Draft

ADVISORY BOARD ON
RADIATION AND WORKER HEALTH

National Institute for Occupational Safety and Health

PANTEX PLANT SITE EXPERT INTERVIEW SUMMARY

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ACRONYMS AND ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
Advisory Board	Advisory Board on Radiation and Worker Health
AEC	Atomic Energy Commission
Anti-C's	Anti-contamination Clothing
CA	Contamination Area
CAM	Continuous Air Monitor
CATI	Computer Assisted Telephone Interview
CDC	Centers for Disease Control
CINDY	Code for Internal Dosimetry
cm^2	Centimeters squared
D & D	Decontamination and Decommissioning
DOE	Department of Energy
DOELAP	Department of Energy Laboratory Accreditation Program
DORMS	Dosimetry Records Management System
dpm	Disintegrations per minute
DU	Depleted Uranium
EEOICPA	Energy Employees Occupational Illness Compensation Program Act of 2000
ERT	Emergency Response Team
HE	High Explosive
HP	Health Physicist
IAAP	Iowa Army Ammunition Plant
IMBA	Integrated Module for Bioassay Analysis
JTA	Joint Test Assembly
LANL	Los Alamos National Laboratory
LASL	Los Alamos Scientific Laboratory
LINAC	Linear Accelerator
M & H	Mason and Hanger
MAA	Material Access Area
MDA	Minimum Detectable Activity
MEK	Methyl Ethyl Ketone

MOCA	4, 4 – methylene-bis (2-chloroaniline)
mrem	millirem
MTC	Metal Trades Council
NaI	Sodium Iodide
NIOSH	National Institute for Occupational Safety and Health
NTS	Nevada Test Site
OSHA	Occupational Safety and Health Administration
PA	posterior/anterior
pCi	picocurie
PPE	Personal Protective Equipment
PT	Production Technician
PVC	Polyvinyl Chloride
RadCon	Radiological Control
RaLa	Radium Lanthanum
RAMS	Radiation Alarm Monitoring System
RDX	hexahydro-1, 3, 5 – trinitro – 1, 3, 5 trizine
RT	Radiation Technician
RTG	Radioisotope Thermoelectric Generator
Rem	Roentgen equivalent man
RWP	Radiation Work Permit
SC&A	Sanford Cohen and Associates, Inc.
SCBA	Self-Contained Breathing Apparatus
SEC	Special Exposure Cohort
SFN	Significant Findings Notification
SNM	Special Nuclear Material
SSR	Safety Secure Railcar
SST	Safety Secure Trailer
SWMU	Solid Waste Management Unit
TBD	Technical Basis Document
TTR	Tonopah Test Range

INTRODUCTION

As a technical support contractor to the Advisory Board on Radiation and Worker Health (Advisory Board), S. Cohen and Associates (SC&A) has been tasked with reviewing the National Institute for Occupational Safety and Health (NIOSH) Pantex Plant site profile and the Special Exposure Cohort (SEC) petition evaluation report. One component of SC&A's review is a series of interviews with site experts, including current site workers, former site workers, petitioners, and worker representatives. The purpose of these interviews is to obtain first-hand accounts of past radiological control and personal monitoring practices, and to better understand how operations and safety programs were implemented at the site over time. Interviewees were identified through available site reports, public meeting transcripts, unions, petitioners, and/or other interviewees. This report summarizes the results of interviews reviewed and approved by interviewees for all Pantex Plant interviews conducted through May 21, 2010.

A team of SC&A personnel conducted several sets of interviews in conjunction with the site profile review and the SEC petition evaluation report review:

- February 22, 2007–March 9, 2007 (Robert Bistline and Kathryn Robertson-DeMers)
- March 18, 2009, Telephone Interview with a petitioner (Kathryn Robertson-DeMers)
- September 14–17, 2009 (Robert Bistline and Joe Fitzgerald)
- May 17–21, 2010 (Kathryn Robertson-DeMers and Abe Zeitoun)

This interview summary also contains information reviewed by principal tour guides from tours of the training bay conducted in March 2007 and March 2009. Interviews conducted in September 2009 were attended by Advisory Board member Bradley Clawson. A total of 38 site experts participated in these interviews.

The workers whose interviews are summarized below represent the time period from 1953 thru May 2010. They collectively worked at the Burning Grounds, the Firing Sites, the Training Burn Pit, Area 4, Area 10, Area 11, Area 12, and the "D" igloos. Some interviewees also participated in offsite activities, including the Tweezer Project at the Nevada Test Site (NTS), in field modifications, and nuclear weapons accident response. Several individuals' responsibilities took them throughout the site. The operational programs collectively represented by the interviewees include the following:

- Assembly Operations
- Disassembly Operations
- Dosimetry
- Environmental Monitoring
- Fire Protection
- Joint Test Assembly (JTA) Program
- Maintenance
- Medical
- Modification Operations
- Quality Control Inspection
- Production Engineering

- Production Stores
- Production Technology
- Radiation Safety
- Retrofit Operations
- Safety (General)
- Security
- Stockpile Surveillance Operations
- Training
- Transportation
- Union Representation
- Warehouse Operations

For the initial set of interviews, onsite interviews were conducted in a secure location, while offsite interviewees were directed not to disclose classified information. Based on experience with the first set of interviews, the Department of Energy (DOE) required that subsequent interviews be conducted at the Pantex Plant in a secure location. An exception was made for the petitioners who were not previously employed at the Pantex Plant. A DOE classification officer was present in the room during the second and third set of interviews. During the third set of interviews/reviews, additional Pantex observers, including management, were present in the room for some of the time. All interview notes (onsite and offsite) were reviewed by the Pantex classification office.

Workers were briefed on the purpose of the interviews, and provided background on the Energy Employee Occupational Illness and Compensation Program Act (EEOICPA) dose reconstruction program, site profiles, and/or the SEC process. They were asked to supply their names, in case there were follow-up questions. Interviewees were reminded that participation was strictly voluntary and that all interview notes would be reviewed for classification following the interview. There was hesitancy on the part of many workers to be interviewed onsite in secure areas. Some workers and former workers fear retribution by the Pantex Plant. Additionally, a number of the interviewees did not participate in the follow-up review of their summaries. These interviews are not included in this overall summary.

Individuals interviewed were offered the opportunity to review their individual interview summaries for accuracy and completeness. This is an important safeguard against missing key issues or misinterpreting some vital piece of information. The routine practice used to allow interviewees to review their summary is to send interviews to interviewees via mail, and have them provide written comments. This was not feasible for the Pantex Plant interviews, because of security considerations. Given the sensitivity of much of the material discussed in the first two sets of interviews, it was decided that an in-person review by the interviewees was required. This process allowed for only limited time for participants to review the summaries. Review of SC&A interview summaries was the primary purpose for the third interview trip.

During the initial set of interviews, one individual indicated he participated in a classified Computer Assisted Telephone Interview (CATI). Another individual's claimant information provided to the Department of Labor was reviewed and deemed to be classified. In the first case, Pantex no longer had possession of the classified interview. A review of the second individual's claimant information indicated that pertinent information to dose reconstruction was contained in the classified information.

The information provided by workers and site experts is invaluable in helping SC&A better understand the operations at the Pantex Plant. This summary report is not a verbatim presentation of the material contained in the interview notes, nor is it a statement of SC&A findings or opinions. It is a consolidated summary of statements, opinions, observations, and comments that the interviewees communicated to SC&A. Its sole intent is to communicate to the work group, the Advisory Board, and other interested parties information acquired by SC&A during these interviews. **Comments are included in brackets where SC&A has provided clarification on a statement. This includes notations (i.e., "DOE redacted") where DOE redacted information from the original summary. Additionally, notations where the Centers for Disease Control and Prevention requested redaction for Privacy Act compliance (i.e., "redacted") may also occur in the text.**

Information supplied by interviewees was based entirely on their personal experience at the Pantex Plant. It is recognized that the site experts' recollections and statements may need to be further substantiated; however, they stand as critical operational feedback and reality reference checks. This interview summary is provided in that context. Key issues raised by site experts were and continue to be reflected in SC&A's site profile and SEC evaluation report reviews, either directly or indirectly. Interviews from all workers who reviewed and approved their individual interview summaries, or who provided answers in written form, were consolidated into a single summary document. The information has been categorized into topical areas related to onsite activities, offsite activities, security, workforce information, radiological controls and hazards, environmental monitoring, medical, incidents and investigations, radiological records, NIOSH technical document-related comments, chemical exposures, and miscellaneous comments. Where conflicting observations and statements were received, both perspectives were retained in this summary.

With the preceding qualifications in mind, this summary has contributed to SC&A's understanding of issues raised in the site profile and the petition evaluation report reviews.

ONSITE ACTIVITIES

[The interviewees, collectively, provided their characterization of the radiation-related facilities and programs, as follows.]

Pantex was involved in assembly, disassembly, modification/retrofit and/or stockpile surveillance of the following weapons programs during its period of operation: Mk-4, Mk-5, Mk-15, Mk-18, W-25, W-28, W-31, W-33, W-34, W-38, W-39, W-40, B-41, W-43, W-44, W-45, W-48, W-50, W-52, W-53/B-53, W-54 (Davy Crockett), W-55, W-56 (Minuteman II), W-57, W-58, B-61, W-62, W-66, W-68, W-69, W-70, W-71, W-72, W-76, W-78, W-79 (Gas Bustled Artillery), W-80, W-83/B-83, W-84, W-85, W-87, and W-88 (Terazzo 3T).

Weapons received by Pantex were required to be one point safe. Pantex also put weapons together for the Plowshare Program.

Portions of a nuclear weapon containing radioactive material include:

(1) Primary (also known as the center item, physics package, nuclear package, or pit)
(2) Secondary
(3) *[DOE Redaction]*

[DOE Redaction] Radioisotope Thermalelectric Generators (i.e., small-scale thermal batteries or RTGs) contained Pu-238. These devices were encapsulated. There were a lot of these units and they were thermally hot to the touch. Engineers and the design laboratories have a more detailed knowledge of what is in a particular unit [i.e., weapon].

Enriched uranium was used in the Mk-4, Mk-5, Mk-18, Mk-31, B-53, etc. The Mk-4 and Mk-5 were in-flight insertables. *[DOE Redaction]* The W-48, fission bomb, had a closed pit (i.e., no opening in the pit). The W-48 case (not the center item) had radioactive material (i.e., heavy metal) in it. The B-53 had a large squash in it.

[During the course of the site expert interviews, interviewees described the various facilities and their functions.]

[Table 1: Pantex Facilities Described by Site Experts]

Location	Description
Igloos (Zone 4)	Critical Material Storage
Zone 11	Development of items for assembly process; Development Mechanical Press Facility; Explosives Matching Area (Building 11-14); Explosives preparation (Building 11-20) Note: There was an explosion in Building 11-14a that killed four individuals.
12-9	Inert Machining Facility for machining on tools and metals
12-17, 12-19, 12-121	Protective Material Fabrication Facility
12-24N	High Explosives (HE) machining
12-26	Production support facilities; Critical material staging
12-42	Production support facilities; Critical material staging
12-44	Disassembly facility; Decontamination facility; Cells where HE was removed from the pit
12-48	Maintenance shop (kept parts for maintenance, repair, and mechanical work)
12-56	Telemetry and mass properties testing; X-ray building (not currently in use)
12-61	Production support facilities, critical material staging
12-66	Critical material staging area
12-69	Critical material staging area

The buildings are spread out with lots of bays and work locations. Not everyone knew everything that was going on within the buildings.

Press operation was a daily operation to support the assembly process. The unit was placed on a horizontal stand about 18–20 inches from the individual. It took half a day to prepare for pressing operations, and a half a day to perform the pressing. Workers often alternated between two presses while the glue was setting on the case. Exposure to the groin occurred when the center items were carried manually and often cleaned with the unit in the worker's lap. The unit sat all night, and then was placed on a horizontal stand to attach the cables. The unit then went to the next bay for mechanical work. The press operation was associated with the assembly of components. Protective clothing included polyvinyl chloride (PVC) gloves. The subassemblies were also cleaned with Methyl Ethyl Ketone (MEK) prior to bonding.

Into the 1980s, there were no personnel, HE, or kilogram limits. This meant that all areas on the line, including bays, cells, production stores, non-destructive testing, etc., were covered up with pits. In addition to the pits, four to eight full-up weapons might be located in the same area. Within the cell, workers could be working on multiple weapons at one time, including multiple physics packages. They would put tape down the middle of the cell. One system was worked on one side of the tape, and the other on the other side of the tape. This was standard practice at the time.

Workers performed operations with the W-68, and the W-76 was staged in the area. For the W-48, 10 units were working and 10 units were being prepared for work. The Mechanical Assembly group could have as many as four units in a bay at a time, with two in the staging area. There could be up to four disassemblies in a day, including weapons systems and JTAs.

Pantex has an active weapons training program, where mock-ups are brought in for Production Technicians (PTs) to train on assembly, disassembly, and testing of particular systems.

Assembly/Disassembly

Smaller weapons can be assembled on stands, while large weapons assembly is completed in a hole in the floor. For example, the W-39 and W-28 were disassembled in Building 12-26, Bay 17, where the weapons were put down into a pit hole in the floor to work on. The W-56 was also worked on in a pit in the floor. During the assembly/disassembly of the W-56, workers sat with their head in the rear of the unit. With the W-48, they sat on a stool. There were a lot of individuals sitting day after day straddling the W-48.

The reservoirs for assembly were shipped from the Savannah River Site. When reservoirs were received, they were weighed to verify something was in them. Reservoirs were made out of stainless steel. Not all the units received by Pantex for disassembly came in with the reservoirs attached. The military was responsible for removal of reservoirs prior to shipment to Pantex for some programs.

There was a tritium issue associated with the tritium bottle on most weapons. They would install the squib valve on the unit followed by the reservoir. This was explosively charged, and you set it off with electricity. Rarely, the squib valve would pop (i.e., the part would fire) and the tritium was dumped. This occurred at least twice; once at Pantex (Cell 1 Incident) and once on a ship on the east coast. There were also issues with tritium bottles venting during transport.

When checking the reservoirs, the workers were told to listen for a hiss. If they heard this, they were to tighten the gland nut and exit from the area. The hiss was what alerted workers to the problem during the Cell I Incident.

During routine work with these bottles (i.e., reservoirs), there was some leakage of tritium. Occasionally there were some high tritium readings. There was leakage in the system through the metal. At one point, they were working on a W-44, which was returned from the field. When they weighed the bottle after it was taken off, the bottle was empty.

During the assembly and disassembly of weapons, pits had to be cleaned. Some workers reported that the pits were placed on racks or tables for cleaning, while others put the pits in their laps. In the case of the pits provided for assembly, the pits could be cleaned in a few minutes. In the case of a disassembly, the pits had adhesive (e.g., resin, epoxy) on them that took longer to clean off. The W-28, W-31, and W-39 weapons had epoxy on the surface of the pits, which had to be scraped off. At times, workers used steel wool and sand paper to remove the epoxy from the pits. This occurred with the W-28 and W-31 into the late-1960s or 1970s. *[DOE Redaction]*

For some of the larger weapons (e.g., W-31), the process for removing the high explosive (HE) from the pit involved packing the unit in dry ice, then putting it into hot water to crack the HE. *[DOE Redaction]*

Initially, there were no kilogram limits for HEs, or personnel limits in the Gravel Gerties. After 1994 and the implementation of the Radiological Control Manual, limits were put in place.

Retrofit/Modifications/Stockpile Surveillance

The process involved in retrofitting is disassembly of the weapon or weapons component, testing, and re-assembly. A retrofit involves a modification of some kind, or a change in weapons parts.

The stockpile surveillance program started at Pantex in the mid-1960s. This program was inherited from Medina when it closed. The disassembly (retirement) work was done at the Clarksville facility. When those sites closed, they sent the work to Pantex. There was no surveillance done at Iowa Army Ammunition Plant (IAAP). When Medina and Clarksville closed, Pantex inherited people from all levels (e.g., managers, Quality Inspectors, PTs, etc.).

When units returned to Pantex for surveillance, a vacuum gas sampling system was hooked to the valve to determine the radiological and physical atmosphere within the system. Several tritium monitors were used during this process, including a Blue Goose and a T-289 Tritium Monitor. Filter washers are collected to measure depleted uranium (DU).

Inspection

An inspector's responsibility was to be present, inspect all parts, and observe and sign off on all operations. They also had to inspect pits before they were used in a weapon. The Assemblers removed the pits and checked the serial numbers.

In order to inspect the pits in Building 12-42, the worker would line 50 drums up in multiple rows. The inspectors from the Atomic Energy Commission (AEC) and Mason and Hanger (M & H) would go through and remove the stamps. Operations would close up the drums, seal them, and put them in the vault. The drums with the pits were out in the open area in the warehouse. People were coming and going. There were no lead aprons worn at the time, even in the vault area. The cans themselves provided some of the spacing required *[for Criticality Safety]*.

Radiography on the units was conducted in Building 12-21 using stationary x-ray units. Portable sources, such as the large Co-60 source, were brought over in pigs (i.e., large metal boxes) to conduct testing on systems that were too large to take to Building 12-21. Later on, they started using the LINAC (Linear Accelerator) machines on the weapons. The weapons were taken over to the LINAC for analysis.

Storage/Inventory

Production Stores was responsible for receiving and shipping nuclear materials and weapons-related components. All incoming nuclear material was inventoried monthly, quarterly, annually, and other times as needed. When shipments of nuclear materials arrived at the plant, Production Stores went out and checked the materials, checked the serial numbers against packing slips, created a list of the items, and put a card or a tag on each item. The pit cans weigh as much as 60 to 100 pounds, requiring workers to use just their hands and body strength to break the chains on the Safety Secure Trailers (SSTs) when the items (pits and other things) were received at the loading docks. With a normal shipment, personnel worked with the materials approximately 4 to 6 hours, 2 or 3 times a week. Cards/tags were carried to the Production Planning group, where they were entered into a database. Information was also provided to the Red Phone/Control Room on a daily basis. Monthly and yearly inventories took more time and kept workers in the areas with radiation and/or waste for longer periods of time.

One interviewee indicated there were no radiation monitors inside the truck trailers or on the docks. The safety department went into the trailers [SSTs] before other workers entered to check the radiation levels. Safety then told the workers whether it was safe to enter the trailer. Those involved unloaded trucks coming from offsite and 1oaded them with items to be taken to the igloos (Zone 4 igloos, "D" igloos, Zone 10, and Zone 11) for storage. When unloading and moving accountable materials, workers had to get items to the proper location within specified time limits. If this was not done, it could shut down the line. This was one of the safeguards used to ensure that certain materials, such as pits, tritium bottles, and HE, were not compromised or taken off the plant. Workers could not stop and take a break until everything was unloaded and/or accounted for.

Production Stores did the inventories in the pit vaults. When time permitted, the Production Technicians assisted with inventories. In the pit vaults, workers had to move the containers to get to the serial numbers for verification. Drums containing the physics package were stacked up. In the process of checking and verifying cards, workers had to climb over the drums to get to material being inventoried, causing excess exposures. They stayed in the vaults when they were doing inventories and were usually in there at least 2 hours or longer until everything had been inventoried.

While conducting inventories, there was a buddy system requirement (i.e., two people maintaining custody and constantly in clear vision of each other). Personnel were required to sit there with the material until someone else took custody. Workers would sit on the containers that contained the physics package. At times, workers could sit with the pits for 8 hours at a time.

Stores clerks and transportation personnel were responsible for conducting inventories of material in the igloos. This occurred once or twice a year, lasted for a day, and involved six to eight individuals. During an inventory, personnel would enter the igloo with a Triton III monitor to make sure there was no tritium release. There were no alarm systems in this area. The clerk would carry the inventory list and transportation would call out the numbers on the outside of the container or on the weapon. A comparison was made between what was actually in storage and the inventory list.

Transportation

The material in SSTs/Safety Secure Railcars (SSRs) was received from the courier in Zone 4. The trailers were parked on a pad. The contents of the trailer were hooked up to a tractor and pulled to the igloos for unloading. This included all components received. Outgoing items were sometimes transported to the airport.

Transportation was also responsible for carrying unshielded pits from one location to another throughout the site. This practice continued up to 2005.

[DOE Redaction] At times, they transported huge neutron generators for the National Aeronautics and Space Administration and spent fuel rods in casks. Technicians had monitoring responsibilities associated with SSTs. This did not occur very often.

Joint Test Assemblies (JTAs)

Joint Test Assemblies were nuclear explosive look-alike units, which underwent military testing such as being dropped from an aircraft or fired on a missile. There have been JTAs made for each unit since 1958. The units contained reservoirs, zippers (i.e., neutron generators), detonators, HEs, and a dummy physics package. These did contain some radioactive material (i.e., DU). There was a beryllium case in the JTA.

For JTAs dropped from aircrafts at Tonopah Test Range (TTR) (or dropped on land), they collected the post-flight debris and sent it back to Pantex in a white box for a post-mortem analysis. In the post-mortem process, workers took the debris apart and evaluated the components.

Due to the manual damage of the system, tools such as chisels and hammers were used to disassemble the case. Some of the components underwent re-acceptance testing for future reuse, while others were discarded. If the JTAs were put on a missile, the residue was not sent back to the Pantex Plant for evaluation. The number of post-mortem JTA analyses done per year depended on the weapons program. For example, with the B-61s, there were about 11 in 1 year.

There were some years when no JTAs came back to Pantex.

Burning Grounds

Hemispheres were taken down to the burning grounds for removal of the HEs. Early forms of HEs were highly sensitive and capable of detonating if dropped. *[DOE Redaction]* To dispose of this type of HE, the hemisphere was placed on a tray in an enclosed wire cage located in an open field. Diesel fuel was electrically ignited from a bunker ~100 ft away from the pad. Transportation workers spent time out at the burning sites (i.e., burning pits and the burning ground) and were responsible for igniting the HE. Upon ignition, the material melted and became a component of the sand. *[DOE Redaction]* The Fire Department was responsible for extinguishing fires wearing Level B protection.

An interviewee involved in the burning operation indicated two individuals were directly involved in the burning operation. In the 1970s, Pantex was burning on a daily basis. At the time, there were no wind requirements. There was no air sampling located right at the burn site. Radiation Technicians came out every once in a while to monitor the field. The process did not produce much removable contamination. The ash under the burn racks was sampled periodically; a few times, there was detectable DU in the ash. This operation continued until at least 1993 or 1994.

There was a survey conducted in about 1992 or 1993 in preparation for the Decontamination and Decommissioning (D&D) effort of Pad 13. This included soil sampling and scan surveys with a Sodium Iodide (NaI) detector. There were some steel plates from the burn site that had to be decontaminated. Survey results would be recorded in a logbook. The area is controlled as a soil contamination area.

Hydroshots

Hydroshots involving depleted uranium shells with specific weapons systems (e.g., W-38, W-53) were conducted at Firing Sites 4, 5, and 10. A uranium mock-up was produced and exploded. There were ~6–12 hydroshots per year. Short-term, high-volume air samplers were used to detect airborne activity downwind. Their placement was questioned by some, because there was an earth barricade around the sampler. Air sampling also consisted of collection of environmental samples at the perimeter to the plant. In one instance, a radio-controlled motor plane was equipped with air sampling and flown through the hydroshot cloud. The concrete in the bunker was found contaminated. During clean-up activities, a 5-gallon bucket full of uranium chunks was collected. There were several inches of oxide encountered during the clean-up of Firing Site 5. There was fixed uranium contamination from the sand, flowing via water, into the bunker.

OFFSITE ACTIVITIES

[The interviewees, collectively, provided information on offsite activities involving Pantex workers, as follows.]

[DOE Redaction]

Pantex personnel participated in weapons testing conducted at NTS. One interviewee participated in the Diablo and Priscilla tests at NTS. This individual was allowed to access ground zero to conduct some radiological measurements. As a result, he received a substantial exposure. The individual noted he received a majority of his lifetime exposure while at NTS. This exposure was not reflected in the individual's Pantex dosimetry file/information according to the interviewee.

Pantex workers traveled to other DOE sites (e.g., Los Alamos National Laboratory, Rocky Flats Plant) and, in some cases, internationally. Operators were sent to NTS to change out limited lifetime components. PTs were sent to TTR to assist with the JTA program.

[DOE Redaction] This required an in-field removal of the firing set. There were several individuals that went to Russia after Reagan signed the treaty. Both countries were going to cut back on the amount of weapons they had. Site experts were not aware of Pantex working with weapons from other countries.

SECURITY

[The interviewees, collectively, provided information on the duties and responsibilities of security personnel, as follows.]

Security was responsible for doing walking patrols, bicycle patrols, and motorized patrols. Guards would go through machine shops periodically, usually when they were inactive, to make sure they were locked down, but there were times when they went through the machine shops while active beryllium machining was ongoing. Some Security personnel were involved in many episodes of special drills, where they would go through buildings crawling on the floors in preparation for possible attacks on the facility. Some members of Security spent time on the construction security force, escorting un-cleared construction workers and observing them during their jobs. This included new construction and some remodeling of older buildings. Security personnel entered virtually every building at the plant.

Security checked the vaults (used for storage of pits and tritium bottles) and other areas at night (e.g., locked and sealed doors, etc.). Every facility door had to be checked by each tour/shift during the first hour of each 2-hour tour. Security personnel could have been around the pits anywhere from 15 minutes to 1 hour, depending on what was going on, the building, etc. One site expert recalls seeing pits when he was on patrol at night.

During guarding of components, the proximity to the units varied. There were times when guards were no more than an arm's length away or closer. Security was around greater numbers of radioactive materials in the old days, because the controls/limits were different. One guard was tasked with guarding the cobalt source for a period of time. In early days, personnel did not receive any training on working around radioactive material.

During vault inventories (in Area F, for example), security stayed outside the entrance out of the way. The doors were open. When this was done, they were there several hours while the igloo was inventoried. Sometimes they would bring a portable radiation monitor with them to the igloos.

Materials were transported in regular semi-trucks, which were the property of the plant, or railcars.

Some Security positions were responsible for purchasing the shipment and historically entered the SSTs/SSRs to inspect the shipment. There were times when they were right next to the shipment for short periods of time, and then moved farther away. During the loading/unloading of the SSTs/SSRs, Security had to maintain surveillance. They observed the loading/unloading of Special Nuclear Material (SNM) from staging areas or docks. During unloading, SNM containers were placed around them and, in some cases, filled the dock area where they were positioned. Security was in very close proximity to weapons and materials when they were received on the loading dock or shipped out.

Anytime tractable materials were moved around the plant, guards were present. When materials were coming into the warehouse areas/docks around Building 12-26, Security was around radioactive material. They had to stay with it at the dock. At the time, they were usually very close to the materials. The weapon was towed right by them. Once the items were inside the ramp, Security could leave.

Security used to go to the Air Base a lot when the plant was shipping and receiving materials by airplane. They waited with the vehicles holding shot guns until someone else took custody. There were times when they had to wait at the Air Base longer when the planes were delayed. They kept out of the way, but monitored activity until the plane was shut.

WORKFORCE INFORMATION

[The interviewees, collectively, provided generic information on mobility of the workforce, over time, and responsibilities and duties, as follows.]

Workers routinely functioned outside of their job titles performing work for which they had appropriate clearance and qualifications. For example, office staff sometimes transported material and parts from storage or labs to assembly points, or the reverse. Production Technicians assisted with inventories. When available, personnel helped out where they were needed.

PTs were a mobile work force throughout the Pantex Plant. They worked all over the plant when the work load got light. Where particular processes were conducted was continuously changing.

There were PTs involved in weapons assembly, who did not participate in weapons disassembly. Quality Inspectors did not necessarily work on the line.

Duties of the Firefighters at Pantex include, but are not limited to, checking fire extinguishers, checking fire doors, conducting building inspections (historical), checking fire systems (historical), and emergency response. Those involved in emergency response are trained in firefighting, with some trained as Emergency Medical Technicians. Thirteen (13) individuals work on each shift. These responsibilities take firefighters throughout the plant, including into bays and cells where weapons work was being done.

Maintenance, security, and transportation personnel went into all areas of the plant. Pipefitters [Maintenance] were responsible for putting the vacuum lines, etc., in the bays and other production areas/Material Access Areas (MAAs). Utilities personnel went into all facilities to do filter changes. Crafts personnel were specially trained to allow them to enter bays and cells as necessary. The Electronics Technicians were responsible for fixing the monitors. The [security] badges had either a red bar or a white bar. If a worker had a white bar, they could only enter the bays with a red bar employee.

Overtime varied by job function. Individuals working in the press operation worked an average of 20 to 24 hours of overtime per week. There were times when Production Stores staff reported working an average of 60 hours per week when working the night shift.

There were subcontractor, temporary, probationary, and short-term employees at Pantex. The job responsibilities included repairs, maintenance, construction, delivery, transport, telephone services, power, climate control, summer work, etc. These workers were used continuously.

RADIOLOGICAL CONTROLS AND HAZARDS

[The interviewees, collectively, provided information on the historical and current Radiological Control Program, including information on the RadCon organization, radiological hazards, administrative and engineering controls, personal protective equipment, radiological monitoring, and personnel monitoring, as follows.]

Organization

In 1952, Pantex hired a [redacted] radiologist to assist with industrial radiography. This individual, in turn, hired a [redacted] Engineer who oversaw Radiation Safety in addition to several other safety disciplines. At this time, there were a few hundred personnel at the plant. The internal plant history document provides information on the plant population by year. An [redacted] expert was also brought in. The [redacted] Engineer was originally given support staff, who were responsible for taking care of the film badges. In the early 1970s, the first Health Physicist was hired. There were only a small number of individuals in Radiological Control (RadCon) [professional and technicians]. After the tritium incident in May 1989, there was a rapid expansion of RadCon staff. Staffing increased to at least 35 by August of 1991, and eventually increased to 50 technicians. This significantly improved coverage; technicians were available to characterize work processes, monitor workers more effectively, and survey areas on a daily basis. By 1991, Industrial Hygiene, Environmental Monitoring, Nuclear Safety, Criticality Safety, Nuclear Explosive Safety, Emergency Management, and Radiation Safety were separated into their own divisions. A Criticality Safety program was initiated, but was eventually incorporated in Nuclear Safety.

In approximately 1982, for an entire year, there was only one Radiation Technician (RT) onsite. The number of Radiation Technicians increased to 2–3 for a period of time. Radiation Technicians in the early days were not able to cover the entire plant. During the Tiger Team assessment, the staffing was such an issue that Radiation Safety management was asked to hire 10 technicians by the end of the day. They also did not have a lot of equipment, and procedures and training were not very good.

A combination of the Cell 1 Incident, the Tiger Team review, and the implementation of the *Radiological Control Manual* (DOE 1994) led to a significant expansion of the RadCon program. The Tiger Team resulted in a change in safety culture. There was a significant improvement in practices and procedures. It may have been down on paper, but at times there were exceptions. Workers always followed safety rules and regulations to the best of their ability. Sometimes the standards were not right and workers had to go around them. There were times in safety where individuals just had to go around the post to get to the other side.

The workers had no concept of the degree of hazard. Originally, the workers were not aware they were working with plutonium. The plant was not required to tell the workers what they were working with. After a while, workers were told that management had found out that the workers were aware management had been lying to them. Management indicated they were not going to lie to the workers anymore and made a statement to this effect in front of about 100 people at the time.

Training courses were not standardized until the late-1980s. At this point, they developed better training courses for workers. Pantex brought in a Texas A&M individual to develop courses for radiation safety certifications in 1993 and 1994.

By the 1990s, there were radical improvements in practices. There was a reduction of ‘shortcuts’ as a result of the increased presence of trained union safety stewards and the gradually increasing cumulative effect of annual union safety training—gradual, because the training was very short term. The curriculum, “Machinery of the Body” (i.e., genetics, ambient and personal factors, toxicology, epidemiology, and physiology), constituted 4 out of the 32 hours of instruction. Only when the same group returned three or four times, did the level of the class dialogue get at the core issues in control and data interpretation.

Radiation Hazards

Radioactive material used at Pantex included enriched uranium, depleted uranium (tuballoy), plutonium, tritium, thorium, radiography sources such as Co-60, and LINACs. Beryllium metal was also used.

[Several exposure concerns/comments were raised by site experts related to specific weapons programs. These comments are summarized in *the table below.]*

[Table 2: Exposure Concerns Associated with Weapons Programs]

Program	Exposure Concerns/Comments	Personal Protective Equipment (PPE)/Radiological Controls
Mk-15	Tritium issues.	
B-25	Oxidation issues during disassembly.	
W-28/B-28	*[DOE Redaction]* The depleted uranium was heavily oxidized, and the DU oxide powder dumped out during disassembly. *[DOE Redaction]* "Workers looked like coal miners." They would blow their nose and black stuff came out. Contamination levels were a couple of hundred disintegrations per minute (dpm) per 100 square centimeters (cm^2).	Some workers used half-face respirators, but workers got sweaty and the respirator moved around. It did not provide a good level of protection. Workers did not wear respirators consistently because of the poor fit. There was no Radiation Work Permit (RWP) driving the use at the time. The workers notified Radiation Safety the respirators were more of an inconvenience. There were no Radiation Technicians around when the workers removed their Anti-Contamination clothing (Anti-Cs). During work on the B-28 program, there was a stop work issued, due to buildup of contamination and poor work practices.
W-33	This was one of the weapons with the highest radiation levels. *[DOE Redaction]*	No additional precautions were taken with this weapon as with others.
W-39	This unit was involved in a dropped pit incident. *[DOE Redaction]* The workers would blow their nose and black stuff came out.	
B-43	There were oxidation issues during disassembly.	
W-45	Tritium issues.	
W-47	There were oxidation concerns associated with this program. There was also dust generated when workers used a saw to cut components apart.	A site expert indicated these units were disassembled in the middle of the cell (not in a glovebox). Another site expert indicated when the W-47 was dismantled, tents were put up and the floor was papered to prevent spread of contaminants. According to one site expert, during the dismantlement of the W-47, respiratory protection was worn. Other site experts indicated respiratory protection was not worn.
W-48	This weapon was radiologically hot.	
W-50	There were oxidation issues during disassembly.	
B-53	There were oxidation issues during disassembly.	
W-55	W-55 and W-56 had both depleted uranium and thorium contamination, which caused issues in disassembly. *[DOE Redaction]* This was likely the result of bad corrosion due to exposure from the salty air. There were some issues with thorium oxide powder during the disassembly of the W-55 in the 1992 or 1993 time frame.	With the disassembly of the W-55, vacuum cleaners could not keep up with the amount of depleted uranium and thorium dust. Down draft tables were used during the dismantling of W-55s, due to the prevalence of black oxide [uranium dust]. No respiratory protection was worn.

[Table 2: Exposure Concerns Associated with Weapons Programs]

Program	Exposure Concerns/Comments	Personal Protective Equipment (PPE)/Radiological Controls
W-56	W-55 and W-56 had both depleted uranium and thorium contamination, which caused issues in disassembly. This was likely the result of bad corrosion, due to exposure from the salty air. There were some issues associated with oxidation of thorium in the W-56. Thorium would flake off.	
W-58	*[DOE Redaction]* This process was like pouring dust out of a vacuum cleaner. The dust was all over. If a worker blew their nose, it was black.	There were no respirators, but a few workers wore dust masks. They did not wear gloves.
W-60	There were oxidation issues during disassembly.	
W-68	Tritium issues/rework.	
W-69	There were oxidation issues during disassembly.	
W-71	The weapon was an external dose concern.	
W-76	*[DOE Redaction]* If you shook it too hard [a particular component], there were flakes that came off.	

Prior to sealed pits and the plutonium dispersion studies, Pantex conducted a test in Zone 5, where a Radium Lanthanum (RaLa) source from Los Alamos National Laboratory (LANL) was brought in via rail, placed on plywood, covered with earth, and allowed to decay away. This was a quick and dirty test of the Gravel Gerties.

Procedures, Radiation Work Permits, Technical Documents

O & Is [Operations and Instructions procedures] had radiation safety requirements within the document. Prior to 1993, safety requirements were not very extensively covered in the PT procedures. The procedures for the B-28 and the B-43 describe the safety requirements, including what respiratory protection and personal protective clothing are required. Radiation Work Permits or the work packages were used, even in the early days. With the implementation of the *Radiological Control Manual* (DOE 1994), RWPs were required to provide controls for work in applicable radiological areas (e.g., radiation areas, contamination areas). For example, entry into a cell required an RWP. RWPs were classified as routine or special (unique, one-of-a-kind jobs). Most procedures were routine, due to the predictable, repetitious nature of the work. Work with the first 10 units served as the basis for radiological controls in technical procedures or RWPs. Today's RWPs and work packages designate the clothing, radiation monitoring, and radiological controls for a job.

There were procedures that provided instructions to [Radiation] Technicians.

Radiological Surveillance

In the early days, Safety smeared the cans and placed material in the vaults. When the material was retrieved, they would open the can and smear the pit. They were more concerned about the high explosives during this era.

Initially, Safety would take a swipe of the top and sides of the containers. They took the drum into a 5' by 5' room, opened the drums, and smeared the pits received from the Rocky Flats Plant. One interviewee indicated that during the period from 1959–1997, there was only one contaminated pit. When the pits were taken onto the line, workers smeared the pits prior to putting it into the weapon. When pits were surveyed for contamination, workers noticed they generated a considerable amount of heat. The interviewee involved with this function does not recall maintaining a log or survey sheets with smear results. The Safety Engineers were not responsible for monitoring the building itself (i.e., floors, walls, etc.).

Quality Inspectors and PTs took some of the radiation smears for alpha contamination. If there was anything questionable (i.e., a high alpha reading.), they would investigate the issue. Positive smears were put in an envelope and taken away. In the early years, the smears were put into the regular trash. *[DOE Redaction]*

Another interviewee said there was detectable alpha contamination on 95% of the weapons out at Pantex (e.g., B-28, W -31, W-43, W-45, W-48, W-50, B-53, W-54, W-55, W-56, W-57, W-62, W-68, W-70, W-76, W-78, W- 79, W-80, and W-83). It was not high, but there was some there. *[This interviewee did not specify pits.]* Reservoirs were not smeared for tritium, because workers already knew there was contamination.

There were no routine smears taken on components by RadCon in the 1980s *[era of RadCon site expert]*. RadCon conducted monthly smears of the floors and walls of the bays and cells, and on the tools. These were typically negative. They were analyzed for gross alpha and beta with a Tennelec. The results were not well documented. Areas were decontaminated to “zero” when contamination built up.

There have been characterization studies conducted at Pantex. First, personnel were sent around the site to discover legacy material. They located a few sealed sources. Contamination surveys and NaI surveys were conducted. Contamination was not the major concern from a radiological perspective.

During the D&D process for Buildings 12-10, 12-24S, 12-24N, 12-40, 11-9, 12-9, 12-9A, and Firing Site 5, the facilities were gridded off and a full characterization was completed of the area. The survey forms, maps and grids are available for these surveys. The DOE Order 5400.5 *[“Radiation Protection of the Public and the Environment,” DOE 1993]* release criteria were used as release levels.

Intrinsic radiation units were built for each configuration being worked on at the specific time *[time of the study]* at the Pantex Plant. For example, these units were built for W-55, W-48, W-68, etc. RadCon would set up units and do measurements on the units. One of the evaluations done was to fly an airplane around while the unit was in transport at the site to detect the radiation signatures. The reports from these evaluations would be available through RadCon.

Radiological instruments used to measure radiation included the Triton II, T-289, T-290, Radeco 442, Radeco 450, and Geiger Mueller counters. A portable alpha counter was used for detection of alpha.

Air Sampling

A complex air monitoring system evolved over the years at Pantex. Air monitoring systems were in place for alpha and tritium for at least some period of time. The alpha monitoring system was not implemented until the 1960s *[per some interviewees]* or the 1970s *[per other interviewees]*. Building 12-24 was the first place they installed the air monitoring. There was also air monitoring in Buildings 12-42N, 12-42S, and 12-26 vaults. Air monitors were not always in the bay or handling area itself, making these samples unrepresentative of what the workers were exposed to. For example, the positioning of the Radiation Alarm Monitoring System (RAMS) and the location of the source were not always conducive to detecting airborne contamination in Buildings 12-26 and 12-24. Air filters were changed and tested. A committee was assigned to characterize the entire air monitoring system and determine how to integrate and upgrade it. This led to a new RAMS.

Workers recall not having alpha Continuous Air Monitors (CAMs) and RadCon coverage available during part of the time they processed the W-28, W-55, and W-56. Other workers recall that continuous alpha air monitoring began in the 1980s. RadCon staff indicated there was implementation of a rigorous air sampling program after the W-43 incident in about 1990. A trending database of CAM filter results is currently maintained to identify trends *[in airborne concentrations]*.

There was personal air monitoring done on some individuals in the 1990s. In the 1990s, during the tear down of the B-28, workers had to wear a full-face respirator and personal air samplers. There was some breathing zone sampling during work on the W-79 Program. In ~2002, Pantex implemented lapel air sampling and Derived Air Concentration-hour tracking. Lapels were put on all workers entering the contamination areas.

[Concerns were raised by interviews regarding air sampling.] The sniffer was positioned at eye level; therefore, it was not really accurate. There were times when the incorrect setting was used on the Triton air monitor. Some interviewees indicated that no smoke testing was done to determine the proper placement of the air monitors. The air flow patterns were into the hallways where people walked through the air flow. This flow was away from the immediate work area.

There were particular weapons programs that bled off tritium. These regularly set off the Triton alarm. A PT would know they had a leaker *[tritium release]* immediately, because they would get a tritium alarm. Workers were to exit the area when alarms sounded. There was some air sampling conducted during the D&D of Firing Site 5. The air samples had a lot of dust loading on them.

There were three major radon studies conducted at Pantex. The range of radon levels for more permanent (administrative) facilities was 5–8 picoCuries (pCi)/1iter. In the production facilities, the radon levels were on the order of 1–3 pCi/liter. Building 12-36 had the highest concentration onsite at 8 pCi/liter.

Contamination Control

The assembly process was very clean, while the disassembly process was not. Pantex handled sealed pits, so plutonium contamination was not of concern. Components *[other than plutonium]* were clean going into a system, but could be pretty nasty coming out of a system. In some systems, DU and/or thorium had oxidized or disintegrated. Uranium is a very nasty oxide, creating flakes and dust. Thorium is not as flakey, and oxidation occurs on the surface. This resulted in loose contamination in the bays/cells while working with specific weapons systems.

Although this contamination occurred, there were no contamination areas (CAs) established in the early years. When the Strategic Arms Limitation Treaty was signed, there was an increase in the number of disassemblies. By the 1980s, the number of disassemblies had increased. This impacted the level of contamination in areas. *[DOE Redaction]* In about 1987 or 1988, RadCon had to shut down the B-28 program for quite a while. The program work was moved to another facility with better controls. With the W-56 Program, they started establishing a contamination area only in the later years because of the thorium.

The Air Quality Act, as amended in 1967, required maximum feasible participation by the public in determining objectives for air quality regions. As a result, one interviewee met with a small group representing a cross section of the area unions, including [redacted] from the Metal Trades Council (MTC). The representatives spoke of the workplace environment, especially a leader from the Pantex MTC, who asked about radiation and dust. The [redacted] of the Pantex MTC leader indicated there was a lot of dust, because the Pantex MTC leader came home from work with irritated eyes. Housekeeping and maintenance were bad in 1969. The interviewee was recruited by the industrial unions and returned in 1971, and many times subsequently by invitation of the MTC. The interviewee learned in more detail about fears of radiation, asbestos in insulation, solvents, beryllium dust measured in “wipes,” and “asthma” misdiagnosed by family practitioners and later diagnosed as Chronic Beryllium Disease.

Contamination areas at the site include areas of the Waste Operations zone, 12-42, and manufacturing. The CA postings come up and down as determined by RadCon. If an area is clean, they will release the area.

Some interviewees pointed out that contamination (i.e., dust) was controlled by putting paper on the floor, using vacuum cleaners, and/or sweeping. Another individual indicated there were no barrier materials laid out and no concern about radiation exposure from DU. Later, the site used down draft tables. It was noted that the surveillance units were not disassembled on down draft tables.

In late-1990, the site implemented task exhaust *[for controlling tritium releases]*.

Individuals were allowed to eat, drink, or smoke in the work areas. If workers had to maintain custody of SNM, they could not leave the work area. Workers would eat in the area with the pits. Some workers put their coffee on the drums. In the morning, one interviewee reported they ate donuts while sitting with the pits. In the early days, workers could have water or coffee on the bench at their work location during assembly. Workers would take their lunches into the work area and drink coffee while they were working on weapons up to the mid-1980s. The plant also allowed smoking on parts of the line and in break areas. These were common practices. Everyone knew about it and no one ever questioned it. One interviewee indicated individuals did not smoke in the work areas until the break rooms were built in about the 1970s. There was a crack down on eating, drinking, and smoking in work areas in the 1990s.

There was no scanning with radiation instruments *[egress monitoring]* after jobs to confirm there was no *[personnel]* contamination. After the Cell 1 Incident, Radiation Safety Technicians would do a whole-body frisk on individuals exiting a contamination area or above.

Respiratory Protection/Personal Protective Equipment

There was a change in the rigor of the RadCon program at Pantex. Radiation Safety Technicians were not available all the time to monitor work on the programs. Personal Protective Equipment (PPE) was required in the procedure, but there was no enforcement. This led to inconsistent application of PPE.

One long-term worker indicated that when he initially started work at Pantex in the early days, they did not wear gloves or lead aprons, or use shielding. Nowadays, Pantex would require a worker to wear lead aprons, leaded glasses, and leaded gloves. During pit vault inventories, one worker reported wearing street clothes, safety shoes, and safety glasses, while his coworker wore cotton coveralls with underclothes underneath. Although the secondary uranium components oxidized in a number of units, no gloves were worn while these were handled. One interviewee commented that whenever you wore Anti-Cs and respirators, you got dirty.

Maintenance reported starting to wear gloves for tasks like filter changes only recently.

Security personnel wore their uniforms. Building 12-1 was the change house. Security personnel removed their uniforms, took a shower, put on street clothes, and went home. Everyone from the line changed in the same place, so Security personnel were exposed to anything they brought with them on their coveralls.

Respiratory protection used at Pantex over time included half-face, full-face, and Scott Air Packs. Initially, there was a multiple use policy. A person would get a new respirator about every month. Workers changed their own filter. Interviewees do not know when this policy changed.

Firefighters stated that no respirator fit testing was done until approximately 1988, when annual testing was initiated (later every 6 months). Other workers reported annual respirator fit testing. The respirators were kept in a cabinet. They were bagged and cleaned periodically.

For a period of time after the Cell 1 Incident, workers were required to wear bottled air (Self Contained Breathing Apparatus or SCBA). By at least 1995, after the implementation of the *Radiological Control Manual* (DOE 1994), workers were put into full PPE and respirators for some programs from the beginning.

Site experts reported not wearing respiratory protection initially during the disassembly of the B-28 secondaries. Others reported no use of respiratory protection during the packaging of weapons items covered with powder. The surveillance units were not disassembled on down draft tables, and respiratory protection was not originally used.

Other Engineering Controls and Lead Aprons

The radiation shielding designed for use with the W-33, W-48, and W-19 programs was not practical, so the workers did not use it during the hands-on work. As a result, individuals went behind the shield to conduct their work. For example, when they were working on the W-19, they had a shield on three sides of the weapon. The unit was placed behind it. During the hands-on work, one individual went around with a flashlight, because there was not a lot of light. Another individual would go around the shield and work on the unit. The shielding was a boxed area or sometimes a foam material. There was glass in the shielding; however, it was distorted. If you had individuals working on the same system, but of different heights, there was a difference between the readings on their dosimeter. Taller individuals could work more effectively around the shield than shorter individuals.

[Other radiological controls were mentioned by worker.] The W-48 units were built in a glovebox with lead-lined glass.

Site experts did not know the exact year when lead apron use began. One interviewee indicated he had been working at Pantex a long time before workers started wearing lead aprons. Initially, Pantex used Butcher-type lead aprons. This apron type only covered the front of the body, but left the back exposed. One interviewee indicated workers used these during vault inventories. There were very few aprons available for workers to wear. In the 1980s, Pantex started using wraparound aprons in the vaults. In the 1990s, wraparound aprons showed up on the line. The W-48, W-56, and W-79 weapons were “hot” *[radioactive]*. There were no lead aprons worn during work with these systems. No lead aprons were worn when unloading trucks *[SSTs]*. The dosimeters were worn under the aprons.

Although lead aprons were provided to workers, there was no requirement to wear them; thus, not all workers wore them. No training on the aprons was provided.

External Monitoring

Prior to the use of film badges, Pantex used Pocket Ionization Chambers. This was likely recorded in a logbook maintained by the [redacted] of Industrial Radiography. The first individuals that were assigned dosimeters (also pencils and chirpers) were the x-ray technicians. Over a period of time, there was an increase in dosimeter assignments. After a time, anyone who entered an MAA had to have a dosimeter.

One worker recalls wearing a film badge in the early-1960s while assembling the W-48. Some interviewees with longevity at Pantex indicated they were not provided a dosimeter when they first came to Pantex, but were provided with one at a later date, including those working on the line. There were several classes of workers (e.g., administrative support, transportation, security, etc.) who were not provided dosimeters until the 1980s. Clerks in the warehouse were not assigned dosimeters until the mid-1980s. One interviewee, who worked in the warehouse, reported receiving a dosimeter in the late-1960s/early-1970s. One individual in Production Stores indicated they were not issued a dosimeter until the early-1990s, when there was a big push to make sure that all workers had at least thermoluminescent dosimeters. Material Handlers, who were not badged throughout the years, were responsible for moving the pits in and out of inventory.

Workers wore wrist dosimeters while handling pits during work on certain systems. One worker recalls use of extremity dosimetry during the assembly of the W-48 Program. Another worker recalls extremity dosimetry starting in the 1990s.

When a worker went into the ramp by the revolving door, there was a dosimetry board. Workers put their dosimeter on when they went into the cell. As they exited the cell, they put it back on the board. Sometimes workers forgot to pick up their badges. Safety Laboratory Technicians were initially responsible for changing out the dosimeters and the air filters.

The dosimeters were supposed to be worn on the lapel. It was difficult to keep the window facing out. When dosimeters were placed at the waist rather than the collar, many individuals would burn out. Sometimes workers were reprimanded for getting a high dose.

Neutron dosimetry was not assigned plant wide. Neutron dosimetry has been a challenging aspect of RadCon. The 802 was not designed to measure neutron dosimetry. With known assumptions (i.e., neutron-to-photon ratios, well characterized field conditions), it could be used to calculate a neutron dose. This was reflected in the algorithm for calculating dose on the Panasonic 802 unit. For Department of Energy Laboratory Accreditation Program (DOELAP) exposures, the neutron-to-photon ratio was unknown; therefore, the dosimeter was not capable of passing the DOELAP standard for neutron dosimetry. The 809/812 was more effective at energy discrimination. The Pantex conversion from the 802 dosimeter *[to the 809/812 dosimeter]* was not all at once.

Pantex is in the process of conducting a pit study to validate the correction factors for lead aprons, validate the instrument correction factors, and determine the neutron-to-photon ratios. This study involves the comparison of ion chambers with dosimeters, and making measurements using dosimeters on phantoms. One site expert noted the neutron-to-photon ratio spiked in the early-1990s.

If a worker exceeded the administrative limit, they were removed from the job until the overall exposure was again below the limits. This was relatively rare. It is not clear why some workers received more dose than other workers doing the same job.

One interviewee reported his film badge was black twice and they pulled him off the line. With the initial incident, they said it was an error. The second time, they told him he had a high reading and a letter was issued.

According to one site expert, one worker left his dosimeter in a pit vault for 3 or 4 days just to see what kind of reading he would get. His reading came back "zero," which proved what some workers thought, that the dosimeters and radiation monitoring were less than adequate.

Internal Monitoring

Based on information provided by RadCon staff, the routine tritium bioassay program was started after the Cell I Incident. In about 1994, they were ramping up the routine bioassay program. Prior to this time, internal monitoring was event-driven, or it was based on experiences with air monitoring, swipe, or other triggers at certain locations. Fecal samples were collected for thorium and plutonium on a monthly basis. Fecal samples were submitted to the Y-12 Plant for analysis. Pantex tried a urinalysis program for thorium, but the detection limits were poor. A baseline plutonium urine and fecal sample was done; however, this evolved into fecal only. There was uranium urinalysis for specific programs. Presently, there is a routine uranium program with samples collected on a semi-annual frequency. There was/is a baseline bioassay sample submitted prior to entry into a contamination area. If the new hires worked in soil contamination areas, they also submitted a baseline uranium bioassay. All new hires submitted a tritium bioassay. Termination bioassay is voluntary. In around 1996 or 1997, RadCon started turning off qualifications if individuals did not cooperate in submitting their bioassay samples. There were a relatively small number of temporary or construction workers or transient workers at the Pantex Plant. In this case, the workers received a pre- and post-job bioassay. There is bioassay data available for uranium, thorium, and plutonium. This bioassay is associated with the dismantlement of weapons. Current RadCon staff does not believe there was a routine bioassay program for heavy metals in the early-1980s.

According to PTs and other non-RadCon staff interviewed, submittal of bioassay samples was random at one time. The bioassay submittal was dependent on the program. In 1982/1983, although individuals would leave the line with dust on them, there was probably no bioassay program at the time. In the late-1980s, with the W-79 Program (Cannon Shell), RadCon decided to do bioassay sampling. The samples were left outside the cell. Not every PT submitted a bioassay.

One interviewee recalled his first bioassay was submitted while working the W-68 in Building 12-64. They gave him a bottle and requested a urine sample. They vented the weapons they were working on to the outside of the bay. They started doing bioassay checks on them. Some PTs got overnight bioassay sampling and others did not.

Another interviewee recalls his bioassay sampling starting in the 1980s. Still another interviewee remembers random sampling several times a year. Workers in the Building 12-41 Laboratory submitted periodic bioassay. Firefighters did not recall being on a routine bioassay program.

There was detectable tritium from vaults likely due to permeation. Some tritium bioassay sampling was done on individuals to investigate dose from permeation. These doses were on the order of 1 to 2 mrem. Tritium analysis was done by Liquid Scintillation Counting.

Two individuals interviewed recalled receiving a chest count during their tenure at Pantex. One individual indicated that some of the PTs had radioactive material in them. Other interviewees indicated they received no chest counts.

Pantex has used Quanterra, the Y-12 Plant, Severn Trent, and GEL in Charleston to process bioassay samples. The sensitivities of uranium urinalysis and the minimum detectable activity (MDA) are a function of the bioassay vendor used at the time (1960–1963 and 1968–1978), and the definition of the MDA at the given period in time.

There were particle size studies conducted at Pantex. The size of the particles was measured under a scanning electron microscope. The range of particle sizes included respirable particles.

There was explosive testing of neutron generators (i.e., boom boxes). The boom boxes potentially contained titanium *[stated on the Pantex tour in October 2010 as erbium]* tritide. A selected set of personnel would tear down the component to determine its survivability and ruggedness. The tear down personnel wore no respirators and had no bioassay.

The internal dosimetry technical basis document *[prepared by Pantex]* identifies where tritides are encountered. Pantex has done a series of studies related to the solubility of tritides handled at the site. The results of this study are documented in the technical basis document for tritides. Some of the material was more soluble than originally expected. A correction factor is applied to the results obtained from routing tritium bioassay to compensate for differences in biokinetics.

All internal dose assessments prior to 2008 were done using the Code for Internal Dosimetry (CINDY, Strenge et al. 1993). Since 2008 or 2009, the dose assessments are done using Integrated Module for Bioassay Analysis (IMBA, James et al. 2005).

ENVIRONMENTAL MONITORING

[The interviewees, collectively, provided generic information on the environmental monitoring program, as follows.]

Laboratory Technicians from the Environmental Monitoring group were responsible for collecting soil, air, water, and waste samples (non-radiological and radiological).

Burning activities occurred all over the plant. For example, there was burning by Building 12-6 next to the old site cafeteria. Mowing and weed control for the Firing and Burning Ground sites required a permit because of the soil contamination.

There was no waste segregation in the earlier years. All the stuff workers used for cleaning was thrown in the regular trash. There were 45 bottles that went in the trash and back to the trash dump. They were taken to be burned along with the rest of the trash, which was then sent down to the scrap area. There was a member of the Safety staff who just happened to see the bottles in the scrap area, and conducted an investigation.

With the W-45 and the W-47, the tritium was pumped out through filters and released to the outside. Nitrogen was then pumped into the reservoir.

Environmental Monitoring reports were initiated about the time plutonium came onsite. This was associated with regulatory requirements. An environmental assessment was completed for the Pantex Plant. LANL wrote the environmental impact statement.

MEDICAL

[The interviewees, collectively, provided information on physicals, x-rays completed as a part of those physicals, and common ailments observed in the Pantex workers, as follows.]

The Medical Department reported to the Plant Manager until 1991. The department now reports to the Environment, Safety and Health Division Manager. Progress reports and statistical reports were submitted monthly by the Occupational Medicine Department starting in 1962 through the present and are archived in Document Control.

The frequency of physicals was annual for those individuals who participated in the Personnel Assurance Program. Annual physicals continued when the program later became known as the Human Reliability Program. Annual and pre-employment exams included urinalysis, blood work, pulmonary function tests, a chest x-ray, a general physics tests (i.e., weight lift test), and a hearing test. Pre-employment chest x-rays were given until 2005. For the remainder of the plant population, a comprehensive voluntary annual physical was offered up until 2008. This included a chest x-ray every 5 years.

Firefighters and Assembly Operators (now known at PTs) received back x-rays prior to 1970. Department of Transportation workers were given more frequent physicals.

An asbestos program was established at Pantex beginning in 1970 with the issuance of the Occupational Safety and Health Administration (OSHA) Act. The beryllium program was initiated in the early-1990s. For the asbestos program, physicals were given in accordance with the grid established in the OSHA regulations. In the case of the beryllium program, individuals received an x-ray, a Lymphocyte Proliferation Test, and other blood tests every 3 years.

The physical exam included a single view posterior-anterior (PA) chest x-ray, which was sent to a radiologist for reading. The reading by a radiologist began in the late-1980s. Prior to this period, the plant doctors read the x-rays. If there was an issue on the x-ray, the worker was sent to his doctor in town. Beryllium surveillance chest x-rays are sent to National Jewish Hospital in Denver for B-Reader interpretation.

It was noted in the interview session with the Occupational Medicine staff that not all x-ray results were logged into the person's medical file on the PX-3A Form. When the site contracted with outside radiologists to read x-ray films, they provided the plant with a report, which was put into each patient's medical file.

X-ray machines in the Medical Department that the medical staff could identify included a Picker (only by hear-say), Continental, and Universal models. The Food and Drug Administration came by and checked the x-ray units in the early years, and in the mid-1990s, a Health Physicist from Dallas was contracted to calibrate and check the shielding, filters, aprons, drapes, etc., every 24 months.

Medical has a decontamination facility. The Hazardous Materials team has a portable decontamination facility.

According to one interviewee, the studied indifference of the local medical community and failure to persist in questions or records exchange by/to plant medical staff is observed in Amarillo and every other weapons plant or laboratory. Thus, personal medical records in these communities from the perspective of worker concerns here are often worthless. The fears were mainly about cancer. But chronic pulmonary and cardiovascular disease is also "associated" in the entangled embankment of mortality and morbidity experienced by these workers.

Some of the ailments identified in former Pantex workers, particularly firefighters, are osteoporosis, renal problems, skin cancers, prostate cancer, colon cancer, strokes, aneurisms, and Parkinson's disease. Among the firefighters, there were six miscarriages and an infant death. Firefighters particularly see this in those who trained at the Fire Pit. Another individual had a work up done by a physician, and he was notified that he had substantial amounts of heavy metals in him.

One interviewee believes the that radiation received from the Cell 1 Incident, along with the routine exposures through the years, are the primary cause of his health problems (i.e., [redacted]) resulting in several medical procedures. When he received an EEOICPA packet, the only diseases recognized at the time were Beryllium, Silicosis, Cancer, and Renal Disease. He identified research indicating that tritium, "beta radiation," can cause heart disease and cancer. He feels the Cell 1 Incident caused his cancer.

INCIDENTS AND INVESTIGATIONS

[The interviewees, collectively, provided information on large and small incidents occurring at the Pantex site, as follows.]

1961 Broken Pit Tube

In 1961, [redacted] workers were tearing down a W-47 surveillance unit in Cell 6. The process called for cutting an HE plug off the pit with a hand cutter. *[DOE Redaction]* The alpha alarm went off. The workers put dux seal over the tube and evacuated. At the time, the alpha monitoring system was not hooked into the air conditioning circuit (i.e., it didn't automatically shut down the system like the RAMS does). The air conditioning system had to be manually shut down. In the meantime, contamination was spread everywhere. There was 100,000 cpm removable contamination (plutonium) measured by a PeeWee Detector.

During the clean-up operation, there were two crews with [redacted] Quality Inspectors and 34 PTs. The clean-up was done on two shifts with one crew per shift. Workers would suit out in two sets of protective clothing with a respirator and enter the area decontaminating as they went into the cells. They entered in the morning and in the afternoon coming out for lunch. The ramp was cordoned off down by Cell 4 and a hot line established. As workers exited the area, they took off one pair of protective clothing, received monitoring, took off the second pair of protective clothing, and were monitored again. They turned off the lights, because they made the decontamination team sweat. There was sweat in the bottom of the respirator. They had to strip all their clothes off prior to going to the shower and cleaning up (twice per day). The clean-up lasted from October 1 to the end of February. Floor and ceiling tiles were removed. The radioactive waste was shipped to LANL.

Those involved in clean-up submitted spot urine samples (twice a day) and had to provide nose wipes during the job. The Safety Inspectors monitored personnel involved closely. No one was notified that there was an issue with exposure. RadCon maintains a copy of the incident report.

Cell 1 Incident

In May 1989, a tritium release occurred in Building 12-44 while workers were removing the tritium reservoir from a weapon in Cell 1. While loosening the gland nut, the workers heard a hissing from the reservoir. As a result, workers evacuated the cell immediately, rather than tightening the nut, which would have limited the quantity of the release. *[DOE Redaction]* This incident resulted in contamination and evacuation of nearby areas.

[An interviewee directly involved in the Cell 1 incident provided the following statement to SC&A.]

> *"The Rest of the Story*
>
> *The Cell 1 Incident at Pantex occurred between 3:00 pm and 4:00 pm on May 17, 1989. The Pantex Emergency Response Team (ERT) was immediately summoned to Building 12-44 to take care of the incident. At around 8:00 pm,* [redacted] *members of the team (myself and* [redacted]*) donned impervious suits, self-contained breathing apparatus and 'one' pair of surgical gloves. The* [redacted] *of us entered the cell, tightened the leaking gland nut on the sqib* [sic] *valve, retrieved the unit paperwork then exited Cell 1. Pantex Management along with assistance from Los Alamos wrote procedures to re-enter the cell, pinch off the tube between the valve and the pit and double seal with a quick hardening Resin. To assure a proper seal, the Pantex Training Dept. acquired a pit tube of the same dimensions and using the pinch-off tube to be used, went through the pinch-off process, tested the pinch-off with a vacuum source and certified it to be sealed.*
>
> *The same* [redacted] *members of the ERT and a Los Alamos* [redacted] *person re-entered the cell, with the same clothing as earlier described and proceeded to pinch off the tube. After pinch-off, the resin was prepared to give a double seal. As the resin was applied a large bubble appeared in the resin and the* [redacted]

of us were preparing for another pinch-off operation while the Los Alamos [redacted] *monitored the area using a portable Triton II. The LASL person then said: "We've got to evacuate. The Triton II has just pegged out and will no longer read." (When a Triton II is saturated it will no longer read correctly). We immediately evacuated and proceeded to report to the Command Group in Bldg. 12-44.*

It was approximately midnight by now, so we were requested to go home and to take a urine sample to be turned into Medical the following day. This we both did. The next day we were told not to enter the cell for a couple of days. I visited with the Pantex HP to ask how much tritium a person was allowed and was told that they were researching that at the present time. I then asked medical how much tritium myself and the other member had received and got no answer.

The above report [Official Incident Report] *states that the "tiny" amount* [that] *was vented into the atmosphere was such a small quantity that it posed no risk to plant employees. The cell was not sealed off. Rather an approximate* 24" *flex hose attached to a blower was put into the cell and air "and tritium" was blown out of the cell, across the ramp and into the atmosphere.*

It was at this time that Pantex decided they needed to call in some more tritium knowledgeable people. They called Savannah River who responded shortly.

I (with a different [redacted]*) was assigned to package the reservoir for shipment to Los Alamos. The Savannah River Technician stated that tritium would migrate through surgical gloves in about five minutes and then skin absorption would occur. Doing a "dry run" in an adjoining cell, I discovered it would take about 30 minutes to get the reservoir packaged and sealed. The Savannah River Tech. they* [sic] *advised me to don six pair of surgical gloves and remove one pair at five minute intervals to avoid skin absorption. This I did and the packaging was completed.*

After the packaging was completed, Cell 1 was re-entered by Pantex personnel for decontamination purposes. All the tooling was contaminated with Tritium Oxide and the concrete wall had an amount of oxide. The word out at this time was that it would be more economical to replace the cell rather than decontaminating it.

There was a DOE investigation of the cell incident and a report filed I am convinced that the report no longer exists. I believe it was destroyed for obvious reasons."

Recently there has been a new module that was added to IMBA for tritium. The dose to the maximum exposed individuals involved in the Cell 1 incident has been recalculated with IMBA using previous bioassay data. Using current models, the calculated dose is equal to 170 mrem. The assumptions made in the dose assigned as the dose of record was that all the tritiated gas was converted to tritiated water. In using the IMBA model, only the portion that was actually converted would have been assigned to dose. This was an academic exercise and the dose of record remained at 1.2 Rem.

During the response to the Cell 1 Incident, the SCBA had to be sent to the fire department for refills and was not cleaned. Workers went right back into the cell using these SCBA units.

The 12-44 cells did not have an exhaust system. There was a hose leading from the cell to the outside across the ramp. This had curtains on both sides. The guards were stationed in the area for hours at this time. The doors were locked normally. When the doors were open, there had to be a guard stationed there. Some of the practices at the Pantex Plant used evaporative air conditioning coolers, and the pads absorb a lot of tritium.

The firefighters responded to the Cell 1 Incident, but they were notified not to go in. The incident set off the radiation alarms. RadCon set up the decontamination zone. There was a fire report generated for the incident. Every time the firefighters respond to an incident, they generate a report. These reports provide details on what was done during the response.

1992 Cracked Pit

In November 1992, the pit of a W-48 cracked during the process of cleaning the HE off the surface of the pit. The surface of the pit cracked audibly and a leak check (pouring hot water on the surface) revealed bubbles emerging from the crack. The cell was promptly evacuated. [Redacted] Radiation Safety Technicians donned a respirator without protective clothing, collected smears, and triple-bagged the cracked pit within 7 minutes after the crack appeared. Although smears of the crack indicated plutonium contamination, the prompt action of the technicians prevented extensive plutonium contamination in the cell. A fraction of the incident was captured on time-stamped video tape, because the disassembly operation was being taped for As Low As Reasonable Achievable purposes. The video tape is classified. One interviewee indicated workers were left locked in the area for several hours until the guards found them later.

Broken Arrows

The Radiation Accident Response team sent personnel from Pantex to Thule, Greenland, to assist after the nuclear weapons accident. Debris from the accident in Arkansas was sent to Pantex. This unit caught fire and melted the HE between the pit and the outside of the unit. The plant received and stored debris from the Greenland and Louisiana accident in Solid Waste Management Unit (SWMU)-82.

Other

Pantex also had incidents related to radiography sources and other radiation-producing devices.

An incident occurred where a stencil was knocked off a W-84. [Redacted] PTs and [redacted] inspectors had to go up to the LINAC facility and replace the stencil. The PTs went through the two doors. The hoist was still swinging and no one would answer. The alarm went off. The PTs went to the [redacted] technician and told the technician of their location when the alarm went off. When they told the individuals where they were, they were told to show them the exact location where they had been. The PTs were told they were close to being fried. A bunch of individuals showed up to investigate, including individuals from Albuquerque. The [redacted] individuals that came over to remove the stencil were put into a room and told they could not leave. They sat there until about midnight. The PTs were sent up to Medical to get blood drawn. When one PT asked why they had to sit in the office, he was told that they thought they were going to die if they had actually been exposed, and there was nothing they could do.

Other incidents raised by interviewees included:

- At Cell 8, there was a spill. The PT pulled something out of the pit instead of a wire. This scattered alpha radiation in the cell. They cleaned it up and painted over it.
- A small detonation occurred during work with a W-39. A hoist was used to swing the pit to the side and the clamps failed. The pit went rolling across the floor and detonated.
- There was an incident where a W-48 was wrapped in a chem-wipe and put down in a container. It was put into storage for 9 months. The chem-wipe was burned up.
- In 1984, a sprinkler system went off in Building 12-84 (Cells 1-8) and water got all over the units. They had to pump the water out to a tanker.
- There was an emergency situation where a radiography source got hung up. Individuals had to enter the area with lead aprons and gloves to remedy the situation.
- There was an incident in Building 11-9 in about 1997 or 1998 where uranium dust was transferred from one container to another. They put down barrier paper and disposed of all the waste.
- In March 1977, an incident occurred in Building 11-14. While machining HEs, there was an explosion and three individuals died.
- In 1978, at SWMU-82, there was an incident involving cylinders. It rained and the cans were found floating. One can had a hole in it. They were moved to another magazine. Contaminated water leaked out. The Radiation Accident Team decontaminated the Magazine 75, which took about a year to complete.
- *[DOE Redaction]* RadCon stopped work and individuals involved were monitored. Airborne thorium was monitored during the incident.
- A few years ago, there was an incident where the combination of chem-wipes, alcohol, and static electricity caused a fire.
- There are grass fires all the time. Approximately 10 years ago, a fire was started as a result of a cigarette. The Hyde Plant was burned down, and the fire approached Zone 11 of Pantex.
- There was an incident with a worker who cut through a DU casing.
- An Mk-5 was being disassembled. In the field, the uranium core was pushed down into the weapon. When the tube was opened up, the workers did not find the uranium core.

The PT had to reach down in the weapon and pull the uranium core out. Individuals were panicked when they originally did not see the core.

RADIOLOGICAL RECORDS

[The interviewees, collectively, provided information on the Radiological Records program and history, as follows.]

The Delphi group was hired to put the Historical Exposure Records System in place. They were tasked with pulling all dosimetry information and putting it into individual files. They also conducted worker interviews regarding these files.

The Radiological Records available at Pantex are in electronic format. The Occupational Dose Records have captured all data available to date. These records include incident reports, personal contamination surveys, nasal smears, and other personal information. Each dosimetry record is located in the Dosimetry Records Management System (DORMS). Data in the DORMS system were started in the late-1980s to early-1990s and are still used. There are thorium, uranium, and plutonium results in DORMS. Searches and sorts can be done with this system, and readouts produced. While records at Pantex are electronic, NIOSH is provided with paper records.

The OPTIX system was used for limited individual data. OPTIX has a compilation of the survey forms back to about 2000. It is designed to hold images of forms. From the survey data that were in OPTIX, RadCon developed an Access database compiling the data from the component survey forms. The database contains 21,000-plus contamination surveys as of September 2009. These data are used for tracking and trending, so RadCon can statistically predict the probability of finding contamination on certain components. Incident files are also scanned into OPTIX. There are only about 7–10 incidents prior to the Tiger Team assessment, and about 20 per year following the Tiger Team assessment. This system has identifiers, such as social security numbers, name, and/or badge number, which are needed to conduct searches, and is searchable by these identifiers.

RadCon is transitioning from OPTIX to the Stellant (ORACLE) system, which is a Universal Records Management system. Pretty much RadCon has all reports (surveillances) since 2000 scanned. Central Records is responsible for converting the system.

There is some question about the completeness of the electronic data. For example, maintenance and support staff did not receive exposures as high as operations staff, but they did receive appreciable dose. An inventory of the records system for badge results indicated the absence of records for individuals. How do you assign a dose?

In the earlier years of operation, the staff did not fill out a lot of forms, but used logbooks instead.

Interviewees did not recall seeing any early progress reports generated by RadCon.

Pantex has previously provided all the PX-422 forms *[Records Inventory forms]* to NIOSH. Everything *[record]* listed on these PX-422 has been shipped to Central Records. These go on to Forth Worth from Central Records.

Pantex has what dosimetry records there are from Clarksville, Medina, and Burlington *[Iowa Army Ammunition Plant]*.

NIOSH TECHNICAL DOCUMENT-RELATED COMMENTS

[The interviewees, collectively, provided input on the Pantex site profile, the SEC report, the NIOSH response to SC&A, and the dose reconstruction and SEC process, as follows.]

There is a concern over the inaccuracy of the data that NIOSH presents in the site profile and the petition evaluation report. The technical basis document (TBD) was written to reflect the period of time from the 1980s forward, and is not reflective of historical operations.

According to some interviewees, NIOSH did not interview a diverse workforce prior to the preparation of the TBDs. Interviews that did occur tended to be short. In one case, an interviewee was asked to meet at Pantex with the NIOSH. By the time the individual was called into the office, the interviewers had about 20 minutes to meet with him before they needed to catch a plane.

According to site experts, the Pantex site profile has undergone revision; however, workers do not feel as though NIOSH has integrated issues raised by them in the new revision of the TBD. NIOSH has characterized the dosimetry and control of dosimetry incorrectly. Employees put in more hours than acknowledged by NIOSH.

NIOSH bas conducted site expert interviews with Pantex dosimetry and radiological records staff. Comments provided on the TBD by Pantex dosimetry were small.

[The basis for the petition was explained by one petitioner.] The records of exposure and personal work and medical histories are incomplete, and those that exist do not accurately reflect actual work conditions. Personal sampling results varied widely in instrumentation, quality, and continuity. They were often collected post-incident, seeking maximum residual exposure. The few ambient/area measurements—seldom continuous—were overly selective in agent, varied in time and instrument position, changes in calibration, sampling technique, administration, and instrumentation over the years. The only reliable record base is length in months and sometimes hours of employment, much of which can be extrapolated from social security and Internal Revenue Service data. This characterization comes from what workers have shared over a 40-year period, and is confirmed in dialogue with experts.

There was an objection to the collection of worker affidavits as inherently intimidating. As one interviewee stressed, “Anyone with even a single day of experience in worker interviews, even in protected, confidential clinical conditions, knows that workers are reluctant to discuss any issue impacting their health or reveal any information that may result in stigma or diminished family role empowerment associated with disease. Under these circumstances, the information is likely to be incomplete."

One petitioner reported NIOSH did not call during the review of the petition; that NIOSH did not respond to written comments sent to them, and there is no one forcing them to do this, so they are not. The petitioner reported then he was not contacted after the release of the evaluation report to discuss the outcome and the rationale behind the evaluation report.

According to a petitioner, there were documents provided to Ted Katz (CDC) by a worker at the June 2 Advisory Board meeting that the work group has apparently never seen.

[SC&A asked Pantex staff whether they concurred with statements made in the NIOSH response to SC&A.]

Production Technology staff do not concur with the following statement made in the *Draft Responses to SC&A Issues on Pantex Site Profile and SEC-00068 Evaluation Report Review* (NIOSH Response to SC&A, NIOSH 2010).

> *The potential for skin contamination was minimal, since* 1) *the contamination events were rare, and* 2) *the duration was short and* 3) *any dose would be insignificant compared to the direct radiation from any large uranium component. Protective gloves and clothing were also worn which further limited the potential for skin contamination and/or exposure. Any and all exposure to oxides could result only from unsatisfactory design, maintenance activities, and stockpile surveillance - and if or when it occurred was brought to the immediate attention of the design labs. Any event regardless of exposure personnel was the subject of thorough incident reviews via "Significant Findings Notification" and sometimes included outside reviews if exposure to personnel was expected (SRDB 14322, 14206)* [M&H 1989, M&H 1990]. *Claims involving skin contamination are rare and doses in those cases can be specifically bounded.*

Workers did not always wear gloves, but they did wear coveralls. Furthermore, the Significant Findings Notification (SFN) did not include every incident. For example, dropping a pit would not result in an SFN.

Pantex dosimetry staff agrees with the following statements made in the NIOSH Response to SC&A (NIOSH 2010).

> *Therefore, the exceptional quality of the nuclear components coupled with the highly standardized and consistent nature of the Weapon Operations at Pantex assure a near zero potential for contamination that could lead to an intake during routine and normal operations. There were perhaps two exceptions, DU oxide and tritium, both of which were recognized as potential contamination sources. However, an abundance of surveillance data is available to demonstrate that the quantities of contaminants from routine operations were insignificant.*

And,

> *At the same time, there are ample documents, information and data available at the weapon design agencies and at the Pantex plant* [sic] *to demonstrate that there were no significant internal dose records that may have been missing or the so called "data gaps" did not exist. Thus there is considerable assurance that "incident-based" bioassay sampling was appropriate and adequate as well as technically based rather than "questionable" as implied in the comments.*

Workers indicated that RDX *[hexahydro-l, 3, 5-trinitro - 1, 3, 5 trizine]* was not the only HE used at the Pantex Plant. There were several HEs used. A list of the HEs used at Pantex is available in the HE Safety Manual.

CHEMICAL EXPOSURES

[The interviewees, collectively, provided input on the chemical exposures occurring at Pantex, as follows.]

Individuals at Pantex worked with hazards other than radiation, including high explosives, MEK, MOCA (polyurethane) *[4,4' - methylene-bis (2-chloroaniline)]*, and trichloroethylene. In fact, Zone 11 hazards mainly consisted of HEs and other chemicals. MOCA was initially handled outside a glovebox, but later they handled it in a glovebox with a respirator. MOCA was boiled in open cauldrons in Building 12-21 according to some workers. Workers mixed MOCA along the west wall of the bay and carried the cup down the hall and to cells without respiratory protection. Brass shovels were used to scoop up excess HE after milling operations.

Back in the early-1980s, solvents were used by PTs without the use of appropriate personal protective equipment. The workers would pour these solvents (e.g., MEK, alcohol, acetone, etc.) from large vessels and use them as cleaners.

Non-sparking tools made of copper, copper alloy, and copper beryllium were used for assembly and disassembly to prevent sparking and potential explosions. Because of their smaller fingers, women were assigned to do electronics work.

Production Stores packaged weapons items that were usually covered with powders. They did not wear face masks or respirators. They had no idea what the powder was, but assumed it included HE, DU, and Beryllium (Be) dusts. They worked with several pallets at a time. When they asked about the dusts, they were told a yellow tag would be on the items indicating Be contamination. Workers were told there was no danger from the powders.

In Building 12-26 one summer, workers were removing asbestos during the day. Those on swing shift were responsible for cleaning up the asbestos powder from desks so they were able to work. Another time, when inventorying the tritium vault, if the workers were unpacking the bottles the air was usually full of some type of flakes (possibly asbestos).

There was a burning pit (near Building 12-35) used by the Fire Department for training. The training was done partly to see if the firefighters could work together to put out fires. The waste (e.g., diesel fuel, wash, motor oil, etc.) was gathered up from all over the site. The material was set on fire, and firemen practiced extinguishing the fire. It was common, for a period of time, to fight fires without SCBAs against the wind until the practice was changed in 1989. During the firefighting, the firefighters were engulfed in the smoke. The firefighters were exposed to a lot of chemicals during firefighter training burn pit activities. The exact contents of the materials burned were unknown by site experts. There were wells drilled at Pantex for environmental monitoring of the Fire Station Pit. Contamination was found 2 ft down. The burn pit was shut down around 1991. They later dug up one of the fire pits. The trash was put into a dumpster, and the dumpster was taken to the pit.

When M & H was still in charge of the plant, the firefighters brought up concerns related to burn pit activities. Because the training was improving over time, the firefighters started to question what was in the barrels they were burning. M & H indicated that they did not know.
At one point, they called the chief at home with concerns, and he told them go fight the fires or we will bring in someone who will. When BWXT came in, the firefighters raised concerns to the company management. BWXT arranged for an independent investigation to be conducted. The investigation was conducted by three DOE individuals from the Albuquerque office. The firefighters did not consider this independent. In September 2001, *Pantex Firefighter Concern Investigation Report* was issued. In the report, DOE said there was no problem. The firefighters noted the report said they were wearing SCBA when they were not. Firefighters were actually told to wear SCBA to fight indoor fires, but not outdoor fires.

Even if enforced stringently, elevated residual risk because of lax standards can be expected at any given point in time in a work history. Because of relative stability in this workforce, years of exposure are longer than found in the general population, which means that the levels in these plants justifiably need to be lower than those permissible in Occupational Safety and Health Administration (OSHA) standards. The practices of limiting accumulated exposure used for radiation should also be used for any toxic agent. By intervention of DOE, OSHA standards or those used in the plant were higher than technically feasible (i.e., the legal criterion for standards setting under the OSHA Act). For example, Be dust exposure is elevated above the technically feasible level by intervention of DOE hygienists through the ACGIH *[American Conference of Governmental Industrial Hygienists]* prior to 1971 and through the Office of the President in every regime since. How does this translate to practices in Pantex? By headquarters, region, and plant hygienists calling, for example, whatever the levels they enforce as “safe,” lulling workers and even management to not question unnecessary exposure under any circumstance. The result is a lax enforcement and sloppy housekeeping.

MISCELLANEOUS

- Skid testing did not involve radioactive material.
- *[DOE Redaction]* The pit was hot to the touch.
- When one worker went to the non-destructive testing, she had to inventory the older x-rays. There was mouse/rodent excrement and urine all over these items. Many of the

items she was inventorying went back to 1956—you can imagine how dirty those things were.

- *[When asked about the hesitancy of workers to talk to interviewers because of fear of retaliation, one petitioner responded as follows.]* Retaliation comes in many forms, such as subtle assignment preferences, promotions, cafeteria camaraderie, social pressures, etc. It exists in the best of circumstances in every workplace. In 'right-to-work' states, the union is typically weaker and the retaliation becomes blunter. There have been frequent reports of this at Pantex, especially with changes in management. Threats of facility workforce reductions or even closing are continuous at the bargaining table, through community interchange, etc. "Especially now!" Younger workers often pressure older workers by downplaying conditions or relating disease to age. "If the company doctor finds out an individual is sick, will they be forced out? (What are they thinking? There are no comparable jobs within 400 miles! Workers comp? That's a joke!) Who protects confidentiality? Who understands what I'm saying? Who are you? Who sent you? What's your game?" These are the typical fears heard at Pantex and every other weapons plant!

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