SAVANNAH RIVER BUILDING TRADES MEDICAL SCREENING PROGRAM

A NEEDS ASSESSMENT

Submitted by
The Center to Protect Workers' Rights

on behalf of
The Building and Construction Trades Dept., AFL-CIO
and
The Augusta, Georgia Building and Construction Trades Council

In Cooperation with
Duke University Medical Center
Medlantic Research Institute
United Brotherhood of Carpenters Health and Safety Fund
University of Cincinnati Medical Center
Zenith Administrators, Inc.

June 23, 1998

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Summary and Response to Needs Assessment Questions

This needs assessment has been prepared for a medical screening program for building and construction trades workers at the Savannah River Site (SRS). This summary responds to the four questions that DOE has asked us to address.

a. Documentation of Need

As expected, and as has been our experience at the other sites where we are conducting similar medical screening projects (Hanford and Oak Ridge), insufficient information on construction workers has been collected and maintained to make definitive judgments about the nature and extent of risk at SRS.

However, based on the available evidence, and views presented by our advisory committee, and the experience we have gained during the Phase 2 implementation of our program at Hanford, a large body of information supports the need for this program, provided that it is implemented with appropriate understanding of the limitations of the underlying data. While it is apparent that building trades workers have been placed at significant risk due to their past employment at SRS, it is not possible to *a priori* decide with any degree of exactness whether an individual has been placed at sufficient risk to warrant inclusion in the medical screening program. For this reason, in implementing the program at SRS, we will rely on a triage design to determine in the case of each individual worker whether there is need for medical screening.

b. Size of Population

An estimation of need based on populations and expected medical examination need has been made (table S-1). We estimate the building trades population at SRS from inception in 1950 to present to have numbered 62,000. Of these, we expect that 37,250 are alive, and that 69% will decide to enroll in the program, but that 33% of these will not meet the basic eligibility criteria, and after the interviews an additional 10% interviewed will decide not to participate in the screening procedures. As a result, we expect to provide an occupational history interview to 17,200 individuals, and conduct a medical assessment based either on available medical records or by conducting medical evaluations for 7,750 individuals.

Table S-1
Summary of population estimates

Population tracing	62,000
Available population	37,250
Interviews conducted	17,200
Medical evaluations	7,750

c. What is Known about Specific Hazards on the Site

Based on a detailed evaluation of available information on potential exposures at SRS and experience gathered from current projects at Hanford and Oak Ridge, there is sufficient evidence to suggest excess exposures to a number of hazards will infer referral for medical evaluation among a significant number of building trades workers at SRS. Sufficient evidence exists to include the following exposures as triggers for specific medical examinations based on the history presented by individual workers.

Table S-2
Hazards which justify medical screening

Asbestos	Silica	Solvents	Radiation	Welding	Heavy metals
Mercury	Lead	Cadmium	Chromium	Noise	Tritium

Note: We have not listed beryllium because we have no site-specific knowledge of its use at SRS. However, based on our experience at Hanford and Oak Ridge, we expect that workers will report beryllium exposures at SRS as well. Tritium exposures are very rare, and there are no reliable epidemiological studies of health effects. We are continuing to assess these exposures in terms of their likely health effects, and medical testing, if any.

d. Anticipated Health Impacts

Based on the size of the worker population and the exposure history at SRS, we expect to find over 10,000 cases with abnormal or positive clinical findings. These range from very common health effects like hearing loss to rare events, such as those associated with exposures to cadmium and beryllium. Radiation exposure poses a special problem. We believe that for most construction workers, radiation exposure will be episodic and only rarely result in more than 20 rems of lifetime exposure, which is the level that should trigger medical evaluation. However, because we lack reliable radiation badge information on most construction workers, it will be difficult to ascertain risk with precision. As a result, for this exposure a significant portion of the population may be eligible for screening based on the self-reported history they present, but we do not expect to find more than 20 positive or abnormal cases.

Table S-3
Expected hazards and their outcomes

Hazard	Expected referral rate	Potential number of exams (from Table 13)	Expected positive or abnormal rate	Expected positive or abnormal cases
Asbestos	25%	6,425	15%	963
Silica	5%	1,285	10%	128
Solvents	5%	1,285	5%	64
Radiation	7%	1,800	1%	18
Welding	3%	780	3%	23
Mercury	1%	260	5%	13
Lead	10%	2,600	15%	390
Cadmium	0.5%	130	10%	13
Tritium	0.5%	130		
Noise	50%	12,850	67%	8,612

Note: Although we have no information on Beryllium (Be) exposures at SRS; based on our experience at Hanford and Oak Ridge we expect to find 0.1% of the workers (i.e, 26 workers) reporting exposure to Be and that we will find two cases of positive testing for beryllium disease on LPT. Tritium exposures are very rare, and there are no reliable epidemiological studies of health effects. We are continuing to assess these exposures in terms of their likely health effects, and medical testing, if any.

1. Introduction and Rationale

a. **Aims**

To develop a program of notification, medical screening, and intervention for building trades workers who may have been exposed to health hazards as a result of prior work at the Savannah River Site. The aims are to:

- Identify and propose resolution to policy issues that surround this program.
- Conduct a site needs assessment.
- Develop a worker-history risk-characterization protocol as the basis to triage workers at risk. (Subject of this report.)
- 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 plan for quality assurance, evaluation, and data management.

b. Focus of Needs Assessment

This needs assessment focuses on three main issues:

- Description of the need for this program, based on the risks associated with the following four sources of exposures:
  - -- The tasks that construction workers have performed.
  - -- The materials that construction workers have been using in these tasks.
  - -- The buildings or facilities at SRS in which construction workers may have been exposed to hazardous conditions of work.
  - -- Any recorded "episodes" where, due to explosions or other failures in procedures, unintended exposures may have taken place.
- Estimation of the size of the eligible population and how it is to be located and recruited into the proposed program.
- The feasibility of the program that is being proposed for phase II to address the needs of this population.

c. Organization

This application is submitted 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 Augusta, Georgia, Building and Construction Trades Council (Augusta BCTC), which represents the target population at Savannah River. This project has the support of all fifteen building trade unions at Savannah River.

The work is being performed by a consortium consisting of Duke University (Duke), Zenith Administrators, Inc. (Zenith), the United Brotherhood of Carpenters Health and Safety Fund (UBC), the University of Cincinnati (UC), and the Medlantic Research Institute at the Washington Hospital Center (MRI). This consortium provides outstanding expertise in coordination with the Medical University of South Carolina (MUSC), the University of South Carolina, Columbia, School of Public Health, (USC,SPH), and Bechtel Savannah River, Inc., (Bechtel) to accomplish the main responsibilities as identified in Table 1.

There is a separate program being developed by the Medical University of South Carolina for production workers at SRS, and we are coordinating our activities with it.

d. Rationale for Program

As will be described in more detail below, certain essential rationales drive this program. Many of these have been reinforced by our experiences over the past one and one-half years developing similar programs at Hanford and Oak Ridge.

The program 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 reliable exposure or outcome 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 reliable exposure data, we proposed a public health approach that would rely extensively on triaging of the workers who have worked at SRS. 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 workers with significant exposures as a result of having worked at SRS, 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 an epidemiological analysis based on these data, but because of inherent limitations in our ability to establish population ascertainment, such analysis will be limited.

Having two distinct programs at one DOE site is not a problem. We established an agreement to work closely with the Medical University of South Carolina and its program for production workers at SRS, and we have collaborated well to date in the collection of site history information. Our experience at Hanford, where we manage a program for construction workers and the University of Washington manages one for production and maintenance workers, has been favorable. By coordinating activities, including referral of workers between programs, we have found that division of labor does not cause confusion, duplication, or gaps. In fact, by having two separate programs that serve politically distinct reflecting different unions, different interests and different needs, we have been able to avoid many potential political problems and have been able to use resources, especially in the area of population outreach more effectively.

2. Need for 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 are monitoring of health effects on the workforce and monitoring of hazards in the workplace. 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 preventive 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 <u>current</u> 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 are 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 (1996). 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 workers exposed to similar 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 do not 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, can decrease the rates of illness, disability or death related to workplace exposures. Specifically, the needs for 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 the history of the site, will be used to define potential exposure profiles for each worker. Tests of biological markers of exposure, where they are relevant many years after 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 work-related activities and potential exposures. Primary health care providers frequently are unaware of a patient's occupational 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 in 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 the Site[1]

The Savannah River Site is located in a 310 square-mile area in southern South Carolina along the Savannah River, which divides South Carolina and Georgia. The Department of Energy site was built in the early 1950s for the purpose of defense production of plutonium-239 and tritium (heavy water). DuPont, which had operated the Hanford Reservation from its inception through the end of World War II, was asked by President Truman in 1950 to "do it again," meaning to plan, construct, and operate a nuclear production facility. The land for the site was acquired in early 1951, and construction was underway by the beginning of February. The first buildings built were giant star-shaped buildings that acted as headquarters for the construction division.

Construction of the plant was managed by the Design and Construction Divisions of DuPont's Engineering Department. The project cost approximately $1.1 billion, and had a peak construction force of 38,582 workers. DuPont made use of union "hiring halls" and forged agreements with the unions to cooperate with one another and forgo their usual jurisdictional claims in order to expedite the hiring process. (This practice got DuPont into some trouble by the fall of 1951, when it was alleged that the company was following a preferential hiring policy by hiring only union members. DuPont defended itself in Congressional hearings, saying that it had no exclusive agreement with the unions and did not require union membership, but admitted that it made little effort to hire outside of the union halls.) By August 1951 construction workers worked a 45-hour week, which was increased to 54 hours in March 1952. The extra hours, and the overtime pay that went with them, were an important hiring incentive as well as a means of hurrying construction. The plant was essentially completed in the spring of 1954 and the majority of the building trades workers left, but some stayed on as maintenance workers for DuPont, and some remained as union construction employees. After the initial construction, DuPont tended to hire civilian craft workers directly, but did not have agreements with unions for such workers as pipefitters, electricians, or insulators, and hired these workers through subcontractors. The major subcontractors at the site between the 1950s and late 1980s were BF Shaw, MK Fergusen, North Brothers, and Miller Dunn.

[1]For sources of information on this history, see Appendix 1.

The primary function of the Savannah River Plant was production of tritium, plutonium-239, and other nuclear materials. The original plant consisted of five production reactors, two chemical-separation facilities, a heavy water extraction plant, a nuclear fuel and target fabrication plant, and support and waste management facilities. The five reactors produced nuclear materials by irradiating target materials with neutrons. They used control rods that were made in the 300-M Fuel and Target Fabrication facilities and filled with heavy water produced in the 400-D Heavy Water Extraction facilities. From the reactors, irradiated materials were moved to one of the two chemical separations facilities (called canyons) in the F and H areas, where the irradiated fuel and target assemblies were refined (chemically processed to separate useful products from waste). The canyons are so named because of their long, narrow shape: each building is 835 feet long, 122 feet wide, and 66 feet high. There was also a small facility specially designed for the production of tritium in the F Area, where tritium was separated from the lithium-aluminum alloy that had been irradiated in the reactors.

By 1957 demand for heavy water had decreased dramatically, and two of the three heavy-water plants were shut down. But demand for other materials was increasing, and the mid- to late-1950s saw the construction of several small production buildings as well as the expansion of facilities in the F Canyon. By the mid-1960s, reactor production had become more efficient as demand was decreasing, so in 1964, R Reactor was shut down and placed on standby status, as was L Reactor four years later.

The program at Savannah River underwent significant changes in the 1980s. In 1981 environmental clean-up activities began under RCRA, including a full-scale groundwater remediation program at the M-Area Settling Basin. The Heavy Water Rework Facility was closed the next year, and the remaining operating reactors were shut down in the latter half of the decade. Although some reactors were restarted briefly in the early 1990s, all are currently in shutdown mode, which is assumed to be permanent. But new production programs were initiated also. Production of plutonium-238 for deep space exploration began in 1985. The Defense Waste Processing Facility and Saltstone were constructed, as was the Tritium Replacement Facility to accomplish the reclamation and recycling of tritium in the nation's nuclear arsenal. But with the fall of the Berlin Wall and the end of the Cold War, production of nuclear materials for weapons use at SRS was discontinued and the Secretary of Energy announced the phase-out of all uranium processing.

A number of operations continue at the Savannah River Site. Construction began on a Consolidated Incineration Facility in 1993, at about the same time the Tritium Replacement Facility began radioactive operations. Nuclear materials are currently being stabilized at a former Separation Facility. Vitrification of nuclear waste began in 1996 at the Defense Waste Processing Facility.

DuPont left the Savannah River Plant in 1989, and Westinghouse Savannah River took over responsibility for nuclear facility operations, administration, and environmental, safety, and health and quality assurance. B & W Savannah River Company oversees facility decontamination and decommissioning, and BNFL Savannah River Corporation is responsible for the solid waste program. The primary construction contractor is Bechtel Savannah River Inc., which is also responsible for engineering activities and environmental reconstruction.

Bechtel took over April 1, 1989, replacing DuPont's Design and Construction Division, which had been the primary construction contractor since the site's inception.

When the DuPont Company was the operating contractor for SRS, it was responsible for both production and construction sides, and in keeping with its overall company policy, its production operations were always non-union while its construction operations have always been union. As a construction contractor, DuPont relied heavily on direct hire; that is, rather than going through subcontractors who then hired construction workers, DuPont tended to go directly to the unions to hire the workers needed for a particular project. This may prove to an advantage for the medical screening, in that DuPont has always maintained excellent personnel records, including records on its construction workforce.

For political reasons relating to the desire of DOE to engage more local employers, Bechtel currently does not direct-hire construction workers at SRS. Instead, it acts as the construction manager and subcontracts with local contractors who in turn hire construction workers. Therefore, since 1989 central personnel records do not exist on construction workers. In other words, we are in some ways in the paradoxical situation of having better records on workers employed in the distant past than during the last nine years.

About 13,000 people are currently employed at Savannah River Site, down from 16,000 three years ago. About 88% are Westinghouse, Bechtel and other subcontractor employees, and 4% are Federal DOE employees. The remainder are subcontractors, security (provided by Wackenhut), and conservationists employed by the Ecology Lab and the Forest Service. Approximately 1,500 are construction workers.

Today, construction workers are less likely to be union members than in the past. As a result of the 1993 Workforce Transition and Community Assistance Act, workers who were previously in production job classifications have increasingly been moved to job classifications that traditionally have been considered construction. Today there are only 700 union building trades workers are employed at SRS.

c. Special Issues for Construction Workers

This 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 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.

Workers particularly in the second category 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 fifteen unions (table 1). 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 SRS, the Augusta BCTC, representing all the trades, is actively involved with this program.

Table 1
Fifteen Building and Construction Trades Unions

International Association of Bridge, Structural and Ornamental Iron Workers
International Association of Heat and Frost Insulators and Asbestos Workers
International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers and Helpers
International Brotherhood of Electrical Workers
International Brotherhood of Painters and Allied Trades
International Brotherhood of Teamsters
International Union of Bricklayers and Allied Craftsmen
International Union of Elevator Constructors
International Union of Operating Engineers
Laborers' International Union of North America
Operative Plasterers' and Cement Masons' International Association
Sheet Metal Workers International Union
United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry
United Brotherhood of Carpenters and Joiners of America
United Union of Roofers, Waterproofers and Allied Workers

3. Sources of Data

We have conducted an intensive search of data sources on the SRS site and its worker population and have interviewed the persons responsible for these data sources.

a. Existing Studies

The following existing studies have been reviewed:

- **Bebbington, WP., 1990.** This is the History of DuPont at the Savannah River Plant.

- **Hickey, JLS., Cragle, D., 1985.** This report looked at exposures to 9 chemicals for 10 different job classifications based on SRS data for the years 1952-84. The major emphasis of the report was evaluation of potential occupational hazards presented to the production workers based on exposure profiles from plant processing descriptions and records, job title records, and published reports. Little actual industrial hygiene sampling data were available; therefore, qualitative exposure for a selected list of chemicals was largely based on professional judgement. Several criteria were used to select a priority list of chemicals of concern from a much longer list of chemicals used at SRS. These criteria included 1) the relative toxicity of the material by inhalation exposure, 2) quantity of the material used or produced, and 3) an industrial hygiene assessment of the potential for worker exposure. Nine substances were selected based on these criteria and included hydrogen sulfide, nitric acid and nitrous vapors (NOx), fluorine compounds (HF, F_2, F salts), sulfuric acid and sulfur oxides (SOx), mercury and mercuric compounds ($Hg(NO_3)_2$, tributyl phosphate (TBP) and dilutent (kerosene), oxalic acid, phosphoric acid, and nickel and nickel compounds.

  Because no site data relating construction workers to exposures were found, the Hickey report categorized these workers as at minimal risk of exposure. In its analysis, this report did not consider exposures to typical construction-related hazards such asbestos, silica, welding, etc. In addition, the Hickey report gave little attention to exposures of maintenance workers to construction-related hazards and process hazards. Our experience at Hanford has shown that most craft workers have experienced both types of exposures.

- **Meyer, KR, McGavran, PD, et. al. Savannah River Site Dose Reconstruction Project.. Neeses, SC: Radiological Assessments Corporation (RAC), 1995. (Commonly know as "RAC study" or "John Till study." In this report we refer to it as the "RAC study" or simply "RAC")**

  The major objectives of Phase I of the RAC study were to: 1) describe the operational history of the SRS, 2) identify materials releases from the SRS during its operation, and 3) identify sources of environmental monitoring and research data. The Task 3 report provides valuable information concerning processes at the SRS; chemicals used in these processes and radionuclides associated with the processes. The RAC study resulted in a list of "key chemicals and radionuclides." The criteria for selection of these materials included: 1) toxicity; 2) quantity present at SRS; 3) potential for release to air or water. A computer data file (CHEMRAD) containing a listing of these 488 chemicals and radionuclides which may have been released into the environment was developed. Approximately 350 chemicals are included in the CHEMRAD file developed by RAC.

  The RAC report provides valuable process descriptions and useful information concerning process materials with potential for releases to the environment. However, these data are limited with regard to evaluating exposures of workers and construction craft workers especially. For example, paints and many solvents were not included in the database as the potential for environmental release was judged to be low; however, exposures of construction and craft workers to these materials can be substantial. Information concerning chemical exposures at SRS is much more limited than exists for radiation as the concern for chemicals was not prominent during the first few decades of SRS operation.

- **Other Archive Sources**. In addition to the summary database sources described above, we have examined and copied relevant records located at the Savannah River Site Archives, Aiken S.C. A bibliography of data sources is shown in Appendix 1.

b. Institutional History Books

An integral part of our study of employment and 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 evidence from a variety of sources, many of them available at the Department of Energy Public Reading Room in Aiken (see Appendix 1), we have compiled information in a sophisticated Microsoft Access database. These have been printed in book form, several hundred pages of information for each major area within SRS, 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 hazards (referenced in literature) and inferred 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.

c. Data Files on Exposures

Table 2 shows an inventory of files which are available for use to characterize exposures.

Table 2
Files on exposures

Name	Description	Type of file	Contact person	Status
GIS file	CD rom of site geography. Provides site aerial photos.	Electronic	Russell Beckmeyer	Requested
Legacy file	128 buildings scheduled for D&D with some information on chemicals & radionuclides.	Computer	Peter Hugus	Print-out received

Name	Description	Type of file	Contact person	Status
DP SOP 158 & 158A.	Old industrial hygiene manual which includes lists of chemicals used.	Paper	Ed Kahal	Requested
HPT	Radiation hazard characterization by building	Paper	Ken Crase	Requested
SIRIM	Significant Incident Reporting Information System. Data file on unintended exposures.	Electronic	Art Blanchard	Requested
SFAIC	Data file of toxic risks in buildings slated for decommissioning.	Unknown	Ed Kahal	Requested and access granted
IH Baseline Hazardfile	Industrial hygiene characterization file for each active building.	Electronic & Paper	Ed Kahal	Requested and access granted
Historical IH sample data	Industrial hygiene sampling data copied by NIOSH.	CD scanned paper files	Larry Elliot	Requested and access granted
IH sample data since 1990	Flow Gemini records of IH samples.	Electronic	Ed Kahal	Requested

d. Files that can be Used to Identify Individual Workers

Table 3 presents an overview of data files available from which to identify workers who have been employed at SRS for recruitment into the program.

Table 3
Files on individual workers

Name	Description	Type of file	Contact person	Status
CIPS	Personnel files since 1991	Electronic	Peter Hugus	Requested
Radiation badge file	Self explanatory	Electronic after 1980	Ken Crase	Electronic file received
Clinic file	File on workers who have been seen at site clinic	Electronic after 1991	John Strickland	Requested
Construction contractor legacy file	File of construction contractors who have been on site	Paper	Art Aflin	Requested
DuPont personnel file	File of employees 1952-90. Contains 29,424 names of former workers.	Paper	Kathee Bleile	Received
Federal Repository files	A list of all personnel files located at the Federal Repository in Atlanta	Paper	Peter Hugus	Requested

Union records	The membership, health and welfare plan, and pension plan records	Paper and electronic	Russell Britt	Available

4. Specific Hazards and Degree of Potential Exposures

a. Overview

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 SRS, asbestos, silica, lead, stainless steel, nickel, cadmium, and epoxy-based paints were frequently used construction materials. Mercury, tritium, and radioactive materials were also contaminants in maintenance, overhaul, and demolition environments. Construction and maintenance craft workers are exposed to solvents doing tasks such as painting and solvent cleaning. High noise levels, which are ubiquitous in construction work, were further increased at SRS when work was performed within highly reflective enclosed areas such as reactor buildings and chemical purification "canyons." The complete spectrum of building and construction trades worker exposures at nuclear sites, including SRS, includes a wide variety of known hazards in poorly defined scope and intensity.

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

We have found no official record indicating that beryllium has been used at SRS. However, based on our experience at Hanford and Oak Ridge, we expect to learn from workers incidents in which potential exposure to beryllium has occurred for which no record exists. For this reason, we will include beryllium in the occupational history questionnaire which will be administered to all workers who agree to participate.

The types of exposures to any potential hazard among construction workers is very dependent upon their trade and where they worked at SRS. 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). Many substances such as asbestos are found throughout the SRS with exposures to construction and maintenance craft workers being of primary concern. Historical asbestos exposures of crafts such as insulators, pipe fitters, plumbers, and steamfitters were extremely high and epidemiological studies have demonstrated high risks of asbestos related diseases among these trades. Additional exposures have occurred among workers who have worked near and with trades using asbestos.

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, exposure may occur to millwrights or carpenters working in an area where equipment repair activities are going on.

The reports by Hickey and RAC provide information concerning possible process-related exposures at SRS which may be experienced by craft workers. The Hickey report identified many possible exposures for process workers but limited their consideration to 9 substances due to limitations in the number of substances that could be considered in the epidemiologic study. In addition to the nine primary chemicals, 6 alternates were listed. These are listed in table 4.

Table 4
Substances included in Hickey Report

Primary Chemicals	**Alternates**
Hydrogen sulfide (H_2S)	Lithium and compounds
Nitric acid (HNO_3) and nitrous vapors (NO_x)	Hydrazine mononitrate
Fluorine compounds (HF, F_2, F salts)	Sodium dichromate
Sulfuric acid (H_2SO_4) and sulfur oxides	Sodium hydroxide (NaOH)
Mercury (Hg) and compounds	Ferric sulfamate
Tributyl phosphate and kerosene	Asbestos
Oxalic acid (HO_2CCO_2H)	Perchloroethylene
Phosphoric acid (H_3PO_4)	
Nickel (Ni) and compounds	

Using the SRS Chemical Information and Inventory System (CIIS) developed in response to SARA Title III, RAC identified over 51,000 chemical entries representing over 3600 separate materials or chemicals were identified by RAC. The final list of chemicals of concern was restricted to those that were "essential process chemicals" or those present in quantities over 50 pounds and listed as hazardous by SARA Title III, CERCLA, RCRA, or TOSCA. Construction and maintenance craft have potential exposures to variety of circumstances including maintenance activities on existing equipment, ventilation systems, or process piping and during process additions or modifications.

b. Perceived v. Actual Risk

Section 3162 of the Defense Reauthorization Act of 1994 established this program. The legislative history shows that this provision was included in the legislation by Congress because of the *perceived* risks expressed by workers who have been employed at DOE facilities. These perceptions have arisen from a culture of secrecy, in which workers were not informed about the materials or tasks they were working on, and at the same time they were not permitted, again for secrecy reasons, to discuss their concerns about health risks on the job with independent experts. It is now clear that instances involving radiation exposures and chemical exposures were covered up, and this has fueled the concern of workers still further.

The struggle to get DOE to recognize beryllium risks and the failure to adequately protect workers is one example of the kind of institutional behavior that has led to the legislation underlying this program.

In our Hanford project, we have asked all workers who enter the program two basic questions:

- Do you think you have been exposed to hazardous materials while working at Hanford? Among the 250 workers enrolled so far, 99.8 % answered "yes."
- Do you think your health has been affected because of your work at Hanford? Of the 250 workers enrolled so far, 90.3 % answered "yes."

Obviously, these numbers are potentially skewed by the fact that these individuals all self-referred to the program when it was first started. Nevertheless, the rate of affirmative responses can only be described as remarkable. It is clear that the *perception of risk* that underlies the legislation is very strong, and the triage system that we have designed for this program (see section 7, below) aims to differentiate real risk from perceived risk by conducting an extensive work history interview as the basis for whether there should be referral to medical screening. For the concerned individual, the perceived risk is as real as the real risk. This program will provide eligible individuals with greater certainty about their real health risks, and in doing so, we provide a very legitimate public health service to the individual.

c. Work Tasks and Their Exposures

Table 5 shows the major construction tasks that are likely to produce exposures that would result in referral to one of the medical modules we have included in the medical screening program. A description of health risks associated with these exposures is given in table 6.

Table 5
Tasks and their associated exposures

Tasks	Associated Hazardous Exposures
Apply epoxy paint	Epoxies, isocyanates, solvents
Apply lead or chromium based paints	Lead, chromium, solvents
Asbestos or transite work (drill, grind, cut, apply)	Asbestos,
Asbestos gasket or packing work	Asbestos
Build or dismantle steel structures	Asbestos, silica, welding/cutting fumes
Cadmium coated steel work (cut, burn, weld, grind)	Cadmium fumes, dusts
Chromium work (cut, burn, weld, grind)	Chromium fumes and dusts

Clean parts	Chlorinated and non-chlorinated solvents
Concrete work (pour, drill, cut, demolish)	Cement dust, silica and abrasive dusts
Cut or install nickel sheet or cadmium-coated metal	Nickel, cadmium
Demolish buildings	Asbestos, silica, welding/cutting, process contaminants
Finish and sand drywall	Drywall dust, silica
Grind paints or coatings	Lead, cadmium, chromium, other paint components
Install, repair or dismantle equipment	General building exposures and exposure to building/process contaminants
Install, repair or dismantle lead shielding	General building exposures radiation, lead
Lead paint coated surfaces (cut, burn, weld, grind)	Lead fume and dust
Lead work (burning, pouring, grinding)	Lead fume and dust
Machine graphite blocks	Graphite dust, silica
Mercury work (any work with mercury, e.g instrumentation)	Mercury
Pipe work (cut, install, remove, repair, grind)	Asbestos, stainless steel. Process contaminants
Pull lead-coated cable	Lead
Sand-blast	Silica
Scrape/sand surfaces to remove paint containing lead, chromium or cadmium	Lead, chromium, cadmium, other paint components
Soldering or brazing	Lead, fluxes
Solvent stripping of walls, ceilings or floors	Solvents
Spray fireproofing or insulation	Asbestos, fiberglass, mineral wool
Stainless Steel work (cut, burn, weld, grind)	Chromium
Use solvents (thin paints, clean, strip or degrease)	Chlorinated and non-chlorinated solvents
Weld/carbon arc gouge/oxyacetelene cutting	Welding fumes, metals, oxides of nitrogen

d. Materials Used

Table 6 shows the major hazardous materials of concern to this program and the health risks they pose:

Table 6
Exposures rated on degree of hazard, scale of 1 to 10, for various crafts

Craft	Potential Exposure	Hazard Rating
Asbestos worker	asbestos	1 - 10
	cement	1 - 5
	fiberglass	1
	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
Boiler makers	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
	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
	lead	1

	metal shavings	1	
	noise	1 - 5	
	perchloroethylene		1
	stainless steel fumes	1	
	stoddard solvent	1	
	trichloroethylene	1	
Heavy Equipment	kerosene		1
	noise	1-6	
Ironworkers			
	aluminum	1	
	carbon steel fumes		1
	metal shavings	1	
	naphtha	1	
	noise	1 - 6	
	perchloroethylene		1
	stainless steel fumes	1	
	stoddard solvent	1	
	welding fumes	1	
Millwrights	acetone	1	
	aerosol spray cleaners	1	
	aluminum	1	
	carbon steel fumes		1
	cement dust	1	
	machinery grout	1	
	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	
	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 workers	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	

Note: Although we have no information on Be exposures at SRS; based on our experience at Hanford and Oak Ridge we expect to find 0.1% of the workers (i.e, 26 workers) reporting exposure to Be and that we will find two case of positive testing for beryllium disease on LPT. Tritium exposures are very rare, and there are no reliable epidemiological studies of health effects. We are continuing to assess these exposures in terms of their likely health effects, and medical testing, if any.

e. Buildings at SRS and Their Exposures

Table 7 shows the buildings at SRS tasks that are likely to produce exposures that would lead to referral to one of the medical modules we have included in the medical screening program. A description of health risks associated with these buildings is given in table 7.

Table 7
Buildings and their exposures

Building	asbestos	mercury	radiation	tritium	cadmium	chlorinated solvents	Accidents
1051	X						
105-C	X		X				X
105-K	X		X				
105-L			X				X
105-P	X		X			X	X
105-R			X				X
108-1K	X						
108-2K	X						
183-2C	X						
183-K	X						
184-K	X						
184-P	X						
211-F	X	X	X				
211-H	X						
212-H	X						
214-915H			X				X

Building	asbestos	mercury	radiation	tritium	cadmium	chlorinated solvents	Accidents
221-1F			X			X	X
221-3F			X				
221-F	X	X	X	X			X
221-H	X	X	X	X		X	X
222-F	X						
230-H							X
232-1H						X	
232-F			X	X			
232-H	X		X	X			
234-2H			X	X			
234-H	X		X	X			
235-F	X						
235-H	X						X
236-H			X	X			
237-H			X	X			
238-H			X	X			
241-901F			X				X
241-908H			X				X
241-909H			X				X
241-911H			X				X
241-912H			X				X
241-913H							X
241-914H			X				X
241-921H			X				X
241-924H			X				X
241-F	X						
241-H	X						
244-M			X				
247-F			X				X
254-2F	X						
284-F	X						X
284-H	X						
291-F	X		X				X
292-F	X						
294-F							X
305-A	X						
305-M			X				
313-M	X		X			X	X
319-M	X						
320-M	X		X			X	
321-M	X	X	X		X	X	X
322-M							X
400-D	X		X				
411-D	X						

Building	asbestos	mercury	radiation	tritium	cadmium	chlorinated solvents	Accidents
412-D	X		X	X		X	X
420-D	X		X	X			
421-4D			X				
484-D	X					X	X
618-G	X						
675-T	X						
679-T	X						
681-1G		X					
701-1D	X						
703-A	X					X	
704-C	X						
704-M	X						
704-P	X						
706-F	X						
707-1F	X						
708-1	X						
708-A	X						
710-M	X		X				
711-A	X						
711-C	X						
711-CK	X						
711-K	X						
714-A	X						
716-A	X						
717-A	X						
717-D	X						
717-F	X						
719-A	X						
722-F			X				
723-A	X						
723-F	X						
735-A	X						
751-A	X						
760-G	X						
772-D	X						
772-F	X		X		X		
772-F	X						
773-A	X		X				X
776-A	X						
777-10A	X		X		X		
779-A			X				
784-A	X						
789-U	X						

f. Episodic and Unintended Exposures

The last column of table 7 shows information on buildings where the site history documents suggest that there were accidental releases, or explosions, etc. There also is a site file called SIRIM (see table 2) that has all incidents reported to the DOE over the years. We have requested this file more than once, but in spite of waiting four months, we have not yet received it. It may provide information on episodes when construction workers have had major "accidental" exposures. Based on our experience at Hanford and Oak Ridge, we expect that the workers will be a better source of this information, which will obtain through meetings with older workers and through the occupational history interviews that will be administered to each worker who participates in this program. As we get additional information, it will be incorporated into our system.

g. Summary of Health Risks

Table 8 provides a summary of the main hazards that will result in referral for medical screening in this program, and an estimate of the risks that these hazards produce for construction workers at SRS.

Table 8
The main hazards and their health effects

Materials	Health effects
asbestos	asbestosis pulmonary function decrements cancer
silica	silicosis
welding	chronic bronchitis asthmatic bronchitis chronic obstructive lung disease lung cancer
beryllium[1]	chronic beryllium disease
chromium	altered renal function allergic dermatitis lung cancer
cadmium	altered renal function
lead	elevated blood lead CNS toxicity peripheral neuropathy renal insufficiency
heavy metals	elevated blood lead
solvents	liver and kidney dysfunction
mercury	neuropsych abnormalities
noise	deafness
ionizing radiation	mutations chromosomal damage cancer
tritium[2]	

[1]Although we have no direct knowledge of Be exposures at SRS, we expect that we will find some.

[2]Tritium exposures are very rare, and there are no reliable epidemiological studies of health effects. Reported health effects include mostly those that would apply to offspring of workers, rather than the workers themselves, such as genetic alterations and adverse reproductive outcomes. We are continuing to assess these exposures in terms of their likely health effects.

5. Size of Construction Worker Target Population

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, and 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

Based on the available information, we have estimated the size of the target population. It is summarized in Table 10.

Table 9
Crude estimate of target population size

Major Construction Periods	Employed Population
1950-56	34,000
1956-80	9,000
1980-86	14,000
1986-98	5,000
Total	**62,000**

We have divided the population into two historical groups: 1950-56 and after 1956. The initial construction period was unique, in that DuPont served almost exclusively as a direct-hire contractor for the entire operation and maintained stable employment for that period of time, and many of the construction workers during that period became the initial production and maintenance workers once operations were started up. Following 1956, there was much more fluctuation in employment with increasingly more subcontractors coming on to the site for short period of time do short-term or limited projects of a specialized nature.

It is now 48 years since groundbreaking took place at SRS. Table 11 shows the age of the workforce if it were alive today, and the estimated attrition from it over time.

Table 10
Age of workers during different construction periods

1950-55	The youngest of these workers would today be 62 years of age (assuming an entry age of 20); the average age of these workers today would be 80 years of age. Therefore it is reasonable to assume that over half of these workers have died or will not participate in this program due to advanced age.
1956-80	The average age would be about 68, and it is reasonable to assume that 33% have died.
1980-88	The average age would be 61, and it is reasonable to expect that 25 % have died.
1989-98	The average age would be approximately 50 years and approximately 15 percent have died.

Note: This calculation is based on a model of the Oak Ridge construction worker population.

Based on these estimates, it is possible to summarize the population available for this program as follows:

Table 11
Available population

Period	Size (from table 9)	Attrition factor (table 10)	Available population
1950-55	34,000	50%	17,000
1956-80	9,000	33%	6,000
1981-88	14,000	25%	10,500
1980-98	5,000	15%	4,250
Total	**62,000**	**40%**	**37,250**

b. Location of Population

In order to conduct a surveillance program, the location of these workers must be known. If workers live widely dispersed throughout the nation, the complexity of surveillance delivery is increased. We do not expect this to be the case for this population. The DOE facilities have generally provided steady employment with good wages, and the construction workers have tended to stay within the area of the DOE facility, even after retirement. Based on our experience in Hanford and Oak Ridge, we estimate the following geographic distribution:

Table 12
Geographic distribution of available population

Location	% of population	No. of estimated currently living people (from table 6) 37250
SRS catchment area (80 miles radius)	80	29,800
Tri-state region (SC, GA, FL)	15	5,600
Elsewhere	5	1,850
Total	**100**	**37,250**

Of the total available population of 37,250, we estimate that 80 percent live within eighty miles of SRS. The majority of these will live in the Aiken, S.C., to Augusta, GA corridor, and they can be served by a single health clinic in that area. Of the population residing outside this radius, three-quarters will be in within the South Carolina-Georgia-Florida (tri-state) region. The bulk of these can be served by facilities in Atlanta, GA, Charleston, SC, and Jacksonville, FL. The remaining 5 percent may have moved away from the region and will be more difficult to locate and provide services to.

These distributions generally agree with our experience from previous worker notification programs, including one carried out with a population of workers from a chemical facility located in Augusta, GA (Tillett, Ringen, Schulte, et.al., 1986).

c. Expected Number of Participants

The more remote from the site the participants are located, the less likely they are to participate. Based on past experience (Tillett, Ringen, Schulte et. al., 1986) We would expect the following participation by location:

Table 13
Expected participation

Location	**Available population (from table 11)**	**Projected participation rate**	**Projected number of participants**
SRS catchment area	29,800	75%	22,350
Tri-State region	5,600	50%	2,800
Elsewhere	1,850	30%	555
Total	**37,250**	**69%**	**25,705**

If these projections of attrition, geographic distribution and participation rates hold up, we would expect an overall participation rate of 69 percent of the total population.

d. Approach to Recruiting Workers

We propose the following approach to recruiting eligible workers into the program:

Table 14
Approach to recruiting workers

Approach	**Description**	**Percentage of Eligibles Reached**
Direct recruitment	Self-referral, outreach office, word of mouth, 1-800 number, advertising though unions, employers, DOE and media coverage	50%
Electronic files	See files listed in table 3	25%
Paper files	See files listed in table 3	25%

We expect to reach 50% through direct outreach from the program office which will be established in Augusta. It is our experience at Hanford to date that the populations at DOE facilities are tight knit with good social networks, and that we will have no trouble filling up the schedule of the program through direct recruitment for most of the first year. During that time, we will develop updated address lists for those individuals who are found in electronic files, and in the second year of phase II we will start to contact them by mail. At the same time, we will begin to abstract information from paper records and update addresses.

Our approach to recruiting through mail is as follows:

- Update all addresses through an CD-Rom search of all current addresses in the United States (CD-Rom updated regularly).
- Send a letter signed by the head of the Augusta BCTC with a brochure, that includes a tear-off return mailer to indicate interest and 1-800 number for those who chose to telephone in.
- If no response, send a follow-up card 30 days after mailing.
- When a positive response is received, mail an intake form with a simple informed consent.
- If informed consent is not returned in 30 days, follow-up with a reminder card.
- If still no response is received, follow up with a phone call to inquire about the reason for the non-response.

6. Expected Health Outcomes

Based on the anticipated exposures and their risks, we anticipate that about 50 percent of those who agree to participate in this program will have had exposures which indicate a need for medical screening. Table 15 summarizes needs based on health outcomes:

Table 15
Expected outcomes

Hazard	Expected referral rate	Potential number of exams (from Table 13)	Expected positive or abnormal rate	Expected positive or abnormal cases
Asbestos	25%	6,425	15%	963
Cadmium	0.5%	130	5 %	7
Chromium	22%	5,654	7.5%	424
Lead	10%	2,600	5%	130
Mercury	1%	260	5%	13
Noise	50%	12,850	67%	8,610
Radiation	7%	1,800	1%	18

Silica	5%	1,285	10%	128
Solvents	5%	1,285	5%	64
Tritium	0.5%	130	unknown	unknown
Welding	3%	780	15	117

Notes: Although we have no information on Be exposures at SRS; based on our experience at Hanford and Oak Ridge we expect to find 0.1% of the workers (i.e, 26 workers) reporting exposure to Be and that we will find two case of positive testing for beryllium disease on LPT.

The following estimates support this table:

Asbestos - 10% prevalence of asbestosis in the members of the following crafts with more than 10 years at SRS and more than 30 years latency: insulators, plumber/pipefitters, steamfitters, boilermakers, sheet metal workers, carpenters, laborers, and a 2-fold RR for lung cancer in these same groups, with increased risk with smoking, increased age, increased years of exposure.

Cadmium - 5% with altered renal function for workers with history of repeatedly welding on cadmium coated steel or parts.

Chromium - 5-10% chronic hand dermatitis in groups of workers with exposure to wet cement - cement finishers, laborers.

Lead - 5% with some organ system toxicity: anemia, hypothyroidism, hypertension, renal dysfunction for workers with history of repeatedly welding on lead-coated steel or parts.

Radiation - Based on current findings in our Hanford project, using 20 rems lifetime exposure as trigger for medial referral. This is difficult to assess for construction workers because of the general lack of reliable radiation badge information.

Silica - expect 10% prevalence in workers who have performed high-risk tasks for more than 5 years - sandblasting without air supplied hood, tunneling, granite cutting.

Solvents, noise, - see table 15.

Tritium exposures are very rare, and there are no reliable epidemiological studies of health effects. We are continuing to assess these exposures in terms of their likely health effects, and medical testing, if any. The typical test is a urine analysis, but the biological half life of tritium in urine is less than 30 days and would thus not apply in this population of former workers.

Welding - 10% prevalence of some obstructive disease in non-smokers, 25% in smokers with more than 10 years in the following crafts: boilermakers, pipefitters, welders.

7. Assessment of Service Delivery Need for Phase II

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 1. 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, 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 and includes a brief intake questionnaire and basic informed consent which potential participants mail in. The intake form includes basic questions about trade and duration of employment at SRS, and also asks whether the workers have had any symptoms or fears of illness due to their work at SRS 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. These criteria can be found in table 16.

Table 16
***Tentative* criteria for inclusion in program**

Five years or more of employment at SRS 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.

Occupational and exposure history. For those who agree to participate by mailing in the intake form and informed consent form and who are found to meet the eligibility criteria in table 17, the first step is to conduct an in-depth occupational and exposure history interview. It is initiated by completing a detailed informed consent in person. At that time, 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.

Because of the variations in tasks performed by construction workers and the lack of underlying exposure data on individual workers, we have found it is not possible to calculate a reliable quantitative estimate of risk for construction workers. Therefore, to make determinations about the need for referral to medical examinations based on the information obtained from the occupational history interview, as part of the Hanford project we have developed and validated a two-part qualitative approach which we will apply to SRS. It takes into account frequency of exposure and level of exposure.

- **Step 1: *frequency of exposure***. Based on years of work at SRS using the start and end dates and subtracting the estimated fraction of time that the worker was employed at sites other than SRS, we apply a qualitative scale of 1-5 to described the frequency of exposure. This is presented in table 17.

Table 17
Exposure *frequency* scoring scale

SCORE	CURRENT DESCRIPTION	RECOMMENDED DESCRIPTION
5	Regularly	Daily or most days per week
4	Often	2-3 days per week

3	Sometimes	1-2 days per week
2	Rarely	Few times per month
1	Hardly Ever	Once per month or less

- **Step 2: *level of exposure*.** The second step of the referral determination scores the ***level of risk*** associated with the exposure with the work performed. As a result, we have devised "minimum exposure thresholds" for defining a worker exposure based on the agents for which these tasks suggest exposure. We differentiate between direct exposure (working on a task) and bystander exposure (working around someone or assisting someone doing the task), since in construction there often are substantial bystander exposures. This scale is presented in table 18.

Table 18
Exposure *level* scoring scale

AGENTS OR TASKS ASSOCIATED WITH AGENT EXPOSURES	MINIMUM QUALITATIVE SCORE	
	Direct Exposure	**Bystander Exposure**
Asbestos	2	2
Beryllium	1	1
Cadmium	3	None
Chromium	3	4
Lead	3	None
Mercury	2	3
Noise	3	4
Radiation	2	3
Silica	3	3
Solvents	3	5
Tritium[1]		
Welding	3	4

[1]Tritium exposures are very rare, and there are no reliable epidemioloigical studies of

health effects. We are continuing to assess these exposures in terms of their likely health effects, and medical testing, if any.

The scales provide the minimum values should be established to consider the worker "exposed" to the agent. For decision making, total years of SRS work would be assigned to the agent or task. As an example, the same pipefitter described above with 5 years of total work at SRS would be assigned to the medical examination module for asbestos diseases <u>if any</u> of the following conditions occurred:

- Direct work in a task associated with asbestos exposure (e.g drilling transite) and a qualitative score of 2 or more for the task.
- Bystander exposure to a task associated with exposure to asbestos with a qualitative score of 3 or higher.
- Asbestos listed as an exposure in the agent list with a qualitative score of 2 or higher.

Basic medical examination. Individuals who meet the criteria for medical examinations and whose health condition cannot be ascertained based on existing medical records, 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 test 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. The medical screening protocol is summarized in table 19 (it is presented subject to final approval by DOE).

Table 19
Proposed medical protocol

Trigger Exposure	**Medical Tests**
Asbestos	CXR and spirometry for workers over 40 years old with >15 years since first entry into high risk trade and at least 5 years exposure at DOE facilities.
Beryllium	Lymphocyte Proliferation Test (LPT) for all workers identified as exposed by our exposure matrix, even if they do not meet the five-year general entry criteria. Second lymphocyte proliferation test will be ordered if the first is positive. Two positive LPT tests would be followed by a chest x-ray and spirometry.
Cadmium	Urinary dipstick for protein in workers who report welding on cadmium coated metal or welding on painted metal structures. If positive, follow with urinary beta-2-microglobulin, followed by urinary cadmium if beta-2-microglobulin is elevated.
Chromium	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, tailored to low, medium and high estimated exposures.

Ionizing Radiation (External and internal radiation, from gamma, beta and alpha rays.)	Thyroid function testing (T4) in being included in the core examination. The physical examination for all workers will be targeted to look for cancers potentially due to radiation (skin, breast, thyroid), and well as others for which there is a benefit from medical surveillance (prostate, colon).
Lead	(a) 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. (b) attention to neurological system on medical history and physical examination in anyone exposed to lead. (c) for any worker with a potentially lead-related disease, order a blood lead level test to rule out lead as the cause.
Mercury	In workers with three years of intermittent exposure, known or presumed, to mercury through high risk tasks or work in high risk buildings: Attention on physical examination and in the medical history, looking for tremor, organic brain syndrome, or change in personality.
Silica	CXR and spirometry for workers over 40 years old with 5 years of exposure in sandblasting, rock drilling, concrete removal and demolition work, bridge and road construction, tunnel construction, concrete or granite cutting.
Solvents	Blood tests for liver and kidney function are included in the core. In solvent-exposed workers, attention should be paid on history and physical examination to central and peripheral nervous system function, as well as liver and kidney function.
Tritium[1]	Urine analysis as part of core examination, if applicable.
Welding	Spirometry for workers performing welding or high indirect exposure for five years to welding.

[1]The typical test is a urine analysis, but the biological half life of tritium in urine is less than 30 days and would thus not apply in this population of former workers.

Surveillance. For 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 to determine their 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 20
Preliminary estimate of need*

1.	Total population (table 9)	62,000
2.	Attrition (Table 11)	24,750
3.	Available population	37,250
4.	Decline participation (table 13)	11,545
5.	Participating population	25,705
6.	Do not meet eligibility criteria (33%)	8,483
7.	Eligible for occupational history interview	17,222
8.	Do not meet referral criteria for medical screening (50%)	8,611
9.	Need for medical screening	8,611

*****Best Estimate

Based on the information in table 18, 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 21
Estimate of Phase II service delivery (Per year for 4 years)

1.	Population tracing (from table 20, line 1)	15,000
2.	Invitations to participate (from table 20, line 3)	9,312
3.	Interviews conducted (from table 20, line 7)[1]	4,000
4.	Follow up to collect medical records[2]	1,000
5.	Medical exams conducted (from table 20, line 9)[1]	1,940
6.	Follow-up telephone interviews to determine satisfaction (from table 21, line 3)[3]	4,000

[1]We assume that 10% of those eligible will decide to decline.

[2] We assume that we will obtain releases for medical records from previous medical exams for 25% of the population interviewed and that we will be able to use these records in lieu of a medical screening.
[3]As explained in our original application, Duke University will conduct an independent satisfaction survey of all participants as part the quality assurance and evaluation.

Figure 1
Triage Design

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Appendix 1

Institutional History Database Sources

The following sources have been used to compile the history of the site that is presented in section 2(b) of this report. Most of these sources are located in the Department of Energy Public Reading Room, USC-Aiken Library, Aiken, SC. DOE and SRS documents have official document numbers at the end of the citation.

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"Environmental Assessment for the Closure of the High Level Waste Tanks in F- and H-Areas at the SRS," July 1996

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"Environmental Assessment: L-Reactor Operation, Savannah River Plant," August 1982, DOE/EA

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"History of Waste Tank 12, 1956 through 1974", DPSPU 78-11-9

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"Safety Analysis - 200 Area SRP, F-Canyon Operations," 1986, DPSTSA-200-10-Supp 4

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"Site Development and Facility Utilization Plan, Savannah River Site, Vol. II Site General Information," DPSP-87-271-2, 1987

"Savannah River Plant History, Plant Activities, January 1973-December 1986," DPSP-74-454-5

Savannah River Plant Area Maps, 1993.

"Soil Contamination Adjacent to Waste Tank 8", DPSPU 76-11-4

Special Incident Report "Environmental Release of Iodine-131 May 29 through June 23, 1961", DPSPU 61-11-21

Spreadsheet of buildings and comments, compiled by Bobby Kennedy, MUSC, part of materials obtained from SRS Legacy File, 1998.

June 23, 1998

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RE: Former workers' notification and medical screening program - Savannah River
DE-FC03-97SF21514

Dear Dr. Peeters:

As requested, enclosed please find ten copies of the *Needs Assessment* for the above reference project. Should you have any questions, please don't hesitate to contact either myself or Dr. Ringen.

Sincerely,

Robert J. Pleasure	Knut Ringen, Dr.P.H.
Executive Director	Principal Investigator

Enclosures

c: Kitty Taimi, DOE
Trish Quinn, CPWR