ORAU Team **NIOSH Dose Reconstruction Project** Technical Basis Document for the Pantex Plant – Site Description	Document Number: ORAUT-TKBS-0013-2 Effective Date: 03/30/2004 Revision No.: 00 Controlled Copy No.: ______ Page 1 of 17
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RECORD OF ISSUE/REVISIONS

ISSUE AUTHORIZATION DATE	EFFECTIVE DATE	REV. NO.	DESCRIPTION
Draft	11/26/03	00-A	New Technical Basis Document for the Pantex Plant – Site Description. Initiated by Jerome B. Martin.
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ACRONYMS AND ABBREVIATIONS

AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
BXWT	Babcock & Wilcox Technologies, Inc.
CAM	continuous air monitor
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DU	depleted uranium
FM	farm-to-market
HE	high explosives
hr	hour
IFI	in-flight insertable
IHE	insensitive high explosives
lb	pound
Linac	linear accelerator
MeV	megavolt-electron, 1 million electron volts
NEOP	nuclear explosive operating procedures
NDE	Non-Destructive Examination
NIOSH	National Institute for Occupational Safety and Health
ORAU	Oak Ridge Associated Universities
RAMS	Radiation Alarm Monitoring System
SNM	special nuclear material
TBD	technical basis document
TLD	thermoluminescent dosimeter
U.S.C.	United States Code

2.0 SITE DESCRIPTION

The Pantex Plant is approximately 17 miles northeast of Amarillo in Carson County (in the Texas panhandle; see Figure 2-1). The Plant site is bounded on the north by Texas Farm-to-Market (FM) Road 293, on the east by FM 2373, and on the west by FM 683. To the south, U.S. Department of Energy (DOE)-owned property extends to within 1 mile of U.S. Highway 60.

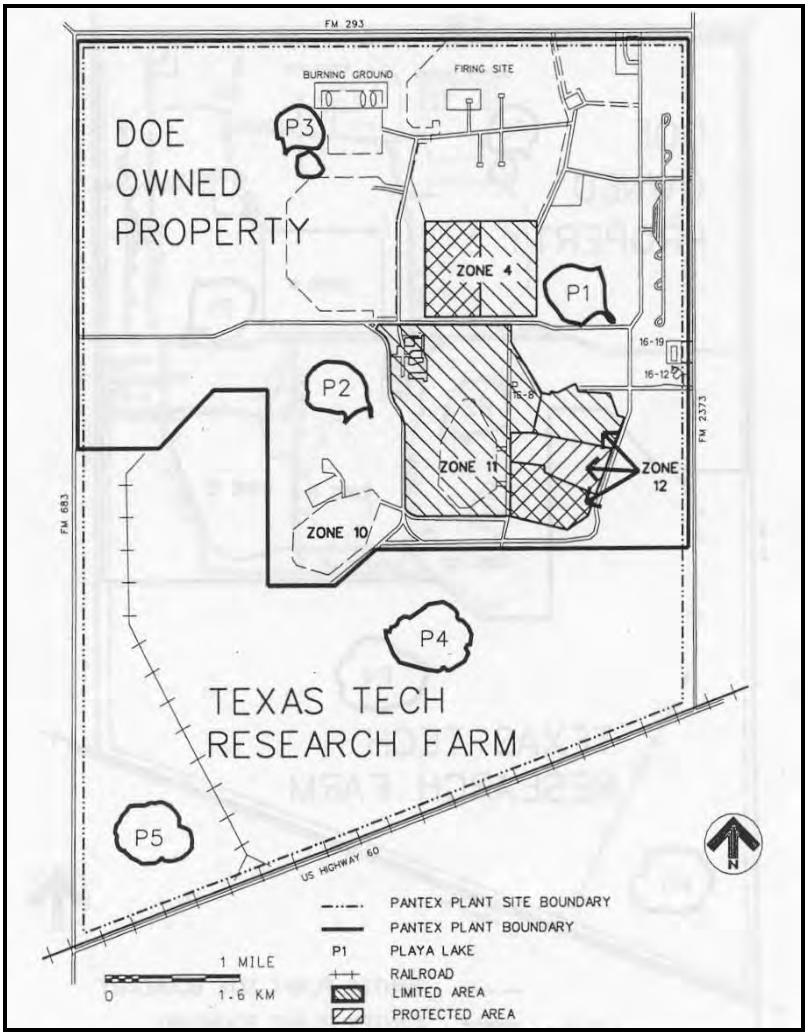

Figure 2-1. Map of Pantex Plant.

The following discussions briefly describe Pantex Plant processes (Section 2.1) and facilities (Section 2.2) and illustrate the origins of the associated source terms. Section 2.3 summarizes the general characteristics of radiation exposure at Pantex. Dose reconstructors would use these data only if monitoring data were unavailable and other methods were not appropriate for dose reconstruction.

Technical Basis Documents (TBDs) and Site Profile Documents are general working documents that provide guidance concerning the preparation of dose reconstructions at particular sites or categories of sites. They will be revised in the event additional relevant information is obtained about the affected site(s). These documents may be used to assist the National Institute for Occupational Safety and Health (NIOSH) in the completion of the individual work required for each dose reconstruction.

In this document the word “facility” is used as a general term for an area, building, or group of buildings that served a specific purpose at a site. It does not necessarily connote an “atomic weapons employer facility” or a “ Department of Energy facility” as defined in the Energy Employee Occupational Illness Compensation Program Act of 2000 (42 U.S.C. § 7384l (5) and (12)).”

2.1 SITE ACTIVITIES

2.1.1 Early Pantex Plant Operations

Pantex Plant was one of the last plants built during World War II to load, assemble, and pack ordnance. The plant began operations in September 1942, only 9 months after groundbreaking. By the end of the War, Pantex had three loading lines running full time, which produced 500-lb bombs, 105-mm howitzer shells, and 23-lb fragmentation bombs. Operations at Pantex stopped the week after the War ended on August 14, 1945 (Gaither 1995). In 1951, when the U.S. Atomic Energy Commission (AEC) was looking for a new *high explosives* (HE) fabrication plant, the unused 6-yr-old HE loading line at Pantex was attractive. AEC contracted Silas Mason Company for the construction of 10 new buildings and modification of 3 others, and construction began on April 13, 1951 (Mitchell 2001). Pantex completed its first HE operations in December 1951 (AEC 1952). By mid-1952, Pantex was at full production, responsible for HE fabrication, assembly of non-nuclear components, retrofits, modifications, and disassembly for retirements. The 10 facilities included six *Gravel Gertie cells* and related explosives-manufacturing facilities that did not process *special nuclear material* (SNM).

Beginning in 1948, the in-flight insertable (IFI) design was used. In this design, nuclear and non-nuclear components were kept separate until the time of use. The nuclear capsule did not require additional assembly, so military technicians could complete the final weapon assembly en route to the target by inserting the nuclear capsule into the mechanical assembly (Mitchell 2001).

Between 1952 and 1954, the primary mission at Pantex was to precision-machine HE castings and send them to Sandia National Laboratory in Albuquerque, New Mexico, for assembly. From 1956 to 1958, with the IFI design, the only nuclear components handled at Pantex were *depleted uranium* (DU) cases and *tritium reservoirs*; during this time there was no processing of nuclear material (Martin 2003a). Because these DU components were new at the time of assembly, this analysis assumed that removable depleted uranium oxide contamination on the components was minimal. In similar fashion, the potential for significant removable tritium contamination was minimal because the tritium reservoirs had to meet rigorous shipping requirements. The only other sources of radiation exposure at Pantex during this period were industrial radiography and medical X-rays.

In the late 1950s the sealed-pit design replaced the IFI design and delivery of sealed plutonium *pits* to Pantex became routine in1958 (Mitchell 2001). New facilities were required for the sealed-pit design, which involved encapsulated SNM; six *Gravel Gertie cells* were completed in 1958.

By 1966, all the older IFI weapons were dismantled, with most of the SNM recycled into the new sealed-pit weapons. In 1964, the weapon surveillance and repair mission was assigned to Pantex, while both Pantex and Burlington shared the retrofits and modifications mission. Pantex renovated facilities for HE development in the early 1960s, and completed the new separated-bay designed weapon assembly facility in 1970. Since 1975, Pantex has been the only DOE weapon assembly, disassembly, retrofit, and modification center (Mitchell 2001).

2.1.2 Weapon Assembly and Disassembly Processes

The nuclear weapon assembly process was highly standardized and consistent. Rigorous procedures were followed to ensure product quality and uniformity. Classified records documented every step of assembly and disassembly of every weapon, including the badge number or inspection stamp of the person completing the step (Martin 2003b). With the advent of the sealed-pit design in 1958, all assembly and disassembly work was on complete, sealed-pit weapons (Mitchell 2001).

Most parts for nuclear weapons assembly were manufactured within the nuclear weapons complex of government-owned/contractor-operated facilities. Pantex received those parts as completed major components (DOE 1997). These components supported one of three major processes: HE subassembly, physics package assembly, or mechanical assembly. A process called *palletizing* involved pulling the required parts for one weapon from warehouse stock into one or two large baskets or pallets, which were delivered at the appropriate time to the bay or cell where assembly would take place (BWXT 2001).

The physics package operation involved the mating of the HE subassembly with the nuclear components. Once assembled into a single unit, the physics package was sent to the Non-Destructive Examination (NDE) section for radiography, then to Mechanical Assembly, where the weapon was built around the physics package. The completed weapon was checked for leaks, which involved filling the weapon with a tracer gas such as helium or argon, placing the weapon in a vacuum chamber, and applying a vacuum in the chamber to detect any tracer gas leaking from the weapon. Once the vacuum leak check was successfully completed, the interior of the weapon was purged and backfilled with an inert gas, usually nitrogen.

The completed nuclear weapons, or warheads, were sent to the paint bay for touch-up painting. Warheads were sent to Mass Properties for spin balancing and to test moments, products of inertia, and center of gravity. Once the mass properties procedures were complete, warheads were sent back to NDE for radiography. Bombs from the paint bay and warheads from radiography were both processed for ultimate user packaging, which included final checks on stenciling, serial numbers, and other program-specific documentation. Completed and packaged weapons were staged for shipment to the U.S. Department of Defense (DOD).

Figure 2-2 is a schematic illustration of the weapon assembly process at Pantex. The shaded steps are those with the highest potential for radiation exposure. The following sections characterize the radiation source(s), the geometry of exposure situations, and the typical duration of exposures associated with these steps.

Figure 2-3 shows how the dismantlement of nuclear weapons at Pantex is basically the reverse of the assembly process.

From 1951 through 1987, weapons were shipped between Pantex and DOD sites (primarily by rail in specially designed and built railcars) escorted by DOE couriers. From 1977 to the present, weapons have moved between Pantex and DOD sites in specially designed and built tractor-trailers, also escorted by DOE couriers (Mitchell 2001).

2.2 SITE FACILITIES

Figure 2-1 shows the location of the major Pantex Plant activities in Zone 4 and Zone 12. Major operations with radioactive materials included staging of SNM in Zone 4 and assembly and disassembly of nuclear weapons in Zone 12 South [Babcock & Wilcox Technologies (BWXT) 2001].

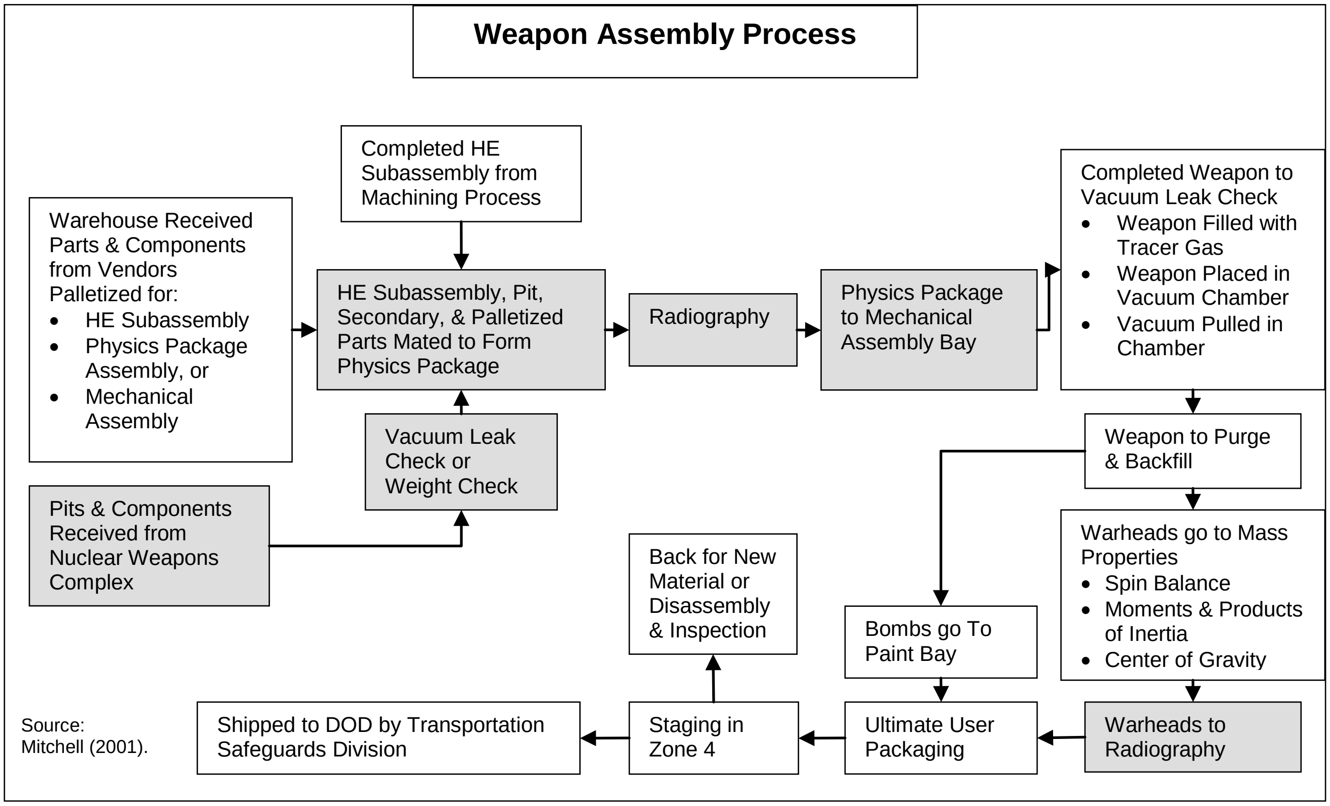

Figure 2-2. Pantex nuclear weapon assembly process.

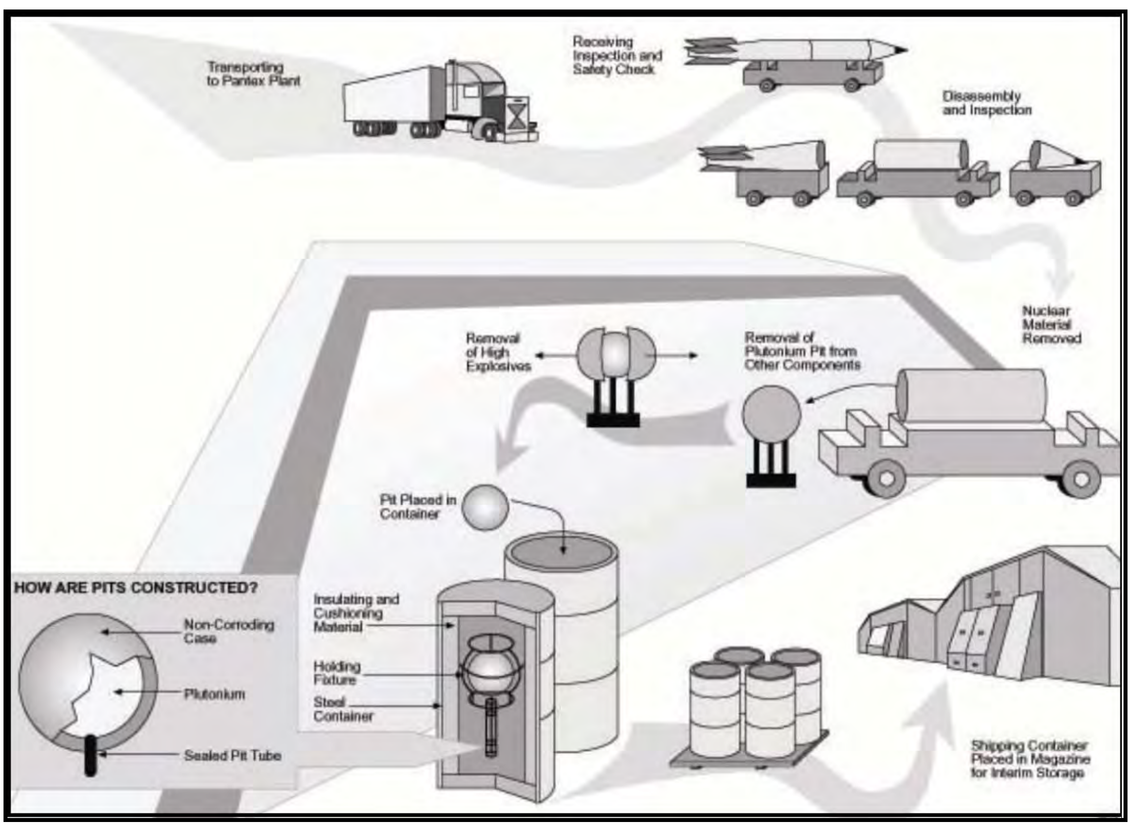

Figure 2-3. Weapons dismantlement and pit storage at Pantex Plant.

The moderate-hazard facilities at Pantex are primarily those for assembly and disassembly and the special-purpose and nuclear staging facilities that have handled complete nuclear weapons (nuclear explosives) and components. The following sections describe the bays, cells, special-purpose facilities, and nuclear staging facilities at Pantex.

2.2.1 Bays

Figure 2-4 shows a generic bay situated off a ramp or hall for transport of a weapon or weapon component into the bay. The bay is accessed through a pair of interlocked blast-proof doors, which prevent the outer door from opening unless the inner door is closed (and *vice-versa*). A pair of double doors (also with an interlocking system) is used to bring equipment into the bay. A special work stand occupies the middle of the floor space for weapons work. Appropriate electrical, pneumatic, and safety alarm systems are permanently installed in the bay. In addition, an elaborate communication system is in place for monitoring the Nuclear Explosive Operating Procedures (NEOPs) and tracking the SNM. Redundant and diverse fire protection systems are in place, and strict control of combustible material is enforced. Certain operations require that the process technicians are electrically grounded to the weapon to avoid static discharge. In addition, operations are discontinued during lightning warnings (BWXT 2001).

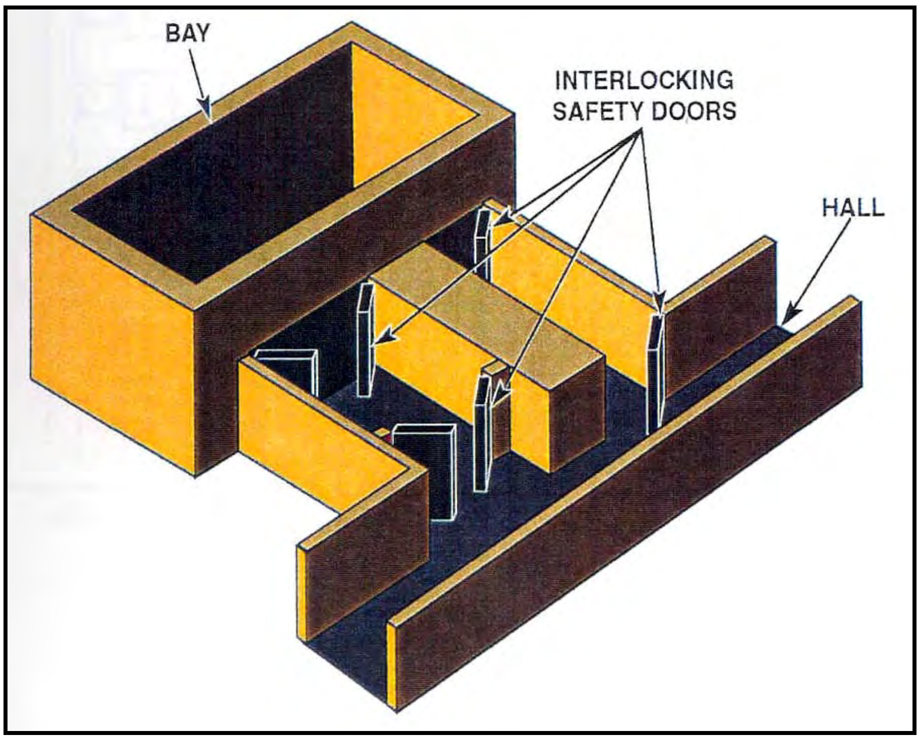

Figure 2-4. Generic representation of a nuclear explosive bay.

The principal function of the bays is the assembly and disassembly of nuclear explosives, particularly the mechanical portion, which includes the electrical components and tritium reservoirs (BWXT 2001). The major operations in these bays are the partial assembly or disassembly of nuclear weapons containing HE and the complete assembly and disassembly of nuclear weapons containing *insensitive high explosives* (IHE).

Physics package assembly and disassembly, where bare pit and HE operations occur, take place in the cells. During the assembly process of a nuclear explosive, operations begin in an assembly cell and then move to an assembly bay for completion. The reverse is true for disassembly. Disassembly for HE weapons begins in a bay and concludes in a cell. Disassembly of weapons with IHE occurs only in a bay.

Alpha and beta continuous air monitors connected to the Pantex Radiation Alarm Monitoring System (RAMS) are used to detect airborne radiological contamination in the bays and cells (BWXT 2001). The radiation safety system in the radiography bays provides interlocking safety devices to protect workers from accidental exposures. Additional safety measures include interlocks between the operating controls; gamma radiation detectors; panic switches; warning lights, chimes, and horns; passageway door switches; RAMS alarms; and fire alarms.

Nuclear explosives, nuclear components, radioisotopic thermoelectric generators, HE, and IHE are transferred to and from the bays using electric forklifts or manually operated transfer carts (BWXT 2001). Only weapons containing IHE main charges can be completely assembled or disassembled in the bays. For pit-HE-IHE disassembly, employees wear lead-lined aprons, safety glasses, and vinyl gloves to handle bare pits. In addition, a safety net is used during pit-HE-IHE disassembly for some operations. All assembly and disassembly operations are performed in the designated bay according to the written NEOPs and the Operations and Instructions Standards specific to a weapons program.

Radiographic inspection and certification of nuclear explosive assemblies and subassemblies are performed in the radiography bays, which currently house an 8-million-electron-volt (MeV) linear accelerator (Linac) and a 9-MeV Linac (BWXT 2001). Each Linac has the capability to examine completed nuclear explosives in addition to nuclear explosive components and subassemblies. The radiography bays contain manipulator systems, turntables, alignment lasers, and closed-circuit television systems. The control room areas for the two radiography bays include a process/service room that provides development and processing of film from Linac operations, film storage, and film viewing and interpretation. In addition to the large fixed Linac units, a portable X-ray machine can be used in the bays to radiograph pits.

Process flow is similar in the two radiography bays (BWXT 2001). Assemblies are brought to the radiography bay in fixtures that allow radiography, or they are removed and placed in suitable fixtures. The operator positions the film behind the unit, perpendicular to the beam with respect to the Linac and the unit. During operation of the Linac, the operator moves to the control room to make the radiographic exposure. All personnel remain in the control room during the exposure. There are numerous emergency stop switches on the walls inside the radiography bays, which disable or prevent the operation of the radiography equipment in the event personnel are accidentally trapped in the bay. The control room is isolated from the Linac room such that exposure rates to personnel follow as low as reasonably achievable (ALARA) principles and do not exceed 0.25 millirem/hr. During operation of the portable unit, the operator would occupy the vestibule portion of the bay where exposure rates to personnel do not exceed 0.25 millirem/hr. The portable X-ray machine is operated via a control console connected to it by cables. The operator, after making the radiographic exposure, develops the film in the process/service room. The operator views the film, makes the appropriate verifications of internal structure, and completes the necessary forms to release the unit for work by other departments.

The generic-use bays in these buildings can be configured for staging operations. Weapons and weapons components are held in staging bays in preparation for use in assembly, special testing, or transportation off the site.

2.2.2 Cells

The mounded earth and gravel cover over a cell is supported by a cable catenary system. The cables are suspended from the top of a cell's round room wall. The cell roof consists of the support cables, layers of wire mesh, gravel and earth coverings, and a Gunite or concrete cap. Figure 2-5 shows a generic cell design from Mitchell (2001).

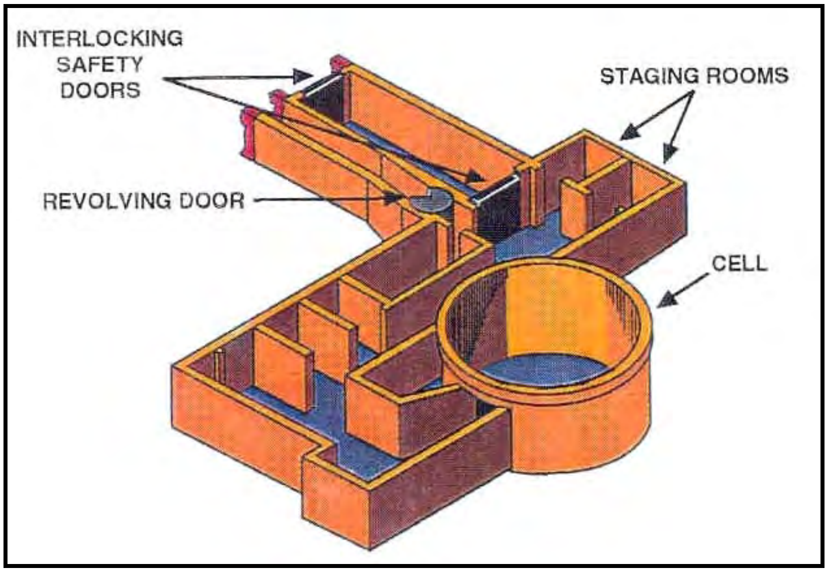

Figure 2-5. Generic representation of a nuclear explosive cell.

The design of the cells is based on Gravel Gertie experiments that show that the structure largely dissipates blast pressures (BWXT 2001). The mounded gravel roof over the round room is designed to lift and vent gas pressures produced in an explosion. Plutonium would be filtered from the vented gases by the gravel structure and release to the environment would be minimized. The equipment passageway doors are designed to remain intact in the event of accidental detonation, and the doors are interlocked so only one door can be open at a time. The two blast doors are also interlocked so only one door can be open.

The cell facilities consist of a round room, staging cubicles, a corridor area, and a unit equipment/mechanical room. All of these areas are inside the blast-resistant cell structure and provide protection from external events, including external explosions, winds, and tornados. The principal function of the assembly cells is the assembly and disassembly of nuclear explosives, particularly operations on the physics package of nuclear explosives that contain HE (BWXT 2001). Work on nuclear explosives that contain IHE can be in the bays. In the future, most of the operations in the cells are expected to involve the dismantlement of retired stockpile weapons.

The cells were designed as assembly/disassembly and inspection areas with the capability to process HE and nuclear explosives components that contain plutonium (BWXT 2001). The major operations conducted in cells are pit-HE assembly, pit-HE disassembly, and complete nuclear explosive assembly and disassembly. A number of specialized operations support quality assurance for these activities.

To comply with DOE and Pantex Plant requirements, plutonium-HE assembly and disassembly operations must be conducted in a cell-type structure where the design features of the facility afford an added margin of safety (DOE 2001). Partial assembly can be performed in a cell to the point where the HE component is considered *cased*. In this configuration, completion of the assembly process is typically performed in the bay facilities.

Components for a particular program are sent to the operating cell performing the assembly (BWXT 2001). Assembly operations are performed in designated cells according to NEOPs and other written procedures specific to a nuclear explosives program. Inspections and audits are performed to confirm that design specifications are met. Acceptance inspections are performed by DOE inspectors. During all phases of assembly, procedures specific to nuclear explosives are followed and checklists are initialed as each procedural step is completed. Once the nuclear explosive assembly is complete, it is sent to radiography (if required) to verify the presence of SNM and to confirm the position of the safing device. If required, the weapon is then sent to the vacuum chambers for final inspection and testing.

During a limited (or partial) assembly, pits are transferred to the cells from the designated SNM staging facility at Pantex Plant. HE comes from an in-process staging facility for HE. Partial assembly in a cell typically results in a cased nuclear explosive assembly containing a pit mated with HE, which is then sent to an assembly bay facility for final assembly into a nuclear explosive.

Cells are also used extensively for the disassembly or partial disassembly of nuclear explosives that have been returned to DOE by DOD (BWXT 2001). Many of these nuclear explosives were designed and built without the added safety benefit of IHE. Therefore, disassembly operations must be completed in a cell after other component disassembly operations have been completed in other facilities.

Plutonium pit-HE assemblies are brought to the cells from other facilities in Zone 12 (BWXT 2001). Special tools and equipment are supplied from warehouse stocks. Some disassembly operations require a portable glove box or other specialized equipment. For plutonium pit-HE disassembly, personnel must use a safety net, safety latches, or SS-2l tooling and lead-shielded aprons, safety glasses, and approved gloves. Some operations require that portions of the round room floor be covered with a barrier paper taped to the floor. In the event of an accident or unanticipated contamination, this barrier paper can be peeled from the floor and disposed of as contaminated waste, which aids containment and cleanup.

During disassembly, suspect components must be checked for radioactive contamination. If components are contaminated, decontamination procedures are performed before the components are transported.

2.2.3 Special-Purpose Facilities

The special-purpose facilities at Pantex include the Paint Facility, the Separation Testing Facility, the Mass Properties Facility, the Weapons Aging Facility, and the Weapons Transfer Station (BWXT 2001).

The Paint Facility is used to spray-paint weapons, components, and supporting container and transportation hardware. Radiation exposure rates to workers in the Paint Facility are comparable to those of transportation workers who move weapons containing nuclear materials, which are typically less than 100 mrem/yr. The Paint Facility is restricted to *Nuclear Explosive Look-Alike* assemblies. The coexistence of HE or IHE and SNM at the same time is not allowed in the paint bay.

Operations in the Separation Testing Facility involve functional separation tests of selected reentry body assemblies, which is a continuing requirement of the Weapons Surveillance Program. Separation tests are conducted remotely with authorized personnel in the control booth during the entire test. Worker exposures to the weapons at the beginning and end of each test are brief, and cumulative radiation exposures are typically less than 100 mrem/yr.

The Mass Properties Facility utilizes two bays and a remote control room. One of the bays has a spin-balancing machine that works much like a machine for balancing automobile tires. The weapon is placed in the machine and spun to measure any out-of-balance forces. The correct placing of balance weights on the weapon is determined from the results of the test. Another bay measures the center of gravity of the weapon and the moment and product of inertia of the weapon. Worker exposures to the weapons at the beginning and end of each test are brief, and cumulative radiation exposures are typically less than 100 mrem/yr.

The Weapons Aging Facility places the weapon or related weapon component in an enclave that controls the temperature of the atmosphere in the enclave such that the weapon components are aged artificially over an accelerated timeframe. As in the case of the Mass Properties and Separation Test Facilities, the operations are observed and controlled from a remote control room. Worker exposures to the weapons at the beginning and end of each test are brief, and cumulative radiation exposures are typically less than 100 mrem/yr.

The Weapons Transfer Station is used for loading and unloading weapons, weapon components, or explosives. It is a completely enclosed high dock that accommodates over-the-road trailers and forklifts.

2.2.4 <u>Nuclear Staging Facilities</u>

Zone 4 facilities are used as a staging or interim storage area for weapons, weapon components, and other process-related materials (BWXT 2001). Periodic inspection of the pits is required; process technicians accompanied by radiation safety technicians perform this operation. Personnel are exposed isotropically to radiation sources during this work.

Zone 12 staging facilities, including pit vaults, warehouses, and SNM component staging facilities, are where nuclear explosive components without HE are staged (BWXT 2001). Pits are encapsulated components packaged in specially designed containers for staging and transportation between facilities. Radioisotope thermal generators are small, self-contained, sealed ^{238}Pu sources of thermally generated electricity. Tritium reservoirs are small metal bottles filled with tritium gas.

2.3 PANTEX RADIATION PROTECTION PROGRAM

The radiation protection program at Pantex evolved gradually over time, with a major expansion after the tritium release incident in May 1989. A radiation dosimetry program was established at Pantex in 1952 by the manager of the radiography group. The technology of the program has evolved over the past 50 years from simple film badges to sophisticated thermoluminescent dosimeter (TLD) systems. Steps in the evolution are shown in Figure 2-6. Each of these steps is described in detail in the Pantex Occupational External Dose technical basis document. The records of radiation doses to individual workers from personnel dosimeters represent the highest quality records for retrospective dose assessments.

The radiation protection program was focused on those most likely to be exposed to radiation: production technicians, material handlers, transportation workers, radiography technicians, quality control technicians, and warehouse-production workers. These workers and their exposure potential are described in the Pantex Occupational External Dose TBD. All other workers at Pantex had little

Tracerlab β,γ film
<--------------------->
+ NTA film
<-------->
Eberline β,γ,NTA film
<-->
Landauer β,γ,NTA film
<---------------------->
Pantex In-House TLD
Two-element
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Six-element
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Panasonic 802
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Panasonic 809/812
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1950 1960 1970 1980 1990 2000

Figure 2-6. Evolution of external dosimetry at Pantex

occasion to enter any radiological areas and their potential for radiation exposure or intakes of radioactive material is considerably less.

From 1951 to about 1980, nuclear weapon assembly operations were generally free of contamination. Occasional checks for removable contamination generally demonstrated negative results, so few precautions were taken in relation to personal protective equipment and clothing. There was no evidence of any intakes of radioactive materials by Pantex workers. The major emphasis was on monitoring external radiation exposure by the methods shown in Figure 2-6.

In 1972, a modest bioassay program was begun for monitoring worker exposures to tritium; in 1976, the program was expanded for a 4-year period with generally negative results. In the early 1980s, with the increasing disassembly of weapons that had been in varying environments, DU contamination became a greater concern and additional radiation protection resources were applied to contamination control. In 1988, an extensive bioassay program for workers exposed to DU contamination was implemented. These bioassay programs are described in detail in the Pantex Occupational Internal Dose TBD.

Airborne contamination is monitored with alpha continuous air monitors (CAMs) and tritium monitors. The air monitoring system was first installed in the early to mid-1970s. The alpha CAM system frequently responds to elevated radon concentrations, but has rarely detected airborne concentrations of uranium, thorium, or plutonium. The tritium monitors frequently respond to minor local releases of tritium gas. The few occasions when airborne contamination was detected are documented in incident reports, which are reviewed in the Pantex Occupational Internal Dose TBD.

Following the tritium release incident in May 1989, the radiation protection program expanded rapidly. In May 1989 there were only seven staff members in the Radiation Safety Department; by mid-1991 the staff had expanded to 50 and new facilities and modern equipment were added.

2.4 GENERAL RADIATION EXPOSURE CHARACTERISTICS

The general radioactive source terms have been consistent throughout the history of Pantex, with few exceptions. From 1951 to the present, depleted uranium and tritium have been present at Pantex. During assembly, the DU was relatively clean and minimal removable contamination was encountered. The tritium was received in sealed reservoirs, and leakage was not a concern during assembly. Minor leakage occurred during disassembly. From 1958 though the present, sealed plutonium pits and enriched uranium components were received, handled, and stored at Pantex. With two minor exceptions, plutonium has always been contained by the pit cladding. In the 1960s, some thorium components were assembled into weapons, and during the 1990s these weapons were disassembled. These source terms are approximately the same for Zone 4 and Zone 12. There are, and have been, a few other radioactive materials present in small quantities as calibration sources or in larger quantities as radiography sources. These source terms are discussed in more detail in the Pantex Occupational External Dose TBD.

Radiation exposures occur at Pantex when workers are involved in operations with radioactive materials, such as the assembly or disassembly of nuclear weapons. The primary sources of external radiation exposure are plutonium pits and DU or thorium components. The primary sources of radioactive contamination (which can lead to intake) are depleted uranium oxide and tritium.

Plutonium pits are sealed to prevent surface contamination problems. Enriched uranium components are solid, hermetically sealed units. Pits emit X-rays, gamma rays, and neutrons that are the major source of exposure to Pantex radiation workers. Direct handling of pits can result in relatively high dose rates. Workers wear lead aprons during pit-handling work, which substantially reduce low-energy photon doses to the torso. Dosimeters are usually worn under the lead apron, which captures the reduced torso dose but underestimates the dose to the head (thyroid, lens of eye). Neutron doses measured under the lead apron can be underestimated. Beta and photon exposures occur during handling of DU or thorium components. The *rule-of-thumb* beta dose rate of approximately 200 millirad/hr at the surface of a DU slab can be used to estimate worker exposures. Exposures to thorium include the penetrating 2.6-MeV photons from ^{208}Tl.

The major radioactive contamination concern is DU oxide during disassembly operations. DU components tend to oxidize while in the field, and during disassembly this oxide is present as a readily dispersible powder. The TBD on Pantex Occupational Internal Dose discusses this contaminant. Contamination on thorium components is much less significant. In addition, tritium contamination is a concern; minor tritium intakes occur routinely but with very little whole-body dose. The one exception is the Cell 1 incident in 1989, which is discussed in detail in the Pantex Occupational Internal Dose TBD.

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GLOSSARY

depleted uranium

Uranium with a smaller percentage of the isotope ^{235}U than the 0.7% found in natural uranium.

Gravel Gertie cell

Heavily bunkered facilities designed to minimize the blast effects and the release of hazardous materials from areas in which assembly and disassembly of nuclear devices occur; characterized by a cable-supported roof of wire mesh and a thick gravel overburden.

high explosive

A chemical compound or mechanical mixture that, when subjected to heat, impact, friction, shock, or other initiation stimulus, undergoes a rapid chemical change with the evolution of large volumes of highly heated gases that exert pressure in the surrounding medium.

insensitive high explosive

High explosive that is so insensitive that there is negligible probability of accidental initiation or transition from burning to detonation.

Nuclear Explosive Look-Alike (NELA) assemblies

Non-nuclear assemblies that represent a nuclear explosive in its basic configuration, but do not contain any fissile radioactive material.

pit

Fissile component designed to fit in the central cavity of an implosion system to create a nuclear explosive.

special nuclear material

Plutonium, tritium, and uranium enriched in the isotopes 233 or 235, but not source material (natural uranium and thorium).

tritium reservoirs

Gas-tight metal containers used to store tritium gas.