first wear a radiation badge? Did you wear a radiation badge on all of your assignments after that date?

2. During the entire time that you worked at Oak Ridge, were you ever involved in a major fire? By "involved" we mean being in a smoke filled area during a fire or helping to fight a fire. (If YES,) Where (what building or area)? When? (If the carpenter recalls more than one fire, ask about all of them.)

3. Did you ever have to be decontaminated? (If YES,) What was this for? Where had you worked? When?

   Were there other carpenters working with you who also had to be decontaminated at that time? (If YES,) Who?

Do you know carpenters who had to be decontaminated at other times? What was this for? When did this occur? Who?

4. **Did you ever work with equipment that then had to be decontaminated? (If YES) What equipment? When?**

COMPLETION OF INTERVIEW:

After administering the set of questions for each job at Oak Ridge, ask the carpenter if he/she would like to add any additional information about any work assignment.

Do you have any other information about any of your jobs that you think I should know about?

Here is a map of ______(X-10, Y-12, or K-25). Could you please place an "X" on all the buildings or areas where you worked for at least a total of 30 days during the entire time that you worked at Oak Ridge.

Give worker map and pen or pencil.

One more thing--here is a short questionnaire about the maps and diagrams we showed you. We want to know what you found most helpful in remembering the details of where you worked.

Give worker short questionnaire regarding memory methods.

Thank you for participating in this interview. As I mentioned earlier, the information you have given me will be used to create a more complete picture of the work done by carpenters at Oak Ridge. Thank you for your time. (Have a nice evening.)

Note on interiew form:

a. end time of interview
b. answer questions about carpenters' recall and cooperation

University of Cincinnati - Department of Environmental Health

PHASE II - OCCUPATIONAL HISTORY DATA COLLECTION
OAK RIDGE PROJECT
Data Recording - In-Person Interview

Name: ______________________ **DOB:** __ __/__ __/__ __

Date: __ __/__ __/__ __ **Interviewer Name:** ______________________

Start Time: ______________

1. When we interviewed you over the phone, we discussed your work at ______ (X-10, Y-12, or K-25).

   Do you work at ______ (X-10, Y-12, or K-25) now? ☐ Yes ☐ No

   Where are you working now?______________________
   or ☐ Layed off ☐ Retired

I am again going to ask you many of the same questions that we asked you during the phone interview. Our purpose is to see if you now remember any more details about your work at Oak Ridge DOE sites.

<u>CURRENT OR LAST JOB</u>:

At the time of your phone interview, you told us that your current or last job at __________(X-10, Y-12, or K-25) was at ______________. I'm going to again ask you about that job. By job I mean work on one project in one location.

Specific questions:

1. Did you work inside the building or on the outside? What was the name of the outside zone?

2. **Tell me a little about what you do at your current job (did at your last job) at ______________.** By asking this general question, you have some information to use to assess the necessity of rephrasing or reordering the questions below.

3. **When did you start this job?** (Try to obtain month and year. If they cannot recall the month, try to get year.)

   (If finished with this assignment:) **When were you finished with this job?**

Now I'm going to ask you some very specific questions about where you are/were working. Answer as best you can. If you are not reasonably sure of the answer, don't guess.

As you ask these questions, keep reminding the carpenter that you are asking about his/her recent job, not his/her experience through all jobs at (X-10, Y-12 or K-25).

4. (If inside a building) On this job at Building ______ in what area are/were you working?

   Is this near any piece(s) of equipment?

5. Do you know or suspect that there were hazardous materials such as asbestos, lead or mercury in the area in which you are working/worked? (If YES ask specifically about lead, asbestos and mercury-mention each substance. Also ask specifically if there were any other substances.)

6. What were the steps that <u>you</u> took in doing this remodeling/new installation? (Probe to obtain as many job tasks as possible.)

____

____

____

7. **During this assignment, how many total hours per week do/did you spend at the Oak Ridge Reservation? Does/did this include travel time?**

8. **Do/Did you use:**

   Paper dust mask?

   Respirator with rubber or plastic mask?

   Gloves made of cloth or leather?

   Gloves made of rubber-like material?

9. Have you worked in or around this building (area) at other times? When? About how many jobs have you been on int this building/in this area?

10. We have sent you a list of tasks that carpenters may do. Think about ALL OF THE TIMES that you have worked in or around this building (location). Look at each task on the list and, as I read it, tell me if you have done this task at ____________(building or location). Remember, now I am asking you about ALL OF THE TIMES that you have worked at this building/in this area. (Use a copy of the task list to check off tasks and frequency.)

    As you go through the list of tasks, the carpenter may remember additional tasks that he performed on this job. DO NOT GO BACK TO EARLIER QUESTIONS AN RECORD ADDITIONAL INFORMATION.

FIRST JOB:

The next step of the interview process will be to focus on the first job of the carpenter at Oak Ridge.

When we interviewed you over the phone, we asked you questions about your first assignment at _______________ (X-10, Y-12 or K-25), which was at_________________.
I'm going to ask you those questions again.

1. Did you work inside the building or on the outside?

2. Tell me a little about what you did at this job at Building __________.

3. When did you start this job? (Try to obtain month and year. If they cannot recall the month, try to get year.)

   When were you finished with this job?

Now I'm going to ask you some very specific questions about where you were working. Answer as best you can. If you are not reasonably sure of the answer, don't guess.
As you ask these questions, keep reminding the carpenter that you are asking about his/her first job, not his/her experience through all jobs at (X-10, Y-12 or K-25).

4. (If inside a building) In what area were you working?

   By which piece(s) of equipment?

5. Do you know or suspect that there were hazardous materials such as asbestos, lead or mercury in the area in which you are working/worked? (If YES ask specifically about lead, asbestos and mercury-mention each substance. Ask specifically if there were any other substances.)

6. **What were the steps that <u>you</u> took in doing this remodeling/new installation?** (Probe to obtain as many job tasks as possible.)

____

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____

7. **During this assignment, how many total hours per week did you spend at the Oak Ridge Reservation? Did this include travel time?**

8. **Did you use:**

Paper dust mask?

Respirator with rubber or plastic mask?

Gloves made of cloth or leather?

Gloves made of rubber-like material?

(If the location of the first job was different from the location of the current or last job, ask Questions #9 and #10. If the same building or outside area was the focus of both the last job and the first job, skip Questions #9 and # 10 and go to the next section.

9. **Have you worked in or around this building (area) at other times? When? About how many jobs have you been on in this building/in this area?**

10. **Go back to the list of tasks that carpenters may do. Think about all of the times that you have worked in or around this building (location). Look at each task on the list and, as I read it, tell me if you have done this task at______________**

(building or location). (Use a copy of the task list to check off tasks and frequency.) DO NOT GO BACK TO PREVIOUS QUESTIONS and record additional information.

OTHER JOBS:

1. Think of your other jobs at ___________ (X-10.Y-12, K-25). Try to remember the buildings in which you worked. I'll write them down as you name them. (After each building is mentioned, ask for building number. If they cannot remember exact building numbers, ask the carpenter to give us his/her "best guess".)

____

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____

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____

2. At _________, were there any other locations that you worked at that were not buildings?

3. I would like to ask you about one other location of work at ____________ (X-10, Y-12, or K-25), Building _________ (or a non-building location). These questions will refer to all the jobs you had at Building _____________.

What kind of jobs did you have at this building (location)? Tell me about the jobs that took the longest.
Record information about these jobs.

Job #1 ____

In what area were you working?

By what piece(s) of equipment?

Job #2 ______________________________

In what area were you working?

By what piece(s) of equipment?

Job #3 ______________________________

In what area were you working?

By what piece(s) of equipment?

Job #4 ______________________________

In what area were you working?

By what piece(s) of equipment?

Job #5 ______________________________

In what area were you working?

By what piece(s) of equipment?

Job #6 ______________________________

In what area were you working?

By what piece(s) of equipment?

4. Go back to the list of tasks that carpenters may do. Think about ALL OF THE TIMES you have worked in or around this building (location). Look at each task on the list and, as I read it, tell me if you have done this task at ____________ (building or location). Remember, I am asking you about ALL OF THE TIMES that you worked at Building __________. (Use a list of carpenter tasks and check frequency. Do not go back and add information to the answers to previous questions.)

5. **Did you know or suspect that there were hazardous materials such as asbestos, lead or mercury in the area of Building _____ ?** (If YES, ask specifically about lead, asbestos and mercury, or any other materials mentioned.)

6. **While you worked around Building _____, did you use:**

   Paper dust mask?

   Respirator with rubber or plastic mask?

   Gloves made of cloth or leather?

   Gloves made of rubber-like material?

GENERAL QUESTIONS:
I have just four more questions. These questions refer to the ENTIRE TIME YOU WORKED at the Oak Ridge reservation, at ANY ONE OF THE THREE PLANTS.

1. Do/did you wear a radiation badge?

   (If YES,) When (month and year) did you first wear a radiation badge?

   Did you wear a radiation badge on all of your assignments after that date?

2. Were you ever involved in a major fire? By "involved" we mean being in a smoke filled area during a fire or helping to fight a fire. (If YES,) Where (what building or area)? When?

   Any other fires?

3. Did you ever have to be decontaminated? (If YES,) What was this for? Where had you worked? When?

Were there other carpenters working with you who also had to be decontaminated at that time? (If YES,) Who?

Did you know of other carpenters who had to be decontaminated at other times? What was this for? When did this occur? Who?

4. Did you ever work with equipment that then had to be decontaminated? (If YES) What equipment? When?

COMPLETION OF INTERVIEW:

After administering the set of questions for each job at Oak Ridge, ask the carpenter if he/she would like to add any additional information about any work assignment.

Do you have any other information about any of your jobs that you think I should know about?

Here is a map of ______(X-10, Y-12, or K-25). Could you please place an "X" on all the buildings or areas where you worked for at least a total of 30 days during the entire time that you worked at Oak Ridge.

Give worker map and pen or pencil.

One more thing--here is a short questionnaire about the maps and diagrams we showed you. We want to know what you found most helpful in remembering the details of where you worked.

Give worker short questionnaire regarding memory methods.

Thank you for participating in this interview. As I mentioned earlier, the information you have given me will be used create a more complete history of the work done by carpenters Oak Ridge. Thank you for your time. (Have a nice evening.)

Finish time: ____________________

INTERVIEW EVALUATION:

1. Did the carpenter refer to the notebook during the interview?

   - ☐ Yes, much of the time
   - ☐ Yes, some of the time
   - ☐ Yes, but only at one or two points during the interview
   - ☐ No, not at all

2. How well did the carpenter seem to remember his/her history?

   - ☐ Very well
   - ☐ Fairly well, some problems
   - ☐ Not very well

3. How cooperative was the carpenter?

   - ☐ Very cooperative; <u>responsive and interested</u>
   - ☐ Very cooperative; responsive
   - ☐ Fairly cooperative; responsive
   - ☐ Not at all cooperative; uninterested; reticent

4. Were there any unusual aspects to this respondent or anything else that should be noted about this interview?

   ____

   ____

   ____

   ____

Appendix D

List of Contractor Records

List of Contractor Records
in Boxes Available to Search

<u>DuPont</u>

- industrial medical construction records
  - archived June 1953
    - 3 boxes, covering employees with names beginning Farm through Flitt
- construction medical records
    - 7 boxes covering employees with names beginning Clark through Cov
    - 11 boxes covering employees with names beginning Hutch through Keen
    - 3 boxes covering employees with names beginning Roberts through Rose
- hospital records
  - archived 1956
    - 69 boxes, no name delimiters noted
  - archived 1959
    - 5 boxes, covering employees with names B through W

<u>General Electric</u>

- personnel files
  - January 1949, six boxes covering employees with names A through T
  - March 1949, two boxes covering employees with names A through Z
  - April 1949, one box covering employees with names L through Z
  - Weekly payroll/personnel 1950, 11 boxes, covering employees with names A through Z
- personnel folders
  - archive date March 1952
    - 95 boxes, covering employees with names A through Z

<u>Vitro</u>

- 32 cubic feet of records with approximately 50 files per box
- personnel files of terminated employees, 1963-1970

<u>Kaiser II</u>

- 44 cubic feet of records with approximately 50 files per box
  - personnel involved in 100N construction 1959-64

<u>Blaw-Knox</u>

- 51 boxes of records (approximately 52 cubic feet)
  - personnel records for the construction of the PUREX facility

<u>J.A. Jones</u>

- Payrolls 1984-1986 (85936,94509,94510,94589,94590) SFRC
- Payroll 1979 (090574)SFRC
- Deceased Personnel Records, approximately 700 records (096216 through 222) SFRC

Valley Asbestos

1979 (090575)SFRC

Kaiser

Official Personnel Records 1981-1983 (085050 through -52)
Payroll 1986-88 (085432, 085451,087502, 087503, 087546, 098552-58, 087631, 087644-51) SFRC

Terminated Personnel Records 1982-1987 (097664-5) SFRC
1964-1986 (097666) SFRC
1976-1967 (097667) SFRC
1979-1986 (097668) SFRC
1952-1987 (097669) SFRC
Craft Personnel Files 1955-1990 (127504) SFRC
Explanation of Benefits1990-1993 (127940-128000)
(Identify individual employees) (133001-2) SFRC

Mortality Record Cards, 1981 (126003) RHA
Mortality Data Validation Report, 1993 (PNL, Area 300, Bldg 3676, Rm2)