ATTACHMENT 1: SUMMARY OF SITE EXPERT INTERVIEWS

Between May 21 and May 26, 2007, Kathryn Robertson-DeMers and Abe Zeitoun of SC&A interviewed 46 current and former employees of the Portsmouth Gaseous Diffusion Plant (Portsmouth). These personnel represent experience at the site ranging from 1954 to the present in the areas of production, laboratory support, maintenance, security, environmental monitoring, medical, and health physics. The purpose of these interviews was to receive first-hand accounts of past radiological control and personnel monitoring practices at Portsmouth and to better understand how operations were conducted. The EEOICPA site coordinator provided organization charts highlighted to identify individuals having 15 or more years of service. Both the United Steel Workers (USW) union and the Security Police and Fire Protection of America (SPFPA) union provided additional recommendations on individuals who had a historical knowledge of the site. Site experts selected represented a reasonable cross-section of production areas and job categories. Interviews were conducted onsite at Portsmouth, or offsite at the union halls. In addition to the interviews, the SC&A representatives received a tour of the Portsmouth site. This included a walk-through tour of Buildings 343 and 344, and a driving tour of other buildings and outside areas.

In preparation for the Portsmouth site visit, SC&A provided a list of questions to workers. Union representatives (SPFPA and USW) graciously provided replies, which are integrated into this summary. During the onsite visit, workers were briefed on the purpose of the interviews, and background on the EEOICPA dose reconstruction program and site profiles. Interviewees were asked to provide their names to facilitate follow-up questions, as needed. Onsite interviews were conducted by Q-cleared members of the SC&A team. Interview notes were screened by a classification officer before they were released to SC&A.

Former workers represented operations in the cascades (i.e., X-326, X-330, and X-333), the feed facilities (i.e., X-340, X-342, X-343, X-344), Cold Recovery (i.e., X-331), the Converter Shop (X-700), the Oxide Conversion Facility (X-705), the Process Services Laboratory, the waste management facilities, the Gaseous Centrifuge Enrichment Plant (GCEP), and Buildings X-100, X-101, X-331, X-345, X-530, X-533, X-608, X-611, X-710, X-720, X-770, X-3000, X-7721, X-7725, and X-744G. Also included were support personnel who worked throughout the site. The job responsibilities or groups represented by this summary include the following:

- Chemical Operations
- Dosimetry
- Environmental Monitoring
- Feed Withdrawal Operations
- Field Decontamination
- Field Radiological Control
- First Line Management (e.g., Foremen, Supervisors)
- GCEP Operations
- Industrial Hygiene
- Maintenance and Crafts (e.g., Converter Maintenance, Electrical Maintenance, etc.)
- Maintenance Management

- Medical
- Process Operations
- Security
- Test and Balance
- Test Inspection
- Union safety representative
- Uranium Material Handler (UMH)
- Work Control.

This report is a summary of information compiled from multiple interviews and Portsmouth site expert input. It is not a verbatim transcript of discussions. SC&A/Saliant regards site expert interviews as a valuable opportunity to gain understanding of Portsmouth operations. The recollections and statements of former workers, based entirely on personal experience and limited by the individuals' knowledge and perspective, may require further substantiation. However, they stand as critical operational feedback and reality reference checks. This interview summary is provided in that context. With the preceding qualifications in mind, this summary has contributed to issues raised in the site profile review.

Operations

The United States Enrichment Corporation (USEC) took over the operations at Portsmouth in 1993. The site remained under Department of Energy (DOE) regulation until 1997, when it was transferred to the jurisdiction of the Nuclear Regulatory Commission (NRC). DOE continues to have responsibility for remediation activities in DOE-owned areas of the site. Due to the sensitivity of operations at Portsmouth, employees were told not to discuss happenings at the site with offsite individuals.

Portsmouth was involved in a variety of activities, including uranium enrichment, oxide conversion, fluorine production, waste management, and associated support activities. The site had metric tons of highly enriched uranium (HEU) in storage; HEU was produced at Portsmouth from the 1950s to the mid-1980s. Low assay feed (<5% U-235) was shipped from Paducah to Portsmouth and to the Oak Ridge Gaseous Diffusion Plant (K-25) for further enrichment. In addition to receiving feed from domestic sources, raw feed (normal assay) was received from British Nuclear Fuels (England), France, Canada, and other domestic sources.

Enrichment took place in the cascade buildings (i.e., X-333, X-330 and X-326). The cascades are composed of compressors, converters, and motors that work together to push the uranium through the process. The X-340 Complex (X-342, X-343, and X-344) provided feed to the cascades. These buildings are also used to transfer uranium in large cylinders from the withdrawal station to smaller cylinders for shipping. Material was transported between cascade process buildings through pipes. It entered the cascade system in X-333, and enrichment would continue in Buildings X-330 and X-326, depending on the desired enrichment. The Cold Recovery function pulled off and housed gases in the Holding Drum rooms. Cold Recovery also performed freeze-out and heating of gases as needed within the cascade. The withdrawal in Building X-330 was called the Tails Withdrawal, and the withdrawal in Building X-333 was called the Low Assay Withdrawal (LAW) station. Building X-333 was allowed to enrich the uranium up to 2.3–3.0%. Building X-330 had an enrichment limit of 15% per the Safety Analysis Reports, operating procedures, and criticality safety documentation. The maximum enrichment of U-235 produced at Portsmouth was 99% U-235 during an experimental test. High assay material contained approximately 80% U-235. Very high assay material contained greater than 93% U-235. High assay product is withdrawn at the Building 326 withdrawal station, intermediate assay product at the Extended Range Process (ERP) station, and low assay material at in Building 333.

Buildings X-326 and X-330 were used for converter storage. The cascades were re-engineered in recent times to feed the high enrichment uranium backwards through the cascades to reduce the enrichment. This material was then sold on the market.

The Process Services Laboratory collected and analyzed uranium-bearing samples from the cascades. These samples included assay primarily for uranium and fluorine. The samples were taken from pre-maintenance cells, vessels, surge drums, and vent stacks. Samples were also gathered for assay in order to determine inventory of uranium within the system. When pulling samples on many occasions, the system and/ or the sample buggy would smoke, exposing workers to hydrofluoric acid (HF) and uranyl fluoride (UO_2F_2).

Radionuclide deposits would form in the process equipment when temperature and pressure controls were not correct. As material ran through system piping, stalactites and stalagmites were formed. There was a considerable quantity of hold-up in the system; particularly in Building X-326. Workers from this area have raised concerns about potential neutron exposures to workers, and potential subcriticalities and criticalities. Operators routinely checked for evidence of deposits in the process systems. The Rascal was used to detect increased gamma measurements above work area background, indicating deposits in the system. The worker would first measure background radiation levels in the process area and then set the meter to read zero at the background level. For example, if the background exposure rate was 5 mR/hour, the instrument would be adjusted so it read zero at 5 mR/hour. (To the northeast of Building X-326 was a cylinder storage yard with sufficient radiation to peg the meter. As a result, background readings were elevated above ambient background exposure rates in Building X-326.) An increase in the gamma dose rate above the general process area background was an indication of a deposit. When deposits were identified, cells were chemically treated and evacuated to surge drums. The exhaust would pass through cold traps, which would freeze out gases at different temperatures. These traps were very radioactive. Use of the Rascal meter was discontinued in about 1992.

Building X-342 was the Fluorine Production Facility and served as a temporary decontamination facility at one point. Decontamination was later moved to Building X-770 and finally to Building X-705, which housed the decontamination operation starting in 1954. Although the Oxide Conversion Process was shutdown in 1978, other activities continued in this building. Process system components were removed from the cascades and transported to the decontamination facility. The first step in the process was to decontaminate the equipment, which produced a uranium contaminated solution. Large items were sent to an automated decontamination tunnel, where the parts were sprayed with acid solutions (i.e., nitric, boric, acetic, and citric), rinsed with water, and hot-air dried. Some smaller parts were also decontaminated in the seal disassembly room. Cylinders were also cleaned in this area to remove heels. This was done in open areas until the early 1970s. After decontamination, the cleaned equipment was transferred to Building X-700, where it was refurbished as necessary.

The waste stream from the decontamination facility was processed for uranium recovery. The solutions were fed into a 5-inch column, run through a slope tank, fed through a filter, and sent to a pre-evaporator and slab scraper. The pre-evaporator made the solution thicker. This formed 2-inch slabs along the wall. Uranium was pumped through a series of solvent extraction pulse columns containing Tri-butyl phosphate (TBP), nitric acid, water, and verasole. The TBP was mixed with the material and sent through the first pulsed column. Output from the first column served as the feed material for the second pulsed column using nitric acid. When water was passed through the material, the uranium would adhere to water. This product was passed through a 5-inch column and fed to a post-evaporator to further concentrate the uranyl nitrate solution. The material remained in four storage columns until ready for subsequent steps. The uranyl nitrate solution was then sent to a drum dryer. The material was rotated and moved down a slope to a calciner. Uranium oxide (U_3O_8) powder was produced in a calciner using temperatures high enough to produce insoluble uranium oxides and, to a lesser extent, transuranics. The material was sent through a rolling mill and placed in cans. These cans had to be changed as they filled. No respiratory protection was used when filling and replacing cans. Cans were segregated by enrichment and taken to the H-Area for storage. An inventory of cans sent to H-area was maintained.

The uranium recovered from the decontamination process could be converted into feed for the cascades, as needed. When needed, the cans from recovery were retrieved and transferred to E-Area, where they were opened, weighed, sampled, and ground. The uranium-containing material was fed into the fluorination reactor (also know as the fluorination tower). Ash from the rod mill was also added. One hundred percent fluorine gas was added to react with the uranium oxide to form UF_6. The gas was transferred into cylinders until the cylinder reached the appropriate weight. This then served as feed for the cascades.

In Building 705–E Area, where the oxide conversion process was done, drums were filled with sludge from the process and stored. The sludge had a consistency similar to hand cream. A Chemical Operator opened the drum and guards stirred the contents of the barrel. This stirring process was done to identify any Special Nuclear Material (SNM) contained in the sludge to prevent inappropriate diversion of HEU from the facility. Gloves were the only Personal Protective Equipment (PPE) worn during this task. This process was stopped shortly after the shutdown of processing.

There was a burn furnace to the east side of X-705, which was used to burn contaminated material. It was shutdown and eventually demolished.

The first part of the Cascade Improvement Program (CIP)/Cascade Upgrade Program (CUP) began in 1973. Almost 200 welders were hired to facilitate the removal and replacement of process equipment. A large percentage of the Portsmouth worker population was exposed to contamination and airborne smoke produced during CIP/CUP. No respiratory protection or dust masks were worn, even during invasive tasks, such as sweeping out cells. Employees were practically working on top of each other. They complained of coughing up powder and/or blowing powder out of their noses.

A smelter was operated in X-744G from 1961–1983. It was used to recover aluminum and form it into ingots. There was limited contamination associated with this operation. There was also a semi-precious metal yard where recovered metals were stored. Some aluminum ingots were sold to industry for commercial use.

X-770 was the Test Loop Facility, which was involved in cascade testing. Material was piped into this facility from Building X-326. Uranium Hexafluoride (UF_6) was pulled from the production area to conduct troubleshooting of the cascade system. This building was one of the worst onsite and had transuranic contamination.

The Gaseous Centrifuge Enrichment Plant (GCEP) was built to supplement the existing gaseous diffusion process. The original design included a series of eight buildings. The system worked better than expected, but was eventually shutdown and not pursued by DOE. Virgin feed was sent through the gas centrifuge while it was operating.

Maintenance workers entered areas of the process and other buildings that were normally not occupied. Confined spaces entries were made into the cell housing, pipe galleries, and even the piping itself. Prior to opening process equipment, cells were taken offline and process gas was evacuated to downstream cells and/or surge drums. Process gas had to be evacuated and the equipment purged to establish a negative pressure. Cells were purged with dry air or nitrogen. The cell was then raised to atmospheric pressure and the system could be opened. When a compressor debladed, an individual would be sent into the piping to recover pieces and perform repairs. Some material would deposit in or near the flange face in the converter. Workers were not required to take their badges with them when they performed this task. A majority of welding and maintenance was done without a respirator, except when process equipment was cut out or when there was potential exposure to nickel.

Some of the other buildings at Portsmouth where site experts worked are described below:

Building	Description	Comments
X-206E	Cylinder Storage Yard	Became a parking lot
X-22070	Cylinder Storage Yard	
X-700	Converter Shop	Housed a Refurbishment Shop
X-7725	Resource Conservation and Recovery (RCRA) Material Storage	Waste Management area
600 Series	Utilities	
X-611	Water Treatment Facility	
500 Series	Power Generation	
X-720	Standards Room/Calibration Facility	

Job Responsibilities

Production Process Operations was responsible for maintaining equipment pressure and temperature in the cascades, for troubleshooting systems for leaks, and for maintaining the Freon system and operating the three withdrawal stations. This also required preparing equipment for maintenance and performing post-maintenance testing.

Chemical Process Operations varied, but included the following:

- Decontamination of equipment after completion of maintenance operations in the cascades
- Decontamination of parts, recovery of solutions, and biodenitrofication in Building X-705
- Operating the X-342 and X-343 facilities

Maintenance was actively involved in repair and mechanical teardown of equipment, including converters, which posed an exposure potential. Maintenance was also responsible for the support facilities, such as the utility systems and chemical feed systems. Facilities Management was responsible for preparing equipment for maintenance. Initially, converters were removed from their cell housing for repairs. Starting in the late 1990s, repairs were done with the converter in place. Building X-700 housed a Converter Shop where equipment was repaired, including internal components. The Instrument Shop (containing sources), Weld Shop (gas welding operations), and open dip tanks (solvent cleaning) were also located in this area. Mercury fumes were of particular concern around the dip tanks.

Building X-720 was used for equipment preparation, refurbishment, repair, and re-assembly. Equipment was cleaned and decontaminated prior to going to this shop. There was a machine shop that ran for two shifts per day. This shop was responsible for fabricating components from alloys, such as aluminum and steel. No radioactive material was intentionally brought to this shop; however, there was fixed contamination on the component and internally contaminated components. Activities conducted in this area caused the fixed contamination to become dislodged and potentially resuspended.

Electrical Maintenance was responsible for conducting electrical work in support of the cascade buildings and the plant control buildings. Mechanical Maintenance maintained the utility systems in the cascades. They also assisted in removing and repairing cell equipment.

Instrument Mechanics were primarily responsible for troubleshooting and performing maintenance on instruments and electronics. This included maintenance of radiation safety monitoring equipment and criticality alarm systems.

Uranium Material Handlers (UMH) are responsible for moving all uranium-bearing containers onsite. Uranium is withdrawn from the cascade and transferred to a customer cylinder for offsite shipment as necessary. UMHs are also responsible for shipping and receiving in support of the Tc-99 removal program. Most UMH activities occurred within the X-342, X-343, and X-344 facilities.

Workforce movement was variable at the Portsmouth site. Maintenance and other crafts (e.g., janitors) could be housed in a particular building or assigned tasks which took them site wide.

Seniority had an influence on the maintenance assignments. Some employees maintained stable positions, while others moved from job to job. During certain periods of time, the general trend favored subcontractors, rather than relying on experienced union workers. There was a reduction in force in 1983 for 4 months and in 1985 for several months. Approximately 1,000 employees were laid off in 1985. Many of these employees were recalled after 1 to 2 years. Especially during layoff periods, many workers changed job classifications in order to stay employed; such workers may have held multiple jobs (different classifications) during their years of employment. Job functions could also vary within a single classification. For example, a worker with a maintenance classification may work in a non-radiological area one day and in a radiological area on another day. Some classifications were formally assigned to a non-radiation area or building, but performed job functions in a radiological area outside of their assigned building. NIOSH identified such workforce movement in their mortality study as a deficiency in determining occupational illness.

The Portsmouth plant ran 24 hours per day, 7 days per week. Overtime varied by job assignment and time frame. It was generally optional for union employees, and was very common. Many of the operators and maintenance crafts would more than double their wages for the year, due to the large amount of overtime. Some worker classifications worked less overtime; one site expert indicated that he worked 2–5 double shifts per month. Some site experts indicated they worked 60 hours per week routinely. Overtime was limited to a predetermined number of hours once the NRC took over.

Site Security

SPFPA Local 66 has a long history at Portsmouth, starting with the first bargaining unit contract on July 11, 1955. Historically, the local union has been responsible for all physical security operations at the entire site since its inception, including the protection of HEU to Low Enriched Uranium (LEU) and all SNM.

Security has worked under Goodyear Atomic, Martin Marietta, Lockheed Martin, and USEC. Currently, Security employees are regulated by the DOE, through the “Arming and Arrest Authority Security Plan,” and the NRC. The DOE and the NRC work in conjunction with each other depending on the location of the security interest within the site. It can get somewhat complicated to determine which regulator actually has the oversight; much depends on what each local contractor is responsible for and is actually licensed to do. The hourly bargaining unit is contracted through USEC; they are contracted across the site for both DOE and NRC interests.

It was emphasized by interviewees that uniformed officers have performed security functions in **every** building and in **every room** of every building. The vast majority of security tasks involve protection of radioactive material, both SNM/HEU and LEU. Due to the nature of their work, officers were not denied access to any area on plant site. In some areas involving production capabilities, officers were charged with the ingress and egress of the rest of the facility’s workforce in a 24/7 operation. Operations performed by officers included hands on work (e.g., manually locking devices on material containers). Because they had access to all buildings, they believe they were exposed to all forms of uranium and chemicals.

Uniformed officers have one function at the Portsmouth Site with regards to radioactive materials and the related process. They historically protected all materials on site with the presence of physical security assets. They were responsible for accompanying SNM from one area of the site to another. Material was transported onsite in a vehicle referred to as the Blue Goose. This vehicle had two seats in the front plus a jump seat where Security sat. The jump seat was adjacent to the caged area that held the cylinders in racks. Cylinders (5-inch, with HEU) were packed into the back of the Blue Goose. While guarding the material, Security personnel could be within 4 inches of the cylinder. They had to be within 1 to 2 feet of the cylinders. They were required to stay with the material from the time the first cylinder was loaded to the time the last cylinder was removed. In fact, security assisted in loading 5-inch cylinders into the vehicle. As the Blue Goose passed through portals, it would set off the criticality alarm. Questions were raised regarding the potential exposure of the guards who were required to stay with the material, sometimes for hours. Industrial Hygiene and Health Physics (IHHP) came and conducted a contamination survey of the vehicle, based on the safety concerns. No contamination was found. Dose rate surveys were not conducted, although this type of survey was requested by the Security union. Material escort responsibilities primarily happened during 8- or 12-hour dayshift operations. Actual amounts of time varied with the size of shipments and enrichment levels.

Security had involvement in processing incoming and outgoing shipments. They were intricately involved in the shipment of HEU, LEU, and SNM. Uniformed officers, both salary and hourly, worked on a 24 hours a day, 7 days per week basis around material at this facility. Within this scope of work were responsibilities for shipment/transportation of HEU, LEU, and SNM. Also, after the HEU Suspension Program was completed in 1999, the local bargaining unit suffered a 70% loss in manpower that was associated with the removal of HEU and SNM at Portsmouth. It is accurate to say that at least 70% of the work was associated with HEU/SNM on a 24 hours per day, 7 days per week basis.

Shipments were brought into Portsmouth via railcar or truck. When shipments were received via railcar, personnel were required to examine the shipments. Portsmouth was a safe domain (i.e., authorized rest stop) for couriers transporting SNM across the complex. The transport vehicles were not opened unless the delivery was specifically for the Portsmouth site.

Support was continually provided for vault areas 24/7 outside and inside the vaults. It was mandated to exert extreme control of SNM vaults and their contents, to include the use of deadly force; SNM was never left unprotected. Again, it breaks down to about 70% of the time in conjunction with SNM/HEU. SNM/HEU was maintained in a variety of metallic cylinders. SNM/HEU areas required a 2-man rule. Officers assumed the responsibility for these materials during alternate and back shifts. Vaults were inventoried and alarm systems were checked over a wide area of the facility. There were areas where only specific workers were allowed. Access was based on a need to know system. The Classified Burial Yard (X-749A) required 24/7 coverage by Security when it was open.

Security escorted visitors in areas where SNM/HEU was present. Alternatively, officers were responsible for assuring that assigned escorts were actually staying within sight and sound of the visitors. In the past, radiological or contamination areas were often not marked, so there is no doubt that visitors did move through radiological areas and contamination zones.

Officers rotated through duty stations twice a week, although they were allowed to trade duty stations with others. There were some officers who liked to be assigned to a particular building or area. Duty stations included work in Buildings X-326, X-330, X-333, the 340 complex, X-345, X-744G, X-705, and X-770, to name a few. Prior to the 1990s, job training was limited. For example, after a guard trainee had rotated through all tours once with a senior guard, he/she was considered fully trained.

Scheduled shifts changed about 50% of the time from 42.5 hours per week (under an 8-hour shift scenario) to 62.5 hours per week (under a 12-hour shift scenario). Voluntary and/or mandatory overtime could occur in any job; overtime was influenced by considerations such as seniority, qualifications, and an overtime tracking board. Within the Protective Force Operations, uniformed officers worked extremely high numbers of overtime hours; this should be documented through payroll records. It was not uncommon for officers to work 12- to 16-hour shifts. Overtime rates, according to some of the officers interviewed, have not been taken into consideration for dose reconstruction efforts by NIOSH. By comparison to other trades on site, the overtime rate is extreme.

Security personnel participated in onsite training exercises throughout the facility. Officers worked and trained inside, outside, on top of, or beside every vault and cylinder associated with HEU/SNM, and within every cylinder and cylinder yard with respect to LEU. They trained on every rooftop and patrolled every rooftop, even while chemicals were vented; they were continually assured that the areas were safe. Officers routinely traveled the tunnel systems and checked alarms under every process building within the system. In short, officers were continually in contact with material areas, except when assigned to a perimeter fence job/task associated with the shift change and the daily operation of the plant's employee population (i.e., portal operations). These facility venues continue to be patrolled today by uniformed officers, both hourly and salaried; in the DOE era, such patrol staff were routinely trained in these locations in order to pass the various audits performed by the DOE. Exercises and training amount to basically the same thing. Such exercises occurred on at least a weekly basis. Official exercises were closely scrutinized by security specialists, but with little regard to radiological areas and contamination zones (since none were really identified). In order to maintain their physical aptitude, the company maintained a running track for security staff in Building 330.

Security personnel visited DOE sites throughout the complex for training and to provide supplemental forces during anti-nuclear demonstrations or security shortages at other sites. For example, some staff supported efforts at the Rocky Flats Plant during the strike. In Oak Ridge and Albuquerque, personnel participated in exercises and certification training. The Nevada Test Site was also specifically mentioned as a site visited by security staff. Time elements would vary depending on problems encountered and the scope of the mission. Several weeks would not be uncommon. This involved both hourly and salaried workers.

It would be possible for some guards to receive more exposure than others, but it seems unlikely that the differences would be very great; at one time or another, all guards did the same work.

All officers were engaged in protecting SNM/HEU and LEU. There is some question as to training in the X-770 Building, which was a test loop for the cascade. Special Response Team (SRT) members did more training in this facility. However, during force-on-force training/testing, all members of the uniformed force were involved in this facility. SRT also used the building for tactical training. The issue of training and exercises actually go hand-in-hand, since extensive training drills were needed to prepare for official security "exercises" and audits by DOE. Uniformed officers often use the term "exercises" in reference to training events, as well as inspection/audit events. The various buildings on site were all used to perform training or exercises, due to their unique characteristics, and each posed its own set of hazards with respect to radiological and contamination issues. No buildings on site were considered unusable or out of bounds with respect to officer training. Some personnel may have received more exposure than others, but the cumulative result over the entire force would be comparable.

Areas of concern for elevated exposure were the Product Withdrawal (PW) area of the X-326 Building and the Building X-345 Storage area. Cylinders were left on carts in the Central Vault when not in use by operations. This required that Security guard the area 24/7. There were long periods of time when Security was assigned to this area. Studies exist on the dose rates coming off the cylinders. Personnel security logs could provide the area assignments of guards throughout their time at Portsmouth.

Several members of Security expressed concern that they frequently were not considered equivalent to other workers onsite when Safety personnel implemented new monitoring programs or upgraded engineering controls, administrative controls, and PPE. Security officers stated that they routinely walked into areas where maintenance or production activities were taking place, with no warning that the potential for exposure to radioactivity existed Interviewees related that officers did complain about this practice for years, but interviewees indicated that management did not respond. It was further noted that to this day, an officer on a routine roving patrol could encounter the same issue. Security officers stated that when they questioned this practice, they were routinely advised that if they did not like it, they could find another job. Security officers also stated that they were routinely told they were in a safe environment.

Management officials did not start keeping accurate logs of which officers were present at incidents until the early 2000s. Some records may exist from before that time, but the tracking of officers who responded was not addressed until the union found out that there was a lack of records in this area and the senior managers then corrected this issue. Officers' names are now supposed to be logged into records within the X-104 Police Headquarters Building and possibly by the Plant Shift Supervisor on duty during an incident. The means were always present to document incidents; however the will or the knowledge to do so was not. Officers were omitted from this process. If records exist of officers' participation in plant site problems, they logically would be stored in the X-100 Administration Building, Records Management, or Document Control. Perhaps the DOE maintained duplicate records, as they were supposed to have safety oversight of the workforce, but these records would be almost non-existent for uniformed officers, since it simply was not done for decades.

Radiological Control

There are a number of documents regarding a 1992 characterization effort. Starting in the 1990s, there was good knowledge of the percentage of transuranics (which includes Th-230 as expressed at the site) and other trace contaminants in different areas. The isotopic characterization was based on technical smears. The transuranic (TRU) percentages are re-evaluated on an annual basis.

The radiological hazards at Portsmouth are associated with alpha and beta radiation. The primary sources of alpha radiation are UF_6, UO_2F_2, (U-234, U-235 and U-238) and U_3O_8. Uranium tetrafluoride (UF_4) was present in the Feed Manufacturing Plant for a period of time. Uranyl nitrate was produced in the cleaning solutions as part of the cleaning operation in Building X-705. Some contaminates (muck) from the system collect in the Freon degrader. These contain a composite of many compounds of uranium and technetium. There may be some unique chemical forms of uranium in this material. The uranium is present in a lot of oxidation states. The primary source of beta radiation is Tc_{99}. Technetium (Tc) concentrated at the top and side purge cascades. There was an increase in the level of Tc as it went up the cascade. Other hazards associated with the X-326 Building include hydrofluoric acid, trichloroethylene (TCE), iron from welding fumes, and metals. The radiological composition of radioactive material in X-330 is similar to that of X-326. There is less U-234 and U-235 here than in X-326. The composition of radioactive material in X-330 was similar to that of X-326, although there is less U-234 and U-235 here than in X-326. The radiological concerns in X-333 were primarily uranium (low assay enrichment) and uranium daughters, such as protactinium. There was minimal Tc in this building. The decay daughter, Th-230, and related decay products were also found at Portsmouth.

Recycled uranium (RU) introduced trace radionuclides to the site. Much of the feed used at Portsmouth came from Paducah, where they filtered out a lot of the transuranics before sending the material to Portsmouth. As long as the uranium, uranium daughters, and trace radionuclides were maintained a gaseous form, the heavy material (e.g., transuranics, along with U-238) would collect at the bottom of the cascade and the lights would travel toward the top of the cascade. The cylinder heel material contained higher concentrations of decay products and transuranics. The transuranic concentrations in the heels of the cylinders were as high as 27%. Potential exposure to transuranics was of particular concern when cylinders were cleaned. Plutonium solutions and sources were handled in the Calibration Laboratory. The dominant transuranic radionuclide found at Portsmouth is Np-237. Americium-241 is present in trace quantities. Transuranic contaminants were identified in Buildings X-700, X-701B, X-705, X-720, X-740, X-744G, X-770, X-6619, and the process buildings starting in the 1960s. There was some storage of plutonium at Portsmouth.

Tritium sights were used as a part of weapons carried by officers for a period of time (mid-1990s). These were leak tested by Health Physics. These devices typically remained intact, but on occasion, guards were potentially exposed to tritium when the sights on their weapons (226's) broke or leaked. There were intentional releases of iodine. Th-230 and its daughters are also found at Portsmouth. Site experts are not aware of work conducted with U-233 at Portsmouth.

A Tc removal effort was conducted intermittently starting in the 1970s. In late June 2002, Portsmouth initiated a project to remove technetium from over 1,000 14-ton cylinders. The material in these cylinders was useless as feed to the cascade because of technetium contamination. The contents of the cylinder are heated to a liquid state. This material is routed through magnesium fluoride pellets to a 14-ton receiving cylinder. The material is typically routed through two sets of traps to ensure the adequate removal of Tc. The technetium often exists in the form of pertechnetate. This process also removes high-energy beta emitters (e.g., protactinium), which causes issues with bremstrahlung radiation. The trapped material is homogenized, sampled, and shipped to Paducah or other DOE sites.

A hazard analysis for potential exposure from particular jobs for determination of sampling and monitoring requirements was not done. The assumption was that all alpha contamination was uranium and all beta contamination was technetium, even though other radionuclides were present.

Cylinder moves and product withdrawal areas created problems. Oxide Conversion was a very hazardous radiological area where officers were stationed within the immediate area. Operations staff felt they received most of the radiation dose in the Cool Shack or from cylinders. Higher radiation exposures are the result of uranium daughters in the cylinders. The populations of workers receiving the highest doses at the present time are the UMH. While lines were being broken apart, Instrument Mechanics received higher exposures. Working in areas with deposits resulted in higher radiation exposure. These exposures would periodically set off the Criticality Accident Alarm System (CAAS) alarms. In one case, a worker received 3.8 rem in 3 hours while working in an area with deposits. Some workers assigned to the E-Area received significant uptakes of uranium oxide. One site expert was asked to become part of the transuranium registry as a result of the intake he received.

A variety of maintenance and safety permits were used, including Hazardous Work Permits (HWPs) and Electrical Work Permits (EWPs). These typically described requirements for industrial safety and provided general direction (e.g., what system valves to close prior to work). The HWPs/EWPs were equivalent to the current lock-out/log-out process. The HWP/EWP logbooks were maintained.

A formal Radiation Work Permit (RWP) program was implemented in about 1992. The RWPs were used prior to this, but were not formalized. The RWPs were typically inconsistent and dependent on which Health Physics Technician wrote them. In other words, there would be different protection and monitoring requirements for similar hazards. Adherence to the RWPs was inconsistent. There were many examples of violations of the RWP requirements. For example, an RWP would require a respirator, but a supervisor may determine that he did not need one in order to inspect a job. There would be no modification of the permit nor sampling or monitoring done. Currently, the Senior Technician is responsible for writing RWPs. Health Physics staff determined bioassay requirements (i.e., gross alpha, uranium, gross beta, or fluoride).

The primary portable radiological contamination detection instruments in use at Portsmouth include the Ludlum Model 12 units with a scintillation or pancake probe. Operators used Cutie

Pie instruments primarily prior to the 1990s, and Eberline Model E140 and Eberline RO2s more recently, for penetrating gamma/x-ray monitoring.

The air-monitoring program included fixed air monitoring in the process and maintenance areas. Air samples were collected on IBM cards with air sample filters. These cards were inserted into the air-sampling units and exchanged on a routine frequency. In the 1979/1980 era, these air sample filters were exchanged each shift. Air samples were sent to the analytical laboratory for processing and analyzed for gross alpha and gross beta. The air-sampling data was used to determine time-weighted average data. Air sampling was not always required when wearing a respirator. In some areas where respirators were regularly worn, there were continuous air monitors for alpha detection. The placement of these monitors in relation to the workers breathing zone was questionable. The monitors usually were stationed a far distance from the work or potential exposure. Breathing zone air sampling was historically not used for radiological purposes, but it was used to monitor potential uptakes of other contaminants, such as metals, solvent vapors, acid gases, and asbestos. Today, portable air monitors are located much closer to actual work activities, and breathing-zone sampling is conducted for many radiological work activities that have the potential for creating airborne contamination.

Radiation generating devices used at Portsmouth included x-ray devices (portable and fixed), portable radiography sources, and large scale sources (e.g., Cs-137 calibration source, Cf-252 source for waste drum assays and instrument calibrations). There was a fixed x-ray facility housed in the X-326 and X-710 (i.e., shielded x-ray facility) Buildings. When Metallurgy closed, the unit in 710 Building was no longer needed. Mobile x-ray units were used in process buildings to examine equipment. X-ray shots were taken of welds in removed parts in the early 1970s.

The CAAS was tested monthly. The first criticality alarm systems (i.e., Argon Gamma Graphs) were built onsite and installed in clusters. Argon Gamma Graphs (AGG) were located at the withdrawal and feed sites, and in the cell areas suspended from the roof. Checks on the electrical and alarm systems were done using a portable radiation source. The radioactive source was on wheels and was stored in a vault adjacent to where safety meetings were held. The door had to be shut to keep the alarms from going off. When the cans would fire, personnel from the Instrument Department would have to climb the cell housing and alarm check the AGGs with a source on a pole. When the can spiked outside these tests, which happened frequently, workers were told the can was a misfire. No electronic dosimeters were used during this operation until much later. The source was manually operated by opening and closing a window. No extremity monitoring was provided during the operation. The AGGs produced strip charts, which were examined by operators when passing through the areas.

The AGG was replaced with the CAAS. Positioning of these units was questionable, because there was shielding between the source term and the CAAS. The AGG served as a back-up system to the CAAS until the late 1980s/early 1990s. A Calibration Facility was developed in the late 1980s/early 1990s to test the CAAS. The detector was brought to the Calibration Facility, where it was tested with a beam simulating a criticality. With the development of this system, CAAS testing was no longer conducted in the field with portable sources. Some electrical checks continued to be performed in the field.

In 1979, the Oil, Chemical, and Atomic Workers Union (OCAW) went on strike because of their concerns with various health and safety issues. As a result, supervision stepped in and decontaminated and painted areas of potential concern.

Interviewed workers believe that management and DOE officials were slow to recognize the potential risk to workers, respond to reported concerns, and provide appropriate training and PPE. Workers relied on what they were told, and they were told that they were safe and their dosimeters were accurate. The radiation boundaries presently in place did not exist in the early days. Radiological areas and contamination areas were not identified with postings in the past; therefore, workers had inadequate information about hazards in specific locations. Individuals learned how to complete tasks by virtue of time and experience. Individuals were told to read the procedures, then to go and operate the systems. Hazards were often communicated to newer staff by older staff. Those who were trained or realized the hazards of what they were working with failed to pass the information on to other workers, and it was felt by interviewees that the managers did not aggressively investigate union (USW or SPFPA) complaints. Interviewed workers observed that it is probable that frontline managers were afraid to raise issues, because their employment would be terminated. Presently, there is a more rigorous training program that is completed prior to assignment to a process, and procedures are more detailed.

Interviewed site experts observed that individuals learned by experience. The original philosophy at Portsmouth was that workers would learn based on the tribal knowledge of other workers. This included safety aspects of their work. There was an orientation upon arrival at the site, but no formal training. Radiological worker training was less than adequate. The early training basically identified the basic safety requirements. For example, beta emitters were assumed to be technetium and alpha emitters were assumed to be uranium or radon. There was little if any mention of transuranics or fission products. Criticality safety training was also not provided prior to the 1990s. Formal classroom training was not available at Portsmouth until the early 1980s (with the issuance of DOE Order 5480.20). In the early to mid-1990s, the site implemented Radiation Worker I and Radiation Worker II training.

Field Health Physics staff was minimal during the era when DOE operated Portsmouth. With only four to six Health Physics Technicians providing coverage for the site, fewer radiation surveys were conducted. Routine alpha surveys were limited to designated areas. Neutron surveys were conducted by request in areas such as the X-326 Building Cell Floor. Operations could request a survey; however, the survey was often not properly completed. There was a lack of workplace air monitoring. Prior to the privatization of the facility, many areas now identified as radiation or contamination areas were not posted. Employees routinely worked in these areas.

There have been significant improvements in the radiation protection program starting in the 1980s, but particularly in the last 15 years. Response to the Tiger Team Assessment (DOE 1990) precipitated many of these changes. Since the regulatory transfer of the site to the NRC, additional upgrades to the radiation protection program have occurred. In the early 1990s, the company hired a large number (over 40) of health physics technicians. Posting of radiological areas has been upgraded, with postings increasing significantly. A routine survey program was implemented. Knowledge gained by the Health Physics/Industrial Hygiene staff and workers in radiation protection has improved. Contamination control and egress monitoring are more rigorous than in the past. Equipment used for radiation detection has improved substantially. Investigation of incidents and non-routine occurrences are more detailed in the current era. The manpower dedicated to Health Physics/Industrial Hygiene was minimal. For example, in 1979/1980, the IHHP had about 8 technicians and 12 staff members to implement the industrial hygiene and health physics programs. The manpower to support these functions has increased, allowing the programs to better monitor these hazards (e.g., increased number of routine surveys).

Contamination Control

In the early years, it was noted that employees were led to believe that uranium could be eaten without causing harm. This attitude continued into the 1980s. Since uranium was treated casually, historical practices occurred that would not be tolerated by today's standards. For example, during a particularly cold part of the year, guards were placed at a post outside the X-744G Building. A temporary shelter was erected with cylinders nearby. Individuals would sometimes lean against the cylinders to keep warm. People were exposed to a lot of radiation, because the managers and employees did not know any better. For example, it was not common knowledge that cylinders gave off more radiation when they were empty than when full. In 1981–1983, IHHP undertook a massive project to upgrade contamination controls at Portsmouth, which also included approximately 6 hours of training in health physics for plant personnel.

Engineering controls implemented at Portsmouth have included local ventilation (canopy hoods), slot ventilation, High Efficiency Particulate Air (HEPA) filtered vacuums, HEPA filter systems, paint booths, fume hoods in the laboratory, and gloveboxes for sandblasting operations. Prior to the installation of some of these controls, there was a reliance on PPE. The cascades are designed as a closed system under negative pressure to prevent release of material outside the building. Prior to equipment removal or breach of a system, the cells were purged to lower potential for radiological contamination. The cascades underwent cleaning by the janitorial services routinely. About every 30 days, the floors were oiled as a part of the cleaning process. Although these control practices were in place, all the process buildings had contamination areas, and the ventilation systems were contaminated.

There were frequent releases ranging from a wisp of smoke to a full-blown continuous outgassing. There was little control of contamination, as demonstrated by the large amount of times that boundaries had to be established and expanded. In the late 1980s and early 1990s, the buildings were typically considered contamination areas with little inside building controls. There were office areas within the production areas.

In the PW area, after the pigtail was unhooked, cylinders were placed on a cart and officers locked a chain around the cylinders. As a result of UO_2F_2 releases, these carts and cylinders were potentially contaminated. During this process, there were problems associated with the badges hitting these potentially contaminated cylinders and carts.

Personnel Protective Equipment (PPE) requirements have varied through time at Portsmouth. For example, Building 705 was shut down in about 1990; employees had to obtain special permission to get into the E–area after it was closed off. Anti-contamination clothing (Anti-Cs) and respiratory protection are now required for entry. However, while E-area was operational, employees worked in the same areas with coveralls, shoe covers, and no respiratory protection. Sometimes operators wore latex gloves and tyvek coveralls. In later years, they started wearing a lot more Anti-C's and rubber booties. Radiation-driven PPE drastically changed in the late 1980s/early 1990s. Prior to this time, the requirements for PPE often were not enforced or effectively communicated to all employees, including during CIP and CUP. Even when PPE was used, it was not always adequate. In 1978 during an emergency response, it was discovered that chlorine could damage a Level A suit.

Security personnel did not change into coveralls in contamination areas. Officers were required to wear their uniforms (i.e., black fatigues) and firearms into process areas. This included access to contamination areas. Boots were provided by management. Shower rooms were available, but security personnel did not have a hot and cold locker room to limit the spread of contamination from work belongings to personal belongings. They used the same locker for their uniform and personal clothing. They were not required to shower prior to leaving the facility, and egress monitoring was not required until well into the 1990s. It was not uncommon for Security personnel to wear their uniforms more than once. Officers routinely wore uniforms home with the consent of management officials until the mid-1980s; they simply washed their uniforms with everyday laundry at their homes. Management officials maintained that the areas guards worked in were free of contamination and radiological concerns. Officers continue to wear uniforms into contamination areas at the present time, but now there are monitoring stations to check through, and training has been provided to inform officers on what to do.

Respiratory protection used at the site included assault masks, half-face respirators, full-face respirators, and supplied air masks and hoods (available in the 1970s). Supplied air was used for seal changes, trap changes, work on the Freon Degrader, and some work in X-705, X-343, and X-344, when supplied air became available. Respirators were placed near areas where employees worked and were only individually assigned if a person wore something different than an average sized respirator. There was no designated storage area for respirators and no requirement to carry a respirator inside production areas. In fact at one point, wearing respiratory protection was up to the individuals. In the mid-to-late 1990s, the site's respirator practice transitioned from 30-day multiple-use practice to limited re-use and single use. Respirators were collected on a scheduled basis to be checked and cleaned at the respirator facility. There were examples of the respirators coming back more contaminated than when they left. In between uses, respirators were wiped down with alcohol for sanitation reasons. The respirators were kept in the area adjacent to the operations, regardless of their usage. Some individuals stored them in a case while not in use. Respirators were worn for specific jobs. For example, operators were required to wear a respirator when changing cylinders. In the early 1990s, a respirator was required when pulling samples. This was not the practice in the earlier years. Dust masks were worn when working on used barrier material. The barrier material was wet down to try to reduce the radiological hazard. Support personnel (e.g., Security) seldom, if ever, wore respiratory protection.

Personnel Protective Equipment (PPE) was not consistent between workers in the same area. On a daily basis within the cascade or associated production or decontamination facilities, incidents occurred where some involved workers were provided PPE and fresh air, while the others wore no PPE. For example, during the changing of a trap, a boundary was set up for a job. Those individuals within the boundary performing the hands-on work wore full-face respirators.

Personnel on the other side of the boundary were not required to wear any PPE. The air space used by all workers involved was the same. This happened quite often. The boundaries were determined in accordance with procedure, based on the distance from the work instead of the distance of potential exposure. There were examples of workers handing tools across radiological boundaries to other workers, so the worker outside the boundary came within a few feet of the work and potential exposure. In many instances, those outside were more exposed, because those inside may have been required to wear an air-purifying respirator. There were cases where those working outside the boundaries got skin contamination and/or high urine counts.

Currently, the site has implemented egress monitoring when exiting from a contamination area; however, this was not always the case. Egress at Portsmouth, including during the CIP/CUP, involved washing your hands and monitoring them with hand-held radiation detectors or using fixed location hand monitors. Brown paper was set down to act as a step off pad. Some hand monitors existed on site, but were placed in ineffective areas after cross contamination had occurred. For example, while there was a monitor in the facilities cafeteria, where a person might use it, there was no order or mandate to use it before eating. In some cases, there was nothing to frisk with prior to leaving for home for years. When hand monitors were made available within locker room areas, the employees were not taught how to use them

There were change rooms and showers available for workers; however they were not required. In the early years, there were hot and cold lockers, but they were often adjacent to one another. Even though shower times were established, showers were not required. To further complicate things, not all individuals had company-issued coveralls, so they wore their personal clothing into the process areas. Company coveralls were only required for certain jobs (e.g., cell entry) and workers. Even when performing work in coveralls for the day, some employees simply changed into their personal clothing and went home without taking a shower. Some of the workers would keep their personal tools inside the hot lockers. Because of the limited facilities and few numbers of women in process areas, there was an issue with providing showing facilities for female employees. Later, operators were required to wear basic coveralls. Permissible contamination levels for coveralls were in the hundreds of thousands of counts.

Workers were permitted to eat, drink, and smoke in the immediate vicinity of radioactive material, including in the process areas. Individuals were also allowed to wear their coveralls to the lunchroom without showering and changing. Management officials encouraged Security officers to take breaks in place when possible, so they took lunch boxes and coolers to their immediate work locations. This changed in the late 1980s/early 1990s. When the policy changed to forbid eating, drinking, and smoking in radioactive work areas, there was a time when it was not enforced. More importantly, there are examples of the “clean areas” (where eating and drinking were allowed) becoming contaminated. Because the temperature in the production area was about 110°–130°F, the company provided drinking fountains and water coolers on the cell floor for the workers. Drinking water was also provided in the decontamination buildings. These eating and drinking practices continued during the cascade upgrade program. Security personnel also ate and drank within areas that retained SNM, such as X-705, X-700, X-744G, X-760 and X-770.

Personnel and personal effects contamination incidents were routine. It was very common to have one's hands contaminated and to have a tool turn up hot. Typically, a worker with contaminated hands would wash until clean. If other parts of the body were contaminated, the worker might go to the hospital for a scrubbing. Procedures indicated that an investigation was to be conducted, but this did not happen often.

There are Designated Material Storage Areas where contaminated items are stored. These are not USEC functional areas and are the responsibility of DOE. They have their own technicians who monitor these areas.

External Monitoring

Employees were monitored with dosimeters when working with radioactive material, as determined by supervision. All individuals in operations were assigned a dosimeter. Visitor badges were assigned to visitors and read nightly. Dosimeters were integrated with the picture badge in 1960 for a period of time. They were worn above the waistline on the upper portion of the chest clipped to the collar or on a lanyard. Dosimeters were to face outward, but this was not enforced. One would see poor practices continuously. Even the Radiation Protection workers had the same poor practice. In many instances, workers were told to wear the TLD badge underneath anti-C clothing, even though there was a window that would allow the TLD badge to detect beta activity. Many site experts indicated their typical recorded exposure was zero. Prior to leaving the site, dosimeters were returned to a badge rack for storage. Starting in the late 1990s, workers were allowed to take their dosimeters home. There is currently an administrative limit of 500 mrem per year at Portsmouth.

The union officials questioned the justification for allowing workers to take their dosimeter home. RadCon provided a background radiation study conducted at the Paducah and Oak Ridge sites. This justification was not accepted, because there was inconsistency in the background radiation data surrounding the Paducah site. The geology of the Portsmouth area is somewhat different than that at Paducah. The union insisted that a Portsmouth-specific background radiation study be conducted. The data indicated that the background radiation in the surrounding areas were consistent. This finding contradicted management's claim that there was more radiation exposure from offsite than from onsite, due to the type of geological conditions of the area. Background radiation used for dosimetry background subtraction was determined with dosimeters in the portals, near the cylinder yards. There was a perception that the site would subtract higher than appropriate background readings from individual badges. This was very hard to prove; however, there was a document that clearly stated that background radiation was 500 mrem on the site. When the union inquired about this in the later years, they were told that it was a misprint.

Pocket ionization chambers (also called PICs or pencils) and other secondary dosimetry were used for real-time monitoring of dose, rather than for exposure assignment. Special dosimetry requirements were not typically formalized, and the use of this type of dosimetry was limited. The reason given was that special dosimeters were less accurate than other types of dosimeter. The personal individual dosimeter was used to determine the dose of record. Electronic dosimetry was used in later years as a backup when maintenance was done on the radiation clusters. They were set to alarm higher than the adjacent radiation cluster. Only a subset of workers wore secondary dosimetry.

There were opportunities for partial-body exposures, and dosimeters may have underestimated the dose to portions of the body. The radiological source term was not always in alignment with the placement of the dosimeter on the chest. For example, when an operator classified a compressor, the operator would typically stand at the opening. A relatively large amount of radiation would come out of the opening of the compressor (or any other piece of equipment). The opening would target the area bounded by the diaphragm to the top of the knees. The badge would typically be located higher (at chest level), thus not exposed to the high radiation field. Furthermore, there was a potential for higher exposure to the lower body than the upper body, particularly when handling 5-inch cylinders. For example, hourly officers had to use kneeling or squatting positions that would expose the lower body to various HEU/SNM containers, due to the nature of the locking mechanisms. This was a daily occurrence. Extremity monitoring was not routinely used; however, it has been implemented with the Tc recovery program.

In the case of the large cylinders, there was more neutron radiation given off by an empty cylinder with heels than a full cylinder. Neutrons were an issue with high and low assay material in the cylinder yards. Neutron instrument use was limited to areas where non-destructive analysis was conducted. Workers questioned the determination that neutron dosimeters were not needed. In 1992, a TLD was introduced at Portsmouth that had the capability of measuring neutron radiation. The neutron dose was not routinely calculated, although the data was available. During the HHE, NIOSH raised concerns about neutron exposures. At that point, the union requested that Power Operators and Switchyard workers be evaluated for neutron exposure. The job responsibilities took these individuals to the tails area or LAW area. Dosimeters analyzed showed positive neutron exposure. There was no phantom used in conjunction with neutron monitoring. There were situations where some individuals in the area were assigned neutron badges, but others (e.g., support staff) in the area were not. Film badge dosimeters would not record neutron exposure.

Each time there was a suspect reading or a missing badge, there was supposed to be a dosimetry investigation. In practice, high badge readings were considered inaccurate and a coworker dose was assigned to the person. The coworker dose was based on job title and did not take into consideration the work area the individual may have been in. Welders would frequently lose their badges, because they had to crawl in pipes and the badges would fall off. If a lost badge was recovered later, it would not be used to indicate the individual's personal exposure. The individual would be unmonitored during the time they were in the piping, leading to missed dose. The Dosimetry group indicated that the measured doses in the field did not exceed the recorded dose.

Internal Monitoring

Workers at Portsmouth had the potential for exposure to uranium oxide, UF_6, and uranyl nitrate. The primary focus of the early bioassay was to detect uranium and fluorides in urine. Urinalysis for Tc-99 began in about the mid-1980s. The supervisor was responsible for determining individual monitoring requirements. This included which radionuclides were assessed for bioassay samples. These decisions were made without adequate knowledge and guidance. A worker would go to the Medical Facility to submit bioassay samples. A labeled container was provided and the sample was collected immediately. This was typically done when employees arrived at work after the weekend.

The frequency of bioassay sampling depended on the worker's job function. Operators submitted bioassay samples on a monthly basis. For security personnel, routine bioassay sampling was not in place during the 1970s and 1980s. Individuals were randomly selected each week for sampling, with a goal to sample all individuals in a department over the year. Later, routine bioassay samples were collected for security personnel on a quarterly basis. Baseline bioassay samples were not originally collected from workers. Portsmouth did not implement a routine fecal sampling program, although workers were potentially exposed to transuranics. In fact, site experts do not recall ever having to submit fecal samples.

Special bioassay samples were submitted when incidents occurred. For example, some workers were asked to submit bioassay samples when seal alarms sounded. Samples were not collected from all individuals in the vicinity, though. In the 1990s, workers were allowed to request and submit special urinalysis samples. This provided a more consistent way to establish internal dose.

In later years, deficiencies in the urinalysis program were identified, so there was an increased focus on special urinalysis. The routine urinalysis program did not have the credibility that was needed. There were many problems. Workers were told to submit urine samples at the end of the shift. There was no mention of voiding or any explanation of the technical basis. Follow-up was not always performed when workers had positive results.

The time frame for receiving results was sketchy—sometimes weeks after a sample was submitted. Individuals were told about urinalysis results if they were positive. If the results exceeded a predetermined level, the worker was put on work restriction. The work restriction remained in effect until urine results fell below the work restriction limit.

Nasal smears were not submitted by workers. Several workers who became contaminated during a release were scrubbed down and their hair was cut multiple times. Formally, individuals were not allowed in radiological areas with open wounds; however, this was not enforced.

The Y-12 mobile whole-body counter visited Portsmouth periodically. In-vivo counts (e.g., whole-body counts) were provided on a routine basis to only a portion of the worker population. Whether an employee received a whole-body count depended on the availability of the trailer or monitoring facility. Few people were required to be counted. For example, security staff did not receive routine whole-body counts, although duties stations took them into E-Area where, there was a significant issue with black oxide contamination on the floor. It was not until individuals from this area began showing up with positive whole-body counts that engineering controls were upgraded, such as installation of gloveboxes. Hire and termination counts were not done. The whole-body count program was discontinued in the early 1990s.

Follow-up whole-body counts were done on individuals who had positive results. Work restrictions were implemented for individuals with positive whole-body counts. In situations where workers were found to have a high body count, they were restricted from work in the oxide area, but not areas where other radioactive material was handled.

The site provided reasons why the whole-body count data is inadequate. An individual approached union representatives to question a relatively high amount of cesium identified on the result sheet. When a health physicist was questioned, he stated that the worker's result meant nothing. He stated that they only calibrate for one of the uranium radioisotopes. Furthermore, he stated that it doesn't matter, because eating a banana would screw up the results.

Occupational Environmental Dose

There were contaminants and radiation sources outside the facilities that may have contributed to worker dose. "Empty" UF_6 storage cylinders (containing "heels" with uranium decay daughters), which emit high-energy beta radiation that interact with steel cylinder walls, produced bremstrahlung radiation, considered the most significant external exposure hazard at the site under normal operations. These cylinders are normally stored outdoors at a distance from the operational areas, although one parking lot was located adjacent to a cylinder storage yard.

Potentially contaminated equipment or radioactive material was stored everywhere. It was not uncommon to be outside and be covered up with some type of chemical release. Interviewees noted that chemicals were routinely vented from rooftops where guards patrolled and trained. It was noted that workers would unknowingly drive through areas where some type of chemical release was settling or was carried by wind currents. These events were considered fairly routine. Soil radioactive contamination areas also existed onsite. For example, Tc-99 soil contamination was identified around the X-705 Building.

The separate set of environmental dosimeters has not show any significant external exposure from the standpoint of the public.

Effluent sampling was conducted at the point of release. Soil and vegetation samples were collected inside the reservation and the security fence since at least the early 1980s. Short-term high-volume air samples were being collected at various locations inside the security fence during the 1980s. Continuous air samples were collected at the boundaries. There are four to eight ambient air and radiation monitoring sites around the perimeter road. High-volume air samples were terminated, due to a consistent failure to detect any pollutants. Some of the environmental air-sampling data is maintained by DOE.

Waste-water sampling has been conducted in accordance with the National Pollutant Discharge Elimination System (NPDES) permit requirements since the site has had an NPDES permit. Local surface-water samples are collected upstream and downstream of site discharges either weekly or monthly, depending on location. All water samples are analyzed for gross alpha, gross beta, technetium, and total uranium, plus any physical or chemical parameters required under the NPDES permit. Also, effluents (NPDES outfalls) are analyzed quarterly for transuranics. Radionuclide samples are collected weekly, and gaseous fluorides are collected monthly. The ambient air monitoring is now a DOE function. Vegetation, soil, and sediments are collected and analyzed semi-annually. Environmental air samples are evaluated for gross alpha, gross beta, and fluorine. Vegetation, soil, and sediment samples are all analyzed for alpha, beta, uranium, and technetium, plus fluorides in vegetation and assorted metals and PCBs in sediments. Groundwater is also monitored for chemical constituents, such as trichloroethylene (TCE). Typical sampling included the following:

- 10 waste water/storm water outfalls (plus several internal NPDES monitoring points)
- 14 surface water sampling locations in receiving streams
- 17 sediment sampling locations (3 are co-located with outfalls, the rest with the surface water locations)
- A total of 46 locations for soil and vegetation samples, consisting of :
  - 15 sampling locations inside the gaseous diffusion plant security fence,
  - 9 locations between the security fence and the site boundary
  - 22 locations offsite
- Groundwater monitoring wells being maintained by DOE (number & location varied over time)

The environmental monitoring locations have been adjusted through the period of operation.

What is referred to as a jetting operation is performed in the cascades and in cold recovery in Buildings X-330 (cold recovery), X-326 (top and side purge cascades), and X-333 (cold recovery). The "Purge Cascades" are sections of the diffusion cascade dedicated to separating the UF_6 from lighter gases that have leaked into the process. The UF_6 is returned to the main cascade and the light gases (i.e., hydrogen and oxygen) are vented. Technetium is carried with the gases and sent through a trap. Although a trap is used, some Tc escapes to the environment. In the cold recovery areas, the gas is also sent through a uranium trap, and some uranium contamination is associated with the gas. Uranium collected in the traps is recoverable for reuse. Buildings X-343 and X-342 also jet from cylinders to pull a vacuum. Building X-344 used a vacuum pump, which would exhaust into the atmosphere outside of the building until the process was shut down.

The purge cascades operate continuously, and are monitored by "space recorders" (ionization chamber instruments) for total radioactivity and "line recorders" (mass spectrometers) for freons, COF_3, HF, air, etc. The space recorders are checked against periodic gas bulb samples. Operational results are recorded in ppm. Continuous vent **samplers** for both Environmental and Nuclear Material Accounting purposes were installed on process vents **starting** in 1983. There are now 12 cascade vent samplers (6 vents are inactive) and 4 non-cascade vent samplers (1 vent inactive). One vent sampler was installed in the American Centrifuge Plant Lead Cascade. These are analyzed for uranium isotopes and technetium. Prior to 2002, there was also an analysis for total fluorides (fluorine gas concentrations were limited to a maximum of 1 ppb.)

Ambient dose in the environment was monitored with film badges initially, and later with TLDs. Environmental TLDs are exchanged on a quarterly basis. TLD control badges were located on the top of Building X-100. The gamma dosimetry program has been contracted out to an NVLAP-certified vendor that has its own quality assurance program. The ambient external exposure within the perimeter is lower than the exposures measured offsite. The local geology is such that the soils derived from the older shales and sandstones have a somewhat higher concentration of natural uranium and thorium than the younger deposits overlaying the shales and sandstones. Portsmouth implemented an Area Dosimetry program for a short period of time in work areas.

Annual environmental reports were initiated in 1964. The Effluent Information System (EIS) was developed about the same time. There have been attempts to reconstruct releases occurring prior to 1964. The environmental contamination issues at the Fernald site precipitated much more detailed environmental reports starting in the 1980s. The waste management group maintains the DOE's EIS/Onsite Discharge Information System. The Environmental Compliance group maintained it to the extent of submitting an annual report. This system continued until the late 1980s or early 1990s. Since the mid-1980's, plant emission and public dose estimates have been based on continuous vent sampler data and estimated emissions from unmonitored vents, in accordance with Environmental Protection Agency (EPA) National Emission Standards for Hazardous Air Pollutants regulations.

Piketon is northwest of the plant and perpendicular to the prevailing wind direction. The prevailing upwind direction is toward Lucasville and Camp Creek.

Several audits of the environmental monitoring program have been conducted over the years of plant operation. For example, there was a Tiger Team evaluation of the program, as well as an evaluation done by NIOSH. In general, the site is much safer now than it was historically. Environmental monitoring and site characterization are active parts of the overall environmental surveillance program. Current environmental monitoring has not revealed any additional significant radiological contamination or releases over historical data.

The state oversight of DOE facilities in Ohio is poor. Up until privatization, the state had nothing to do with Portsmouth. The state Occupational Safety and Health Administration eventually became interested in the plant. Ohio conducts an ecological study of the local streams every few years. In general, the state has not attempted to correlate plant releases with the results observed in the studies, and the Ohio EPA studies are not limited or even focused on radiological issues.

Remediation

Site remediation and decontamination and decommissioning are an active part of the DOE mission. CDM is the current DOE contractor responsible for this function.

Field Services is a section within Waste Management/Environmental Compliance. Field Services collects all environmental samples (except vent samples) and all waste characterization samples in accordance with approved sampling methods. (Vent samples are collected by the Process Services Group within the Laboratory). The X-710 Laboratory is responsible for all analyses except pH, temperature, and similar field tests. These characterization samples are analyzed for transuranics, but typically not for Th-230. The Technical Section of Waste Management/Environmental Compliance is responsible for evaluating sample results, maintaining the environmental databases, and waste management.

The X-749 pond has been remediated and capped. Initially, this pond received solutions from the 701 Complex. The J-7 holding pond has been elevated, because the watershed originally drew through the holding pond. Sludge removal was conducted at 701 on a periodic basis. The X-749 Radioactive Burial Yard was used to dispose of contaminated machinery and spent absorbents. A TCE plume was identified at this location. The X-735 was the site's sanitary landfill; it contains a cell that was used for the disposal of asbestos or asbestos-containing material. The X-734 site, opened in the 1950s, was the disposal site for construction material. DOE is responsible for monitoring the construction landfill. Waste was put in old converter shells and sealed awaiting disposal. The site housed several scrap yards, including one for precious metals. DOE conducted a study related to storage contamination in these areas. Some items (e.g., barrier material) were shipped offsite for disposal.

Occupational Medical Dose

Medical x-rays were received onsite at the Medical Facility. The nurses were originally responsible for performing x-rays onsite. Annual medical exams were provided to employees. This primarily involved respiratory protection and heat stress evaluations. The exam also included an x-ray, urinalysis test, blood test, pulmonary function test, hearing test, an electrocardiogram, and a physical. Initially x-rays were taken with each exam. When Occupational Safety and Health Administration standards were implemented, new medical evaluation requirements were implemented at Portsmouth. Individuals who worked with asbestos were required to have a chest x-ray every 1–5 years (depending on their age and exposure history). This program was implemented based on the requirements in 29 CFR Part 1910.1001. X-rays became voluntary for some workers several years ago. A standard film size was used for chest x-rays. Personnel interviewed do not recall receiving lumbar spine x-rays. Site experts do not remember having lateral x-rays. Medical x-ray units were evaluated by a state agency.

Incidents/Accidents

When a significant incident occurred, the Emergency Operations Center was activated. Both the Fire Department and Security responded to the incident. Security personnel, followed closely by the Fire Department, were generally the first to arrive or were already on the scene. Officers helped to identify the affected area and the problems pertaining to the emergency. The Fire Department would enter the areas to ascertain what was going on and to ensure that individuals were appropriately evacuated. They established where boundaries and control areas would be set up. There was no standard requirement for establishing the location of control points in earlier times, but control points are established in the present time. Officers set up the perimeter of affected areas to close off roads and control traffic, and helped to establish command posts. For particular incidents, roads out as far as the perimeter were blocked. The emergency response team at Portsmouth was composed of individuals from various disciplines. During an incident, these individuals would suit up in Level A protective clothing and accompany the Fire Department. Site operations were responsible for closing release points and collecting operational data. The environmental monitoring group was responsible for evaluating potential offsite dose, while health physics was responsible for evaluating onsite conditions. Soil, water, or other samples would be collected and evaluated by Environmental Compliance based on the circumstances of the release.

With respect to see and flee problems, officers were often ordered to shelter in place, while other personnel evacuated the affected area or building. Since the NRC took over, this policy has been revised, so that officers leave the affected areas. When work was conducted in the vault areas and a radiation alarm sounded, workers would exit the area. The officers would remain behind to ensure all personnel had exited prior to exiting themselves. This was partly for the purpose of safety and partly to ensure the physical security of the product.

The threshold for documentation of incidents would depend on who was working on the particular shift—if they did not personally deem something important, then chances are good that a report does not exist. This changed under NRC guidance. Incidents and/or non-routine occurrences, when documented, were summarized in the operations log book. The details would vary depending on who entered the information. There seemed to be a conscious decision to omit details in order to prevent from identifying performance inadequacies. The fire department also kept a run log book that would have some information.

Workers interviewed were involved in many incidents, including large releases, small releases, accidents, contamination, fires, spills, etc. Conditions that would be considered incidents today were routine in the past. Releases to work areas were not uncommon. A majority of process gas releases occurred at the withdrawal stations. When the pigtail connection to the cylinder is broken, there is a small release (e.g., like exhaled cigarette smoke). These releases were typically ignored. When such a release occurred, workers would back off and let the UO_2F_2 dissipate. Some workers wore respiratory protection during this operation, while others did not. A majority of process gas releases occurred at the withdrawal stations. In 1975, there was a release from a high assay 5-inch cylinder in the X-344 facility. A major release occurred upstairs at Building 326, producing a grayish, white cloud that filled the building. Releases included chemical and radiological hazards. Fires involved not only smoke from the fire, but typically released radioactive material in the mix. Oil spills could cause a large amount of radioactive contamination around oil sources. The oil from the pumps typically was designed to capture radioactive material. That material leaked from the pumps all the time. Also, the site had a practice of injecting free fluourine into the system to improve efficiency. This practice seemed to strip the traps, freeing the radioactive material and allowing the fluorine to vent through the stacks. There is data that identifies short-term high concentrations of elements leaving the stacks. Also, there is evidence of radioactive material in all the ventilation duct systems (including the clean buildings).

Employees worked in and around a 50-year old process for enriching uranium. This system was known to be less than efficient with mechanical problems, and yet, according to workers interviewed, not all workers were informed of the problems associated with the system, nor were they properly trained and equipped. For example, documentation exists that raises questions regarding the state of management and physical equipment in Building 326. It was believed by some that the DOE knew seals were leaking faster than they could be replaced. As the cascade became older and more unreliable and the HEU/SNM suspension program ground to an end, incidents increased to become what workers considered to be routine events. According to workers interviewed, every last use was ground out of the cascade, without financial expenditures to fix problems, because management and the DOE evidently knew that plant closure would occur. Money simply was not routinely spent on maintenance issues. During the HEU/SNM removal programs of the 1990s (through 1999), when the programs were complete, the old system was re-engineered to basically run in reverse (to re-feed HEU/SNM back through the old and failing system), even though it was known to have problems running through normal operations. Equipment failure was not uncommon.

Some of the specific incidents recalled by site experts are provided below.

- There was a rupture of a copper line in E-Area in 1974 or 1975. The room filled with smoke because of a release of highly enriched UF_6. There were three individuals in the area at the time. Clean-up of this release involved 6–7 individuals. Also during 1974 or 1975, there was a glovebox fire in the E-Area exposing 3–4 individuals.
- In the 1990s, there was a fire in the purge cascade as a result of an exothermic reaction of metals and chemicals used in the process. The system was ruptured, causing the fire. Black smoke filled the building and traveled to the east. Dozens of individuals were in the path of the plume and exposed.
- On March 8, 1978, a 14-ton cylinder was dropped outside, south of Building X-344. The cylinder ruptured, resulting in a large release of UO_2F_2. There were yellow deposits visible on the snow on the ground that day. Contamination was spread within Buildings X-330, X-342, and X-344.
- In December 1998, a fire occurred at Cell 25-7-2 at the south end of X-326, destroying the cell. This resulted in an episodic release. A formal occurrence report was written.
- Pig tails were used to fill cylinders (1,400 lbs). In about 1979, a pig tail pulled from a cylinder released process gas into the area. This gas migrated and exposed the employees in Building 340. The uranium also settled to the floor, causing contamination.
- During the replacement of seals, there was a potential for release of process gas, since the operation resulted in overpressurization.
- In X-700, the instrument shop maintained sources to conduct their work. At one time, they were custodians of a Cf-252 sealed source that leaked.

There were also releases to the environment. For example, a plume was released from Building X-326. It traveled over the X-100 Building, Inter Connection Portal and Medical. There was an unusual smell in the air. This caused concern, so the site tried to shut down the parking lot.

July 26, 1994 Security Guard Cell Incident

Significant concerns have been raised by site experts regarding the documentation of serious incidents at Portsmouth. For example, on July 26, 1994, an incident involving security personnel occurred while “cells” were being shot. (The process of shooting a cell involves forcing chemicals through the process system to unclog uranium buildup.) In accordance with procedures, individuals were to be notified when the cells were shot, so they could take appropriate protective measures. In this particular case, the security guards were not notified that this was to occur. At the time of the incident in question, an AGR monitor went off. As a result of not being notified security personnel were exposed to an unknown release of material. Acute symptoms were experienced by those involved. The cells involved in the incident were particularly troublesome, since the seals at the compressors had a history of leakage. The seals were leaking faster than they could be repaired. Problems with leakage from this bank of cells were identified starting in 1979. A bioassay sample was collected approximately 2 hours following the incident from one individual involved. The interviewee did not know what the sample was analyzed for, but stated that no blood samples were taken following the incident. Safety staff members were sent in to perform atmospheric sampling for potential hazards 6 hours following the incident.

The guard union safety representative and employees involved in the above incident examined the onsite medical and radiological files to obtain information on chemical and radiological exposures. The hardcopy radiation exposure index card indicated the injured guard had received in excess of 1–3 rem of external exposure. Health Physics did not think this dose likely, so they assigned an estimated dose by assigning an external dose received by coworkers who did not have an equivalent assignment. This was translated into the electronic dosimetry data record as less than detectable. There was a change in the dose in September of 1994. The dose was changed to zero. Site experts believe this was done as a result of harmed individuals hiring an attorney. Eventually, the record was surreptitiously changed back to the estimated values.

Based on worker recollections, several company- and DOE-sponsored investigations were conducted, with a determination that "nothing" had occurred. Martin Marietta Energy Systems conducted an investigation in 1996 on the dosimetry program, even though they had been notified in September of 1994 that dose from this incident had been altered. The Inspector General of DOE indicated that this had been changed, but that this was an isolated occurrence.

Meetings between the guard union representatives and the Plant Manager resulted in a heated argument, where union representatives were told they were lying about the incident. In the meantime, the cell shots were continuing, and more were being exposed during these subsequent releases. As a result, additional employees received similar exposures in the days that followed July 26, 1994.

Being frustrated by the company and DOE investigations into the matter, it was noted by interviewees that the Security Union Safety Officer requested an HHE from NIOSH. Two NIOSH employees conducted the HHE investigation at Portsmouth. The company denied that shots took place during the time in question. During the course of this visit, NIOSH personnel conducted a tour of the cascade areas and visited the specific area where the July 1994 incident occurred to evaluate operation's logbooks for the period in question. Interviewees indicated that the first logbook they were shown did not indicate there were shots performed on the day of the incident (July 26, 1994), or that the pressure readings went above atmospheric pressure. They indicated that the logbook looked "suspicious." A second logbook was apparently requested, which did indicate that shots had been completed that day and that readings had exceeded atmospheric pressure. The investigators were not allowed to take a copy of this log that held the entries in question, because of classification issues. Interviewees related that because of this restriction, each of them, NIOSH, and union safety representatives from United Plant Guard Workers of America and OCAW sat down and read the log one at a time. Individuals involved in operations that day would not come forward. This investigation branched into several other investigations related to the leaking seals and deposits in the cascades. One such investigation was documented in a report prepared by NIOSH, and can be obtained from them.

Some site experts feel that, in their opinion, the incident was covered up, and that DOE did not want to admit there was an issue.

Records

Site experts interviewed indicated that the Health Physics records database was implemented by computer support personnel. Health Physics records were computerized in the mid-1980s, with many historical records being added to the database going back into the 1950s. Bioassay results from the laboratory reside in the database. There was no routine monitoring for thorium and transuranics prior to the 1990s.

The procedures implemented by Portsmouth are not classified; however, current procedures developed by USEC are proprietary. Interviewees suggested that there are several documents that may benefit the site profile review. There are logbooks identifying the firing of smoke detectors and the AGG alarms, as well as the radiation clusters firing. The Nuclear Criticality Safety department would have a number of evaluations of deposit characteristics. There are also operational studies of where specific radioactive material deposits in the system.

The site experts noted that there are numerous references to planned expeditious handling (PEH) deposits, but references to specific neutron probes are very vague. They indicated that the best description would be found in the report, *Classifying and Handling Equipment Containing Uranium Deposits*, XP4-CO-CM9709, Rev. 9, effective date June 20, 2002, which they termed an "IN HAND" procedure [a copy of this report, and others cited, was not provided, although it was indicated that one or more of them had been provided during NIOSH document retrieval]. In that report, it was indicated that a "Calibrated neutron probe with probe shield on 3 sides with portable shield in front for checking background" was included in a list of tools to be used (see paragraph 7.1). Similarly, the site experts noted that the removal and handling of PEH equipment is covered under a procedural document, NCSA-Plant028.

There is reference to the Rascal meter in procedure CA-MP 7.5 (Rev. 1), *Preparation for and Changing Process Gas G-17 Valves, Piping, and Expansion Joints,* effective date January 27, 1992, a General Intent procedure. According to those interviewed, this document is currently "ON HOLD" pending evaluation for revision or deletion as of October 15, 1998. Likewise, the interviewees indicated that in this report, the Rascal meter is described in the procedure under tools needed and reads, "Rascal Eberline PRS-1 Gamma Radiation Meter."

Portsmouth was required to submit documentation on their dosimetry program to Idaho as a part of the DOELAP and NVLAP processes. This data may be useful in evaluating the quality of data available through Portsmouth. Dosimetry and bioassay results were occasionally made available to workers.

Data Integrity

The union officials found out that the process for assigning external dose was inconsistent and/or not documented. The implementation and enforcement of rules related to dosimetry were not reliable. There are concerns that the data are incomplete and inaccurate. A mortality study of Portsmouth was conducted by NIOSH. The value of the study was questioned because of the completeness and integrity of the data. There was also an issue of the falsification of dosimeters, which was noted by interviewed subject matter experts who worked during the early to late 1990s, and it is probable that this practice extended well back into the history of the facility over several decades until the perpetrators and this practice were identified. Dosimetry and recording practices are discussed in *Internal Investigation into Health Physics Management Practices*, POEF–150-96-0088. At one point, access to the dosimetry database was unrestricted. Now access is limited to certain individuals. Data stored on magnetic tapes was overwritten, making it unavailable. Many workers to this day don't trust the dose records at this site. Martin Marietta Energy Systems prepared an extensive report on the Portsmouth site that should include information about dose records or lack thereof. This entire issue is hotly contested.

The site experts observed that although a DOE moratorium on records was initiated in 1992, personnel monitoring data from the 1970s–1990s stored on archived tapes no longer exist. The tapes containing the data were recorded over 20–30 times. These archived tapes were requested by NIOSH. Portsmouth has an archived tape machine available in Building 100. This was an important source of data, which would allow for data verification of the current dose of record. Interviewees indicated that first-hand information and documentation is available to support the above.

Numerous site experts expressed their opinion that the company went out of its way to hide issues. Union members indicated that an anonymous letter was sent to the union indicating that backup magnetic tapes containing personnel monitoring records were destroyed. Interviewees indicated that DOE and the company were aware of issues with medical and radiological records, yet they chose not to act at the time.

Historical operations and potential exposure conditions should have been kept in the X-100 Administration Building, and duplicate copies should have been maintained by the DOE as the legacy regulator. The guard's union (SPFPS) has some documentation that has already been presented to the DOE, Inspector General, Ohio Bureau of Workman's Compensation, the Senate Subcommittee on Governmental Affairs, Former Congressman Strickland (presently Governor of the State of Ohio), Nuclear Regulatory Commission, and the United States Enrichment Corporation. Various agencies no doubt have collected their own source information in conjunction with what the local bargaining unit has reported to them.

Site Profile-Related Comments

Several buildings at Portsmouth were missing or poorly covered in the site profile. Site experts provided information on additional buildings where exposure potentially occurred:

Building		Comments
X-746	Cylinder Storage	Incident occurred in SE corner
X-760	Test loop from the 710 Laboratory	
X-744H	Storage	Storage of potentially contaminated components
X-744J	Storage	Storage of potentially contaminated components
X-745G	Empty Cylinder Storage Yard	
X-745C	Empty Cylinder Storage Yard	
X-745F	Heel Cylinder Yard	

There was also an area behind the switchyard that was used to store empty cylinders.

The USW indicated that NIOSH was only able to capture Portsmouth records from the site dating back to 1985.

NIOSH did not interview the salaried maintenance staff, and Maintenance staff members interviewed do not recall being informed of a worker outreach meeting.

Concerns have been raised by union officials (SPFPA) related to the ability to perform dose reconstruction. The union questions how dose reconstruction can be conducted for Portsmouth when the monitoring data is faulty. Issues have been raised to NIOSH regarding the corruption of the TLD database and the method for determining which badges are processed. The Security union has provided NIOSH and the Advisory Board with copies of documentation casting doubt on the credibility of the personnel dosimetry data. In the fall of 2005, NIOSH received a copy of *Internal Investigation into Health Physics Management Practices* (Butler 1996), a memorandum regarding an investigation performed by Lockheed Martin. These same documents were provided to the Advisory Board during the June 14, 2006, Advisory Board meeting in Washington, DC. Additional issues were raised about the practice of bioassaying only a portion of the group exposed following an incident. This information was communicated to NIOSH by union officials during worker outreach meetings. A statement was made by a NIOSH official that if it was deemed that dose reconstruction was not possible, workers at the site would be out of luck and get nothing.

Miscellaneous

- Chemical hazards were also of concern at Portsmouth. Chemicals handled or used in the processes, included beryllium, asbestos, arsenic, mercury, TCE, TBP, acids, and Freon, to name a few. Beryllium was present in the form of alloys. There was some arsenic at the Steam Plant as a result of coal burning. Certain units within the X-326 cascade also had arsenic. Asbestos was present; however, the policy with asbestos was to leave it in place and remove it only when necessary. When removal did occur, HEPA vacuums were used to control the dust. Fluoride urinalysis was originally part of the HP program and was computerized. Workers could identify release of fluorine gas by the warning properties.
- Chemical controls in the laboratory were not very good. Vent hoods were used and some operations were conducted in an open area. Work with acetone was historically done with no ventilation. Acquiring hoods required a special request, because the company

didn't want to spend a lot of money on items like hoods. One function of the lab was to clean out U-tubes, which were used to pull samples. The laboratory also handled dry ice and acids.

- Even if a worker was sickened by a release, nothing was ever found to have caused the event. Worker's compensation was routinely denied. Workers many times would not report incidents, due to inaction of management officials. If personnel asked legitimate safety questions, they were considered trouble makers and were harassed or disciplined. There have been two lawsuits filed as a result of improper protection and subsequent exposures at Portsmouth.
- Some of the disorders identified by site experts occurring to current and former security personnel include aortic aneurisms, bladder cancer, and other forms of cancer.
- Concerns were raised with the DOL concerning exposure to asbestos at Portsmouth. Workers were able to smell the hydrogen fluoride in the E-area.
- Site experts indicated they were told that once the dose reconstruction was provided by NIOSH, it could not be questioned in DOL appeals.
- Portsmouth participated in the work for other programs by processing samples from K-25, Y-12, and Paducah in the late 1990s.
- Environmental monitoring and criticality safety were separate from the IHHP group.

Observations by SC&A

During the tour provided by Portsmouth staff, SC&A representatives made several observations related to the current radiological postings:

- At the present time, there is a fixed contamination area (FCA) posted at the south end of X-326. A TLD is required for entry to the areas inside the security fence. The ERP area is posted as a radiation area and FCA. There is a note that the area is not to be disturbed.
- Portions of X- 344 are posted as a radiation area and a fixed contamination area. It is further noted that no physical destruction of surfaces or disassembly of equipment is allowed without prior approval from Health Physics. Other portions of the building, such as the technetium trap area and the mezzanine by the autoclaves, are posted as High Radiation Areas. It is also noted that there are several Nuclear Criticality Safety Requirements posted throughout the building. These postings were initiated by USEC and were not present during the years of operations.
- The foundation of Building 770 was left in place when the building was demolished. The foundation itself is now posted as a contamination area, with an RWP required for entry. A second boundary surrounds the building foundation and is posted as a soil contamination area.
- The X- 333 Switchyard is not posted as a radiological area.

Questions from Interviewees

- If records have been altered through the years, how can the data provided by DOE be used to reconstruct dose for the EEOICPA program?
- If records were destroyed, where did all the records come from that are currently being used in dose reconstruction?

References

DOE 1990. Baseline Compliance Assessment (Tiger Team): Portsmouth Gaseous Diffusion Plant, DOE/EH-0144, April 1, 1990.