SC&A S. COHEN & ASSOCIATES
AN EMPLOYEE-OWNED COMPANY

May 3, 2006

Mr. David Staudt
Center for Disease Control and Prevention
Acquisition and Assistance Field Branch
Post Office Box 18070
626 Cochrans Mill Road – B-140
Pittsburgh, PA 15236-0295

Subject: Contract No. 200-2004-03805, Task Order 1: Transmittal of Attachment 6 of the Draft Review of the NIOSH Site Profile for the Y-12 National Security Complex

Dear Mr. Staudt:

Enclosed is Attachment 6, Site Expert Review Summary, of the Draft Review of the NIOSH Site Profile for the Y-12 National Security Complex. This document was delivered to you on September 19, 2005; however, Attachment 6 was not included in that deliverable, as it had not yet been completed or subjected to the appropriate clearance for classified information.

Please insert this Attachment in the appropriate place in your draft copy of SCA-TR-TASK1-0007. Should you have any questions regarding this deliverable, please contact me at 732-530-0104.

Sincerely,

John Mauro, PhD, CHP
Project Manager

cc: P. Ziemer, PhD, Board Chairperson
Advisory Board Members
L. Wade, PhD, NIOSH
L. Elliott, NIOSH
J. Neton, PhD, NIOSH
S. Hinnefeld, NIOSH
L. Homoki-Titus, NIOSH
A. Brand, NIOSH
J. Broehm, NIOSH
L. Shields, NIOSH
A. Makhijani, PhD, SC&A
H. Behling, SC&A
M. Thorne, SC&A
D. Chan, SC&A
H. Chmelynski, SC&A
J. Fitzgerald, Saliant
J. Lipsztein, SC&A
K. Robertson-DeMers, CHP, Saliant
S. Ostrow, PhD, SC&A
K. Behling. SC&A
Project File (ANIOS/001/07)

Attachment 6: Site Expert Review Summary

Interviews were conducted with 35 BWX Technologies, Inc. (BWXT), production, maintenance, and health physics personnel, and 3 Wackenhut Services, Inc. (WSI), security guards, who are currently employed and have worked at the Y-12 National Security Complex in Oak Ridge, Tennessee, collectively since 1969. The interviews were conducted by Joseph Fitzgerald and Kathryn Robertson-DeMers, Q-cleared members of the SC&A Y-12 review team. The purpose of these interviews was to receive first-hand accounts of past radiological control and personnel monitoring practices at Y-12, and to better understand how operations were conducted. Production operations interviews were conducted by Mr. Fitzgerald in groups of 3–5 employees on June 14 and June 15, 2005. Interviewees were selected by worker representatives to represent a reasonable cross-section of production areas and job categories. Radiological control and security interviews were conducted by Ms. Robertson-DeMers on June 2–3, 2005. Three guards with long employment histories, including the union health and safety representative, were interviewed together. Field radiological control, dosimetry, and environmental monitoring personnel were interviewed in three sessions, respectively. Interviews were conducted onsite in secure meeting rooms at Y-12. Time was also spent reviewing classified and unclassified health physics records and reports, and conversing with records staff.

Workers were briefed on the purpose of the interviews, and background on the Energy Employees Occupational Illness Compensation Program Act of 2000 (EEOICPA) dose reconstruction program and site profiles, and asked to provide their names in case there were follow-up questions. Union workers interviewed signed a visitor log. Participants were reminded that participation was strictly voluntary and that all interviewer notes would be reviewed for classification following the interview.

Y-12 facilities represented by the site experts interviewed included Buildings 9201-2, 9201-5, 9204, 9206, 9212, 9215, 9995, and 9998. The job categories represented included the following:

- Steamfitter
- Chemical Operator
- Maintenance
- Janitor
- Machinist
- “Outside” Machinist
- Boilermaker
- Electrician
- Electroplater
- Health Physics
- Environmental Monitoring
- Security Guards

Individuals interviewed were given the opportunity to review the documented interview for accuracy and completeness. This is an important safeguard against missing key issues or misinterpreting some vital piece of information. Some disagreement between site experts arose related to documented policies for radiation protection versus actual practice. Both views are presented in the summary.

All interviews have been documented and summarized below. The information provided is not a verbatim discussion, but is a summary of information from multiple interviews with multiple individuals. Individuals have provided this information based on their personal experience. It is recognized that these former worker recollections and statements may need to be further substantiated before adoption in the Technical Basis Document (TBD). However, they stand as critical operational feedback. These interview notes are provided in that context; former worker input is similarly reflected in our discussion and, with the preceding qualifications in mind, has contributed to our findings and observations.

Radiological Control (Rad Con) Organization

The radiation protection group, throughout the operational history of the Y-12 Plant, was centralized. There have been centralized procedures applicable to all areas of the facility. In 1969, the safety department at Y-12 included health physics, criticality safety, industrial hygiene, environmental monitoring, and some waste management activities. Technicians in the safety department performed health physics, industrial hygiene, and environmental monitoring duties. Industrial Hygiene separated from the Radiation Safety Department in the 1970s. Criticality Safety split off in 1988. The environmental monitoring group also eventually split from the Radiation Safety Department and became an independent group. In the 1970s, there were about 30–40 individuals working for the Radiation Safety Department. This number increased to about 135 in the 1980s and 175 in the 1990s. The Health Physics Department was subdivided and included a group referred to as Health Physics Services. This group was responsible for instrumentation, dosimetry, radiobioassay, and special projects. The Tennessee Department of Environment and Conservation (TDEC) has general oversight and a right to audit the Y-12 Plant.

Radiation Protection Requirements

The regulatory basis and/or guidance for the radiation protection program have varied over time. Initially, Y-1186, *Health Physics Program*, was issued in 1957. This document summarized the recommendations of National Council on Radiation Protection (NCRP) 59 issued in 1954, which were adopted later by the Atomic Energy Commission (AEC) in AEC Manual, Chapter 0550, *Codes and Standards for Health, Safety, and Fire Protection*. The Y-12 document was updated over the years to reflect the most current recommendations of the NCRP and the International Commission on Radiation Protection (ICRP). Subsequent radiation protection program documentation included the following:

- Y-KB-27, *Radiation Safety and Industrial Hygiene – Guides and Limits* (Issued 1970s).
- K/TL – 1074, *Development of Derived Levels for Radiation Control* (the Bailey Report) (Issued 1981).

- DOE 5480.1A, *Environmental Protection, Safety and Health Protection Program for DOE Operations*, Chapter XI, "Requirements for Radiation Protection" (Issued August 1981).
- Y/DD-291, *Oak Ridge Y-12 Plant Health Physics Handbook* (Issued August 1984).
- DOE Order 5480.11, *Radiation Protection for Occupational Workers* (Issued December 1988). Initially, the company had what was referred to as the *Radiation Protection Standard*, a company-level document based on national and international standards.

From 1992–1996, the *U.S. Department of Energy Radiological Control Manual* provided program implementation guidance. Finally, in 1996, 10 CFR 835, *Occupational Radiation Protection*, became the regulatory requirement governing radiation protection programs across the DOE.

Workforce

Former Y-12 contractors include the Tennessee Eastman Corporation (1943–1947), the Union Carbide Company (1948–1984), Martin Marietta Energy Systems, Inc. (1984–1996), Lockheed Martin Energy Systems, Inc. (1996–2000), and BWXT Y-12 LLC (2000–present). The construction contractor at the site was MK Ferguson (formerly Rust Engineering). Up until approximately 1990, Y-12 provided health physics support to the construction contractor. From 1990–1998, MK Ferguson developed its own Radiation Protection Program, and their health physics support was independent of the Y-12 Health Physics (HP) group. Y-12 provided their dosimetry and radiobioassay services. MK Ferguson had their own set of instruments, and was responsible for the calibration of those instruments. They also did their own dose calculations, based on raw data provided by Y-12. In 1998, Bechtel Jacobs came to the site to take over decontamination and decommissioning, and legacy waste operations. Although Bechtel Jacobs's staff physically worked onsite, they contracted their health physics services to an outside organization (not Y-12 HP).

On the Y-12 site, workers often moved between different operations. This was especially true of support personnel, such as health physics, security, crafts, and janitorial staff. Maintenance workers and janitors moved around the various facilities and operations on a frequent basis. These workers performed cleanup and maintenance work on all machines and processes. In some situations, a large building had its own maintenance support within the building. Unlike other employees, machinists and chemical operators were assigned to specific shops.

The movement of the work force between Y-12 and the other Oak Ridge sites was common. Occasionally individuals from one plant were loaned to another site. Extended assignments to other facilities usually resulted in a change in employment. There was a Central Engineering staff, which was utilized by Y-12, Oak Ridge National Laboratory, and Oak Ridge Gaseous Diffusion Plant.

Overtime hours were often significant, at times approaching 20 hours per week in certain job categories (e.g., chemical operators, trades, machinists). Building 9212, in particular, has a history of extensive overtime. There was a substantial amount of overtime in the guard force.

Security was working 60 or more hours per week from 1981 or 1982 through 1993. Although there was overtime prior to the 1980s, it increased during this heavy production era. In 1994, when the plant was shutdown, there was a reduction in force. As a result, security had to do the same work with fewer individuals. Therefore, from 1994–1996, security personnel were working up to 70 hours per week. This overtime was not optional. From 1997–2001, the work week decreased to about 60 hours per week. Following September 11, 2001, the average work week was 60–65 hours per week.

Production

Production was a priority over radiological control historically. Uranium was not considered a significant radiological hazard. Production goals were established and those goals were met! When serious safety problems were encountered, there was stop-work authority exercised by radiological control staff. The number of employees working at Y-12 was tied to production. At the end of the Cold War, large programs at Y-12 started to wind down. The DOE put the plant in standdown in September 1994 with influence from the Defense Nuclear Facility Safety Board. Many operations have restarted, but others are still shutdown.

Oak Ridge National Laboratory (ORNL) maintained the Biology Building (9203), Fusion Project (9201-2), and post-Tennessee Eastman Corporation (TEC) Calutron Operations (9204-3) on the Y-12 site. Their technical support and radiation protection personnel were ORNL employees who worked at the Y-12 site. Y-12 radiation protection staff provided minimal support to these projects, such as source inventory and control. Y-12 personnel, such as maintenance, criticality safety, janitorial services, security, etc., supported ORNL projects and regularly cleaned or worked in these areas. These individuals had free access to the ORNL operations at Y-12.

Other radionuclides processed or worked with at the Y-12 plant included ^{237}Np, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{228}Th, ^{230}Th, ^{232}Th, and americium. Processing of ^{233}U occurred on and off in Building 9206. Tritium has been and is stored at Y-12. To the best of one site expert's knowledge, there have not been any sources of ^{226}Ra onsite, except a few radioactive sources.

Recycled uranium was received at Y-12 starting in the late 1950s. Y-12 was getting metal and liquid products from Savannah River. Apparently, Y-12 managers wanted to keep Y-12 uranium production lines strictly segregated from these recycling operations. There was a concern over the presence of "sister" products in the recycled feed that would contaminate the uranium processes.

When recycled uranium (RU) materials were received, the seal of incoming material was broken and a sample taken. The sample was analyzed to determine if feed material was within Y-12 specifications related to impurities. The analysis evaluated ^{106}Ru, ^{144}Ce, ^{95}Zr, transuranics, and other radionuclides concentrations. The ratio of impurities to uranium was tracked by Health Physics. Most transuranics present at Y-12 are in trace quantities as part of recycled uranium. Plutonium-239 and ^{241}Am were on the order of parts per billion upon receipt. As the material went through the chemical processing, impurities, and uranium daughters were removed from the product, but concentrated in the raffinate. As a result, the West End Treatment Facility is considered a transuranics area.

Thorium was used at Y-12 to manufacture parts. There were heavy thorium campaigns in the 1960s. The principal chemical form was thorium metal. Processing of thorium involved considerable rolling, shaping, and machining. Health Physics indicated that special precautions were used, including air sampling and machine enclosures. Machinists handling thorium indicated no special precautions were taken during the grinding and shaping of thorium metal.

The presence of plutonium was denied by plant managers for many years. Plutonium was separated for the last time in Calutrons (9204-3) in 1978–1979. However, workers were told that recycled "tear downs" from Los Alamos needed to be checked for plutonium. Workers indicated that the Building 9203 facility contained plutonium. The "plutonium laboratory" remains contaminated (with sealed gloveboxes), is kept on negative pressure, and is kept locked. Historically, some parts or components were "sputtered" with plutonium.

Security

In general, the security force was rotated throughout the plant based on the post they were assigned to. This included providing security support to ORNL buildings on the Y-12 site. Security was responsible for a variety of functions at the Y-12 Plant. When material was transported between facilities in a "blue goose," security was required to escort the material. Some Alarm Check tours took them into areas where they had to climb over and around containerized special nuclear material. They also were frequently around unassembled parts. They served as escorts for visitors and personnel as necessary. In addition, they were involved in the destruction of classified material at the Burnhouses. The exact content of the documents is unknown, as they were bagged.

Buildings 9206 and 9212 were the most radioactively hazardous buildings onsite. Both housed incinerators. Building 9206 housed the heavy water and the green salt conversion process. Workers in Building 9206 would collect the ash from the incinerators wearing respiratory protection, while security wore nothing. Special Nuclear Material was stored in Building 9720-5, production areas, and in other areas of the plant. Buildings 9720-9, 9720-10, and 9720-11 were secured metal buildings.

Some posts were located adjacent to the production area. Building 9215 was involved in machining and milling of highly enriched uranium. There was a control point (Post 50) in this area where individuals had to hand over their badge and get an area-specific badge. This post also served as a monitoring station for special nuclear material and metal coming in and out of the facility. There were also posts near the location where industrial x-rays were taken. The instruments at the post would peg when x-raying of casting was underway.

Security personnel provided personnel frisking after Personnel Contamination Monitor alarms starting sounding in the late 1980s. Guards received minimal training (i.e., battery check, basic operation) on conducting these personnel surveys. They remember occasionally (a couple of times per month) finding uranium chips on employees leaving the area. The chips would stick to the clothes.

There was a vault located in Building 9213 where criticality experiments were conducted by scientists from ORNL for a period of time. This area was used for security training and storage of vests and equipment. The vault was posted as a contamination area, although they were told it was a fixed contamination area. Security conducted drills in and among equipment in the scrap yard, which also had fixed contamination. At times they would hide inside the equipment.

Guards wore coveralls for work. Both their work and personal clothing were stored in the same locker. They also wore company-issued shoes. During escorting activities, there were situations where escorted individuals or other individuals in the area were provided with personal protective equipment (PPE), whereas security personnel were not. For example, if security was simply escorting workers performing a task that required a respirator, they may or may not be required to wear a respirator.

Prior to Radiation Work Permits (RWPs), there was no routine bioassay monitoring for security personnel. Very few lung counts were done. Sampling or counts were performed following suspected incidents. When RWPs were implemented, the bioassay became RWP-based and anyone who entered under that RWP submitted the appropriate samples.

External Dosimetry

Line supervision had the responsibility for notifying Health Physics when employee work locations changed or new employees were hired. All employees were given film dosimeters from 1961 to 1980. From 1980 to the mid-1990s, all employees had a thermoluminescent dosimeter (TLD). In the mid-1990s, TLD issuance was reduced to include only those workers with a need to access radiological areas, including radioactive material areas.

Currently, the RWP prescribes the dosimeter to be used. Additional information may also be available in the work planning documents. Special dosimetry may have been required in some situations. For example, the disassembly of the Department of Defense reactors (e.g., Fran reactor) required additional dosimetry and radiological controls. Typically, non-routine operations require work planning. The historic Health Physics reports indicate that special evaluations were done for select jobs.

In 1947, Union Carbide Corporation became the contractor for ORNL, the Oak Ridge Gaseous Diffusion Plant (K-25), the Y-12 plant, and the Paducah Gaseous Diffusion Plant (Paducah). Processing of film badges for Union Carbide facilities was actually completed at Y-12. ORNL did have what they referred to as a "Radiation Worker dosimeter," which was assembled and processed at ORNL. Each individual facility was responsible for dosimeter distribution. From the 1980s forward, the policy was that if you were on the Y-12 payroll, Y-12 was responsible for providing personnel monitoring. The switch from film badges to TLDs was a corporate decision that affected Y-12, K-25, and ORNL. Initially, the TLD was a two-chip dosimeter; however, in 1989 a corporate decision was made to change to the four-chip dosimeter.

From 1949–1960, a small fraction of the population was monitored. These included individuals in Building 9212, chemical operators, machinists, and all other individuals working with radioactive material. Currently, there are approximately 2,500 radiological workers at Y-12. The total workforce is approximately 4,700. In the late 1980s/early 1990s, virtually everyone onsite received a film badge. Most of the construction workers were also monitored. Assignment of dosimeters to subcontract personnel and visitors was based on entry into a radiological area. In 1994, a dosimeter-needs assessment was performed. Eventually, external monitoring was discontinued for non-radiological workers.

In the past, the photo identification and associated dosimeter was worn on the collar, because the security credential had to be visible. This was even the case in Building 9206 glovebox that had their maximum exposure at waist level. One worker (not an interviewee) was exposed at the waist level to a narrow beam of radiation from a gap in his glovebox shielding. Those working in arc melting were assigned two dosimeters; one badge worn at the collar above the lead apron and the other badge worn on the torso under the lead apron. The higher of the two results was recorded in the dose of record. At least as far back as the 1950s, workers took their routine dosimeter home at the end of their shift.

Workers were later instructed to wear their dosimeter on their torso. Neutron dosimeters were to be worn on the belt or clipped to the shirt. Due to the potential for contamination, dosimeters were placed inside of a plastic baggie (“twirlie”) upon dressing out in coveralls for the radiation areas and taped to the front of the coverall. External dosimetry staff completed an analysis of the effect of this practice on the beta dose and determined the density thickness of the plastic was less than that of the coveralls (i.e., coveralls would provide beta shielding, if badge was worn under them.)

Temporary badges were issued when the routine badge was forgotten in the earlier years. When the dosimeter was coupled with the security credential, individuals were sent home to get their badge. With those workers who had both a routine and temporary dosimeter, the results were summed and recorded as the dose of record.

The original extremity dosimetry was crude and consisted of film attached to the hand with electricians tape. This type of monitoring began in the late 1940s. Chemical operators wore ring dosimeters when handling transuranics, particularly plutonium.

There have been approximately 1%–2% lost or damaged dosimeters over the past 15 years. In conditions where dosimeters are lost or damaged, external dose is calculated based on survey data and time of exposure, previous monitoring data, and/or co-worker dose. This information is documented and included in the person’s Personnel Dosimetry Record (PDR) file.

There have been no fading or other film badge response studies located by the External Dosimetry staff to date. The switch from film badges to TLDs occurred in 1980. There were performance data and comparison data on both the film and TLD programs. There were several studies completed related to the TLD response. From 1989 forward, angular response and linearity were tested and the relative impact to the dose evaluated. Fading studies were also conducted, and correction factors were considered in the dose calculation algorithm. Quality assurance shots on the TLD system were/are periodically done. Data comparing pocket ionization chamber (PIC) results and the film badge results are available in the HP progress reports back as far as 1948. The plant used stay times; however, timekeeping was not used to the knowledge of the site experts.

Neutron monitoring was assigned to individuals working around neutron generating sources and the 86" Cyclotron. In the 1980s and 1990s, workers in the UF_4 processing (fluid beds) and storage areas were monitored for neutron exposure. No positive results were observed for these individuals, so the neutron monitoring for this group was discontinued in the mid- to late-1990s.

The insensitive portion of the NTA film was evaluated to determine whether there was photon exposure detected. If the result from the insensitive film was below an established threshold (based on known neutron-to-photon ratios), the sensitive film was not processed. A zero value was recorded in this case. External dosimetry staff was not aware of a particular methodology used to determine slow neutron dose in the era when NTA film was used. Historically, beta/gamma dosimeter results less than the minimum detectable dose results were recorded as zero. Null values, which occur in some records, indicate that the dosimeter was not read. Currently, if an individual is not monitored (i.e., no dosimeter number), there is an absence of records in the dosimetry records

The area dosimetry program was initiated in the 1980s. Dosimeters were collocated with air samplers. The current area dosimetry program was implemented in the mid-1990s to come into compliance with the DOE *Radiological Control Manual* requirements. Reports are issued and data was/is used for trending. If there is an increase in the trend, this may have been the result in additional radiological controls and external monitoring. The location of the earlier area dosimetry records is not known.

Internal Dosimetry

The internal monitoring during the TEC period of operations (1943-1947) included uranium urine tests and blood tests for uranium. From the 1950s onward, the plant had uranium urinalysis capabilities. Initially, internal monitoring for uranium was based on job evaluations, potential for uptake, and hands-on work with radioactive material. Air samples and bioassay trends were observed to evaluate potential updates to bioassay requirements for particular areas. The supervisor was responsible for notifying HP of job changes.

Beginning in 2000, the RWP was used for determining bioassay requirements. For insoluble uranium (Buildings 9215 O-wing, 9215 M-wing, 9212 E-wing, 9201-5, 9201-5N, and machine shops), the frequency of the bioassay depends on the type of RWP an individual is working under. Each RWP had a bioassay indicator code to determine the type and frequency of samples. For example, an F RWP required the individual to submit paired urine and fecal samples bimonthly. With a Y RWP, the individual submits quarterly urine samples. This type of sampling was/is routinely evaluated to determine whether frequencies require adjustments.

Bioassay monitoring for radionuclides other than uranium has historically been based on the relative ratio of the particular radionuclide to the uranium. Y-12 implemented bioassay techniques for plutonium and other radionuclides at least as early as the 1980s. Prior to this, ORNL provided these bioassay services.

Y-12 evaluated the potential dose from trace materials in recycled uranium. Although there was no significant dose contribution from incoming material (i.e., <10% of the internal dose), the raffinates were of concern as the trace materials were concentrated in this form. Neptunium-237 was/is a primary contaminant in the raffinate stream. There are currently 2–3 site RWPs that required neptunium bioassay out of hundreds of RWPs issued.

There was a set of Y-12 workers on loan to ORNL who worked on a plutonium project. ORNL provided plutonium and strontium analysis in the early to mid-1950s in support of this project. These results were provided to Y-12 for dose calculations and placed in the individual's PDR file.

Tritium monitoring was limited to a few individuals. Gas House (Heavy Water Conversion) personnel had been monitoring for tritium in the past. Tritium surveys were also performed in this area to track contamination. There were some areas, such as disassembly, where field instruments are used to monitor airborne tritium levels (e.g., Building 9204-2E). Field instruments monitoring for airborne tritium levels was discontinued and is no longer done. Site experts are not aware of the presence of tritides at the site.

Since the mid-1990s, the worker monitoring (i.e., dosimetry and bioassay) has been based on the requirements of the RWP for the particulate area. Bioassay frequency is based on the solubility class of the radioactive material. It may also be required for a particular job. In general, the monitoring frequencies varied from monthly to annually. Site experts canvassed indicated that personnel monitoring criteria have changed over time.

The criteria used to determine who was placed on what bioassay program also have varied over time. Lung counts were once performed on at least an annual basis. Additional lung counts were performed in the case of an incident. In-vivo counting was the chosen method for thorium monitoring. Fecal sampling was historically used as a special bioassay method, and was not performed routinely. There were hundreds of thousands of urine samples taken at Y-12 prior to the 1980s, as those individuals working directly with radioactive materials were on a weekly urine sample frequency. This can be demonstrated with a review of the data.

Some support workers (e.g., janitors and maintenance workers) were not monitored via urinalysis or lung counts, even though they serviced and cleaned production areas in Buildings 9206, 9212, and other areas of the plant. Some site experts noted that random urinalysis was performed in some of the shops before the 1980s. Many support workers did not recollect being put on a routine monitoring program and did not routinely submit samples prior to the implementation of the RWP method for determining bioassay.

Currently, internal monitoring is specified in the RWP. Routine monitoring may include lung count, urinalysis, or fecal analysis. Fecal analysis was initiated in August 1998. The routine fecal sampling frequency at Y-12 is bi-monthly and is triggered based on RWPs. The worker is provided with a due date for the sample. When the RWP required a fecal sample, the worker received a card requesting the sample. The card may have been received a month after the job was completed. Since some fecal samples are not provided until weeks after the potential exposure, some workers question the meaningfulness of the sample. Health Physics has indicated that the sensitivity of the fecal sampling program has been evaluated and is well documented. There are fewer lung counts than in the past. In-vivo counts are based on a rolling 12-month average of bioassay participants' samples. Those with the highest average are counted first. Some individuals (e.g., janitors and security) no longer receive routine lung counts as they did in the past. They are not seen as key to production. Some production staff (e.g., chemical operators, casting workers, enriched uranium workers) who routinely work with radioactive materials are required to submit monthly urine samples and to have quarterly lung counts. Fecal sampling and lung counts are common for individuals working with Class Y uranium.

During the process of plating parts with black uranium oxide (referred to as "black oxide"), "boiling" of the black oxide solution gave off considerable fumes. Currently, personal air monitors are used around black oxide operations in addition to fecal and urine bioassay. The shift to fecal and urine analysis from exclusively urine analysis occurred in 1998, when it was determined that urinalysis was insensitive to the insolubility of the high-fired oxides. Prior to 1990s, if there was an incident, the worker got a lung count. In Building 9212 E-wing, 40–50 workers were routinely exposed to high-fired (black) oxides.

In the late 1950s, the Monday morning spot sampling technique was implemented for urine bioassay sampling. Workers were told to report to a sampling station after the weekend (any two consecutive days off) and leave a sample. In October 1989, the site switched to 24-hour sampling. Bioassay kits were taken home and brought back to work when completed, helping to minimize tampering and cross-contamination of samples.

In-vivo counting was fairly accurate in measuring natural, depleted, and enriched uranium. Original counters were NaI detectors. The top five intakes at Y-12 were discovered via in-vivo counting due to the insolubility of the compound. In 1992, the site switched to germanium detectors. Information from in-vivo counting was provided to Internal Dosimetry for dose evaluation.

With the use of well-water sampling, food study information, and a review of ^{238}U concentrations in unexposed worker samples, a natural uranium background has been determined. Natural background uranium typically has a ^{234}U to ^{238}U ratio of 1:1. Enriched and depleted uranium have ratios of 3:1 and 0.9:1, respectively. For results above the detection limit, the ratio of ^{234}U to ^{238}U is evaluated. A ratio of greater than 1:1 is considered enriched uranium and a ratio of less than 1:1 is considered depleted uranium. This value is used in internal dose calculations.

Dose calculations at Y-12 were based on personnel monitoring data (i.e., urinalysis, fecal sampling, in-vivo counting). There are a few isolated cases where air monitoring was used to determine internal dose. Default internal dosimetry assumptions have changed over time. Inhalation was the default mode of intake. During 1989 to 1994, the default assumptions were "Q" Class material (90% Super-W/10%Y), 8 micron particle size, and a chronic exposure scenario. Class Q was a default assumption for select areas. The "Q" solubility class was originally discovered by early HP staff at Y-12. They observed an effective biological half-life in the lungs of 120 days. Class Super-W is a modification of Class W that increases the half-time in the lung from 50 to 120 days. The basis for the 8 micron particle size assumption was a particle size study completed in 9212 E-wing. The study indicated the average particle size was 8 micron. There were also earlier particle size studies at the plant. From 1995 to 1997 during the plant standdown, an acute exposure with midpoint was assumed. In 1997, the default particle size was changed to 1 micron (i.e., ICRP default). In August 1998, the default assumptions were changed to solubility class based on work area. Both acute and chronic exposures were considered based on bioassay data. In 2000, the site issued an exemption request to 10 CFR 835, *Occupational Radiation Protection*, to allow the use of the *Human Respiratory Tract Model for Radiation Protection* (ICRP 66) lung model in internal dose calculations. The current Y-12 internal dosimetry TBD provides information on potential missed dose based on derived investigation level intakes.

The practice for closing out doses each year and reporting them to the DOE Radiation Exposure Monitoring System (REMS) repository was the responsibility of the facility that monitored the individual last. Several sites could calculate the dose during the year if an individual moved between sites, but only one site reported the individual's dose.

Historically, the areas with the greatest number of intakes were the chemical processing areas, Building 9212 E-wing operations, and casting. These individuals had more hands-on contact with radioactive material. Building 9215 M-wing tended to be a radiological "hot" area.

In the past, internal dosimetry procedures were often documented in the HP reports. Dosimetry personnel determined the need for special bioassay sampling and work restrictions. Individuals were, in some cases, excluded from operations (given "cooling off" periods) when their whole-body count, urinalysis, or fecal analysis results exceeded a pre-established value. Currently, special bioassay samples for insoluble material generally include both urine and fecal samples. For fecal samples, one sample is taken right away and another a week later. For incidents involving soluble uranium, only urine samples are collected. Special sampling is done in the case of an incident (e.g., spill).

There have been comparisons between various types of bioassay and field data at Y-12. For example, a comparison was done between urine data and air sampling data. The dose calculated based on urine data exceeded that calculated from air sampling data.

Air Sampling

There have been fixed-head air samplers, breathing zone samplers, and continuous air monitors (CAMs) at Y-12. Y-12 had an extensive fixed-air head sampling program throughout the plant. The samplers were placed 6.2 feet above the ground. Air sampling placement has stayed consistent since at least 1969. In the 1960s, the air sampling equipment was modified to use punch cards with filters. The filters were mounted on the punch cards. During air sample exchange, the punch cards were simply exchanged, making the job more efficient. Whatman 41 filters were primarily used for air sampling. In a few cases, Millipore samples were used for low-volume air sampling. Once the punch cards with filters were collected, they were merely fed through the counter. Each sampling location was assigned a specific code. The digits indicated the operation, department, and area within a department. Fixed-head air sample results were used to categorize airborne radioactivity areas, identify personnel protective equipment, provide first indication of potential intakes, and provide trending for air concentration levels. Currently, a concentration greater than 0.38 derived air concentration (DAC) requires the use of a respirator.

There was limited testing of CAMs as early as 1992. CAM use was implemented relatively recently (in 1994). A small breathing zone (BZ) air sampling program was established in 1989 for a period of 1 year. A full-fledged BZ air sampling program was established in 1998. There are currently between 20–30 CAMs used today. Along with the initiation of the BZ program, DAC-hour tracking was started. This data is used as a trigger to determine special bioassay (>20 DAC-hours) and appropriateness of respiratory protection.

Flow meters, used in air sampling, were calibrated monthly, and typical flow rates are 17 liters/minute. Air samples were counted initially and after a period of decay. There were areas with elevated levels of radon and thoron in the workplace; however, this was typically associated with background. There was no occupational dose calculation done for exposure to radon or thoron. Further information on radon and thoron concentrations can be obtained from a study that was completed by Y-12 Health Physics Services to evaluate radon and thoron concentrations in the workplace.

There have been a few comparison studies between fixed-head air sampling and breathing zone sampling. One study indicated that the BZ results were 4–10 times higher, depending on the operation. A later study showed a difference of 10 or more, with the breathing zone sample being higher.

Contamination Control

The radiation protection program implemented and enforced at Y-12 prior to the mid-1980s was not as comprehensive as the current program. A number of issues existed prior to the mid-1980s, which would not be tolerated by today's standards.

- Gross contamination throughout plant areas
- No Personal Protective Equipment (PPE) other than gloves

- No formal respiratory protection program
- No As Low As Reasonably Achievable (ALARA) program
- Eating, drinking, smoking permitted in highly contaminated areas
- No radiation safety training (other than criticality)

Management seemed to be more concerned about criticality safety and production, rather than radiation protection. In the areas where enriched uranium was handled, criticality safety was a significant concern. High Efficiency Particulate Air (HEPA) filters were watched carefully to ensure that concentrations did not create criticality safety issues. As a result of the concern for preventing criticality accidents, there were a number of analyses run by the safety department, even for simple operations.

There was gross contamination in some areas of production. One janitor reported wearing a respirator just to sweep the steps in Building 9212 used by workers on their way to the local break room. Initially, respirators were not provided for this task. In general, contamination control for production workers prior to the mid- to late-1980s consisted of changing into coveralls and work shoes prior to entering operations areas; however, the change houses were not in the immediate operations area. Some workers were provided work gloves. When workers exited radiological areas, showers were taken and work clothes left behind. Although there were showers available, they were not required. Production workers were not concerned about taking contamination home.

Managers, inspectors, and some support personnel (e.g., health physics technicians, security guards, engineering) wore their street clothes and shoes into radiation areas at the plant (sometimes with lab coats) and went home that way. Contamination control was such that material could be transferred home if personnel did not change their shoes. This was the case with support personnel who were not provided company shoes and who did not wear shoe covers. Periodically, personal vehicles were checked and sometimes found to contain contamination.

The understood rule of thumb for Y-12 technicians was that “people were not surveyed.” The exceptions to this rule were when spills or accidents occurred. The first personnel contamination monitoring was done with portable alpha detectors, and was initiated in Building 9212 in about 1989. When personnel contamination monitoring was first implemented, the instruments were put in the operating areas. The corrosive atmosphere of the operating areas caused instruments to fail. Health Physics eventually managed to move the personnel contamination monitors to the change houses. At this point, a clean side versus a potentially contaminated side was established. Finally, the equipment was moved near the production building exits. No egress monitoring (i.e., use of automated personal contamination monitors) was implemented at exit points of change rooms or main gates until the 1990s. PCM-1B and PCM-2s replaced manual frisking in the mid-1990s. In about 1989, the personnel contamination limit was 15,000 dpm/100 cm^2 alpha. In the early 1990s, this was eventually reduced to 5,000 dpm/100 cm^2 alpha. This contamination limit has been used since then. The transuranic areas have a lower contamination limit.

Beginning in the early 1990s, Y-12 began tracking entries into radiological areas. There were approximately 1,000,000 exits per year (multiple exits per person) from radiological areas. At times, radioactive material was tracked out of the immediate production area.

Prior to 1990, it was common to eat, smoke, drink or chew gum in contaminated plant areas. For example, the Building 9204-4 lunch room was within 20 feet of a large metal press where depleted and highly enriched uranium were pressed. In Building 9215, the break room was on the other side of a sheet metal wall near an area handling enriched parts. Although there was an island in the production area for consuming food and drink, some employees kept their coffee and food in the immediate work area. Machinists were almost “chained” to their machines, in that they could not leave for even lunch or coffee breaks (even the restrooms were nearby). Security guards remember seeing visible black powder on food eaten by machinists.

Management told workers not to worry about contamination and to take coffee back to their lathes and grinders. In fact, drinking large volumes of coffee and other liquids was said to be good for “cleaning out” soluble uranium. Managers insisted at the time that “uranium won’t hurt you.” The Building 9206 break room was closed a number of times due to elevated contamination. The Building 9206 change room had high contamination readings. In the Building 9215 break room, the seats had to be replaced because of fixed contamination. Individuals were not required to change and shower prior to entering break rooms or the cafeteria. In the late 1980s, individuals were directed to wash their hands prior to eating, and not to eat, drink or smoke in the production areas.

The system developed for technical smears was similar to that used for air sampling. Cards were used in place of filter paper. A smear machine was developed to control the smeared area to 100 cm^2. The cards were then counted. Some site experts indicated that prior to 1985, workers would accompany radiological technicians doing smear samples to measure removable contamination on equipment designated for outside sales. The workers would “acid wash” the location prior to the smear being taken. Others indicated that general areas were sometimes mopped prior to contamination surveys.

Prior to modern posting requirements, Y-12 used two types of postings; (1) Regulated Area and (2) Contamination Control Zone. In Building 9201, radiation areas were roped off, but unbadged workers were still permitted to enter. New workers could observe activities in controlled areas and still not be badged unless they directly handled radioactive material. Personnel not handling radioactive material were not considered radiation workers subject to badging. Anybody who came onsite within the production areas could move freely about, even in street clothes. Even Building 9215 M-wing was not zoned and restricted until the 1970s. Health Physics personnel interviewed indicated that the criteria for personnel monitoring was/is well documented, and that non-radiation workers were badged.

The engineering controls at Y-12 were established not only to protect workers from radiation, but also from chemicals. Engineering controls included hoods (sliding and open bay), gloveboxes, ventilation, and use of negative pressure. With the machining operations, each machine had an exhaust system and coolant was used on the material to reduce airborne suspension. In the mid- to late-1980s, area monitors were installed on the production line machines. There was a lack of suitable engineering controls by today's standards.

High volume air sampling was performed in parts of plant; however, workers understood that when results came back with elevated readings, these were attributed to elevated "radon" from the bricks in the building. Air samplers were not operative at a number of interior plant building locations for considerable periods of time before the 1980s.

A small BZ air monitoring program was implemented in 1989. Once a month, workers were selected in certain production areas to wear lapel air samplers for measuring BZ air concentrations. One worker remarked that it seemed to him that the BZ sampler was always given to the "cleanest" worker, i.e., the one with the least likelihood of high airborne readings, because elevated levels above certain criteria could shut a particular job down. A full-fledged BZ program was implemented in 1998.

Little radiation work planning was conducted before the 1990s; "you just went where you needed to." Also, no radiation protection training was provided. The RWP program began in 1995. From 1990 to 1995, there was a more casual RWP program. Work controls prior to 1990 were based on informal communications between HP and the production supervisors. Health Physics would notify production supervision about what personnel protective equipment (PPE), including respirators, were to be worn for a particular job. The supervisor was then to pass on these requirements to the workers performing the task. Maintenance activities were often done "off-shift" with little supervision and adherence to procedures.

There are major differences in the level of PPE required historically versus currently. For example, in an area requiring no PPE in the past, full-face respirators, booties, and anti-contamination clothing (anti C's) are worn. ALARA was not implemented for uranium operations until the late-1980s. There was welding of highly enriched uranium metal components without respirators in Building 9206. Machinists handling thorium did not take any special precautions when grinding and shaping thorium metal.

Workers had respirators in the mid- to late-1980s, but there were no requirements for their use during the Union Carbide tenure as operating contractor. At the discretion of the worker, they could carry respirators and don them if they felt conditions warranted additional protection. However, workers indicated that filter cartridges were often reused and stored in contaminated areas. Management would joke that "it was just a little dust; it will choke you first." Each worker was assigned a single respirator. The individuals were responsible for cleaning them. Respirators were stored in an individual's office or a cubicle. This was the practice until the mid-1980s. Following a DOE audit by headquarters, the site went to a single-use policy. Y-12 was accused of using people as the controls by relying on bioassay limits.

In Building 9206, before the 1970s or early 1980s, there were no scrubbers on the stacks or exhausts; highly radioactive dust and fumes were being released, and workers were being contaminated at high levels when they had to work on building roofs doing routine maintenance.

Plating ships in Buildings 9206 and 9212 would likely have had the “hottest” radiological releases.

In September 1994, Y-12 was shut down because of violations with DOE safety requirements. This shutdown instigated major cultural changes in radiation protection practices at the plant. For example, eating, drinking, and smoking were finally prohibited in radiation areas. Another big change is that there are now formal operating procedures, as compared to the “seat-of-the-pants” approaches followed before. On the downside, there were a lot of contamination incidents experienced following the 1998 shutdown.

Radiation Generating Devices

Radiation generating devices (RGDs) were commonly used at the Y-12 plant for nondestructive testing of weapons components. There were both stationary and portable units. Radiation generating devices used at Y-12 included a Van de Graff generator, a 14 Mev Linac, ^{60}Co sources, a ^{252}Cf source, electron beam welders, and x-ray units. These units were located in Buildings 9204-2E, 9203, 9204-4, 9201-5, 9980, and 9981. One ^{60}Co source (5–7 Curies) was nicknamed the "casket." A bare ^{210}Po source was received onsite at one point. An individual accidentally stepped on the source, causing a substantial spread of ^{210}Po to the surrounding area.

Incidents/Occurrences

Incident reporting and documentation were not consistent through the years of operation at Y-12. Prior to the early-1990s, there was no formal process for documenting incidents as there is today. Line supervision was responsible for notifying Health Physics when an incident occurred. If an incident was significant, such as one resulting in significant personnel exposure, a summary report or correspondence was generated. The threshold for this type of incident reporting was a judgment call. The HP group also kept daily logs of radiological control activities. Items were provided to management as a part of a weekly report. These were consolidated into monthly and later quarterly reports. Monthly meetings were held and average air sample and survey results were discussed. These reports and meetings were also a mechanism for documenting incidents. For those incidents involving classified information, there is likely a classified and unclassified version of the report. The Radiological Records Center at Y-12 has incident reports and work restrictions by date going back to the 1950s.

With the implementation of DOE occurrence reporting, a formal process was implemented. Currently, Radiological Control has an incident investigation procedure. Derived Air Concentration (DAC)-hour tracking, bioassay, and dosimetry are used as triggers for incidents. Personnel contamination > 5,000 dpm/100 cm^2 triggers a Personnel Contamination Report. Contamination > 50,000 dpm/100cm^2 triggers occurrence reporting. An incident form is filled out by field radiological control staff. The field RadCon is responsible for determining who was involved and what occurred. Given this information and other field monitoring information, the internal dosimetry staff determines if special bioassay sampling is necessary.

There is a Dosimetry Investigation Database that allows for tracking and trending of incidents. The environmental group also maintains a database of spills. Currently, incident identification numbers are assigned to incidents with an extension for each individual involved.

There were a number of major and minor incidents specifically mentioned by site experts:

- Uranium chip fires
- Elephant Snout (vacuum) rupture involving molten UF_4.
- Criticality accident
- Process material spills and leaks

Uranium metal "chip fires" were common in Building 9215 and in depleted and enriched uranium metal processing areas. The frequency was as high as 2–3 times per shift and would range from small flare-ups to large fires that would engulf machines. The final stage of HEU machining—fine machining—presented the largest fire hazard. Machinists were regularly exposed to uranium fire fumes and were expected to douse the fires themselves. Not all the uranium chip fires were formally documented. Health Physics would take a high-volume air sample after the fact. If the air count was high, there may have been a letter issued.

In Building 9212 during the time period 1985–1993, Y-12 experienced "contained releases" of highly enriched uranium solutions in acid, which were cleaned up with mops wielded by workers. Leakage from interior process piping was common. During routine tours of Building 9212 B-wing, guards reported seeing "green sludge" leaking from overhead pipes. Sometimes drip pans were used to collect leaking material.

During the process for conversion to UF_4, a torch was sometimes used to warm the fluid-beds. The fluid-beds had to be kept warm. The worker began using a torch to warm the bed. He stopped to take his lunch break. When he came back, he picked up the torch and began warming the fluid bed where he left off. Molten uranium sprayed all over the worker. He suffered acid burns, discoloration of his skin, and a substantial uptake of uranium. There was no personnel contamination monitoring until the Monday after the event.

There was an incident with a machinist where the "elephant snout" became plugged with a wipe. Due to the plug in the system, containment failed. This incident is referred to as the Elephant Snout incident.

Following the criticality accident in 1958, radiation monitoring was tightened considerably. Another era of tightened radiological practices was in 1985, when Union Carbide left as operating contractor.

High-Risk Jobs

There were several types of jobs that posed a higher risk to workers than others. High-risk jobs identified by RadCon include the following:

- Filter changes (internal)
- Breaking containment for systems (internal)
- Trap changes in the exhaust systems (internal)
- Other maintenance activities
- Reprocessing of material from the Savannah River Plant (external)
- Uranium-233 storage (external)

In general at Y-12, 75% of the dose came from internal exposure and 25% of the dose came from external exposure.

Radiological Instruments

Instrumentation used at the site has changed as new technology has become available. Beta/gamma survey instruments were used for the detection of depleted uranium (DU). Alpha survey instruments were used for the detection of enriched uranium (EU). The initial instruments used for radiation and contamination surveys at Y-12 were the following:

- Sampson Nuclear Chicago Non-discriminating Ion Chamber (alpha survey)
- Victoreen CDV-700 Thin Wall GM Detector (beta/gamma survey)
- Cutie Pie (CP) Ion Chamber (dose rate)
- Technical Associates Juno Discriminating Ion Chamber (alpha/beta/gamma)
- Jordan Radector Gas-Filled Ion Chamber (Emergency Kit)
- Teletector (Emergency Kit)
- Tritium Monitor (Emergency Kit)
- CP with gamma-to-neutron correction factor (neutron measurement).

The Rem Ball was introduced in the late-1970s/early 1980s for work in the B-wing with green salt. Neutron surveys were conducted in areas handling enriched uranium (e.g., Buildings 9212, 9215 M-wing, and 9215 O-wing). In the mid-1970s, the Ludlum Model 12 with air proportional probe and ZnS scintillation counters were introduced for alpha surveys. The CP was used through the late 1970s when it was replaced with the Eberline RO-2 and RO-5 ionization chambers. In the late-1970s/early 1980s, the Ludlum Model 3 with a pancake probe was introduced for beta/gamma surveys. Johnston tritium monitors were used in some areas for tritium detection. The current instruments used at Y-12 include the following:

- Ludlum Model 12 Count Ratemeter with a Ludlum Model 43-5
- Ludlum Model 12 Count Ratemeter with a Ludlum Model 43-65 (alpha)
- Ludlum 2221 with Scalar Count Ratemeter with a Ludlum Model 43-65 (alpha)
- 43-5 ZnS Scintillation Detector with alarm
- Ludlum Model 3 survey meter with a Ludlum 44-9 (alpha/beta/gamma)
- Eberline Model RO-2 ion chambers
- Ludlum 2220 Scalar Ratemeter with Ludlum Model 43-65 (alpha)
- RO-7 dose rate instrument (limited use)
- RO-20 ionization chamber

- Bicron Model Micro Rem Tissue Equivalent Rate Meter
- Ludlum Model 12-4 Count Ratemeter (Rem Ball)
- Ludlum 177-45 Alarm Ratemeter with Ludlum Model 44-9 (alpha/beta/gamma detection)
- Ludlum Model 177-45 Alarm Ratemeter with Ludlum Model 43-65 (alpha)
- Eberline Model PCM-1B Personnel Contamination Monitor
- Model PCM-2 Personnel Contamination Monitor
- Ludlum Model 2929 Dual Scalar with a Ludlum Model 43-10-1 (alpha/beta)
- Johnston Laboratories Triton Model III Tritium Air Monitor
- Automess Model 6/12 Beta Teletechtor Dose Ratemeter
- F & J Specialty Products Model HV- First High Volume Air Sampler
- SAIC Model HD-28 Low Volume Air Sampler
- Bicron Model Radiographer Dose Ratemeter
- Eberline Model Alpha-6S CAM
- Ludlum Model 239-1F Floor Monitor.

The PCM-1B personnel monitor was introduced in about 1989. Early in the 1990s, the PCM-2 was introduced. The Keithley Model 36100 Survey Meter was used after the CP was phased out, but is no longer in use. In the late-1980s/early 1990s, there was a substantial increase (i.e., approximately tenfold) in the number of radiation monitoring instruments onsite.

Instrument calibration in the early years involved a single point calibration with an electroplated or planchet source. Y-12 implemented *Radiation Protection Instrumentation Test and Calibration* (ANSI N323 – 1978) in the mid-1990s. After implementation of ANSI N323 (1978), a ^{60}Co well source was used for ionization chamber calibrations. An infinite thickness uranium source (10” x 16”x 0.25”) was used to calibrate sidewall Geiger-Mueller counters. Infinite slab uranium sources are no longer used. Neutron instrumentation was/is performance checked using an AmBe source.

Environmental Monitoring

Prior to 1983, there were large ambient air samples collected from about 10–14 samplers within the perimeter. The filter media was large (10” x 14”). In addition to ambient air sampling, HP monitored stack releases, wells (core wells), groundwater, and biota.

Depleted uranium was treated like any other metal. Billets were stored outside. At one point, RadCon observed a purplish trail leading from the DU stored outside and the drain. EU was more valuable and was stored in appropriate facilities. This material was more closely guarded. There were areas that handled residue where there were noticeable elevated levels of radon and thoron.

Y-12 had two systems for environmental monitoring. The first system was maintained by ORNL for the Oak Ridge Operations (i.e., ORNL, Y-12, and K-25). Although ORNL managed the program, both Y-12 and K-25 supported this effort financially. The results from this monitoring program are documented in the Annual Site Environmental Reports (ASER). These reports have been issued since at least the 1980s. For the National Emission Standards for Hazardous Air

Pollutants (NESHAPS) reports, the releases are modeled by valley. Offsite ambient air monitors are used to validate the model. The Y-12 valley lies between Pine Ridge and Chestnut Ridge. Environmental data from this valley includes releases from ORNL operations located on the Y-12 site. Results are segregated by valley, because the meteorological conditions are specific to the valleys. The most representative air sample location is the one at the Scarboro Community. There is a good correlation between the NESHAPS-modeled Maximum Exposed Individual (MEI) and the air sample located at the Scarboro Community, with the modeling giving a higher dose.

The second environmental monitoring system is in the perimeter air monitoring system. Originally, this system was managed by the Y-12 HP group. When the Environmental Monitoring (EM) group split from the HP group, this responsibility was transferred to EM. In 1994, the number of onsite monitors in operation was reduced from 12 to 3. At this time, Y-12 stopped operating the onsite system. There was no regulatory driver for operating these samplers, and the equipment did not meet current standards. The TDEC took control of three of the stations. Originally, the exchange rate was weekly, but TDEC changed this to bi-weekly.

There has been an established soil, groundwater, and vegetation monitoring program at the site. Liquid effluent monitoring was/is permit driven. Data from liquid effluent monitoring are also available in the ASER. A state stream runs through the plant. As a result, there are monitoring points not far removed from the worker population.

There was an extensive stack monitoring program. HEPA filters, scrubbers, and fiber filters were used to reduce air emissions. The NESHAPS reports list emission points at the site and associated controls at these emission points. Cyclones and baghouses have been less effective than HEPA filters. HEPA filters, which control environmental discharges or provide personnel protection, are tested every 18 months. There are also break-through monitors on major sources.

The State of Tennessee is responsible for authorization of air permits at the Oak Ridge Operations, including Y-12. They have control over implementation of NESHAPS for the Oak Ridge area. The Environmental Protection Agency rules have been adopted by the State unchanged. The State also has Resource Conservation and Recovery Act control. As a result of the State relationship with Y-12, information on environmental monitoring may be available through the State.

Both the NESHAPS report and ASER include routine and unplanned radiological releases. ORNL is responsible for compiling the ASER. The NESHAPS reports include information from multiple radionuclides. These reports are reservation-wide.

Miscellaneous

There were a number of unsanctioned practices that occasionally occurred related to the personnel monitoring program. Individuals would sometimes disassemble security badges to remove the criticality component, as it was made of precious metal. There is evidence that one individual was spiking his urine. The dosimetry folks were able to use air sampling data to determine that the urine results were false. This individual was fired.

As a result of the security at Y-12, all personnel and other records are screened prior to being provided to NIOSH. If there is a situation where the Mosaic Law applies, individual work history records may be sanitized. The dosimetry and medical records are left intact. There have been approximately 50 individual records sanitized prior to being provided to NIOSH. The Office of Worker Advocacy has reviewed the screening process for both Y-12 and K-25, and indicated that the process was appropriate. With respect to reports, much of the sanitizing has involved the removal of code words.

NIOSH/ORAU did contact the internal and external dosimetry staff at Y-12 during the development of the Y-12 site profile. External dosimetry had several conversations with the ORAU team, and provided data retrieval support. Internal dosimetry also provided this support; however, they were actually asked to review and comment on the internal dosimetry site profile. In their latest visit to the site, HP and EM personnel were interviewed.