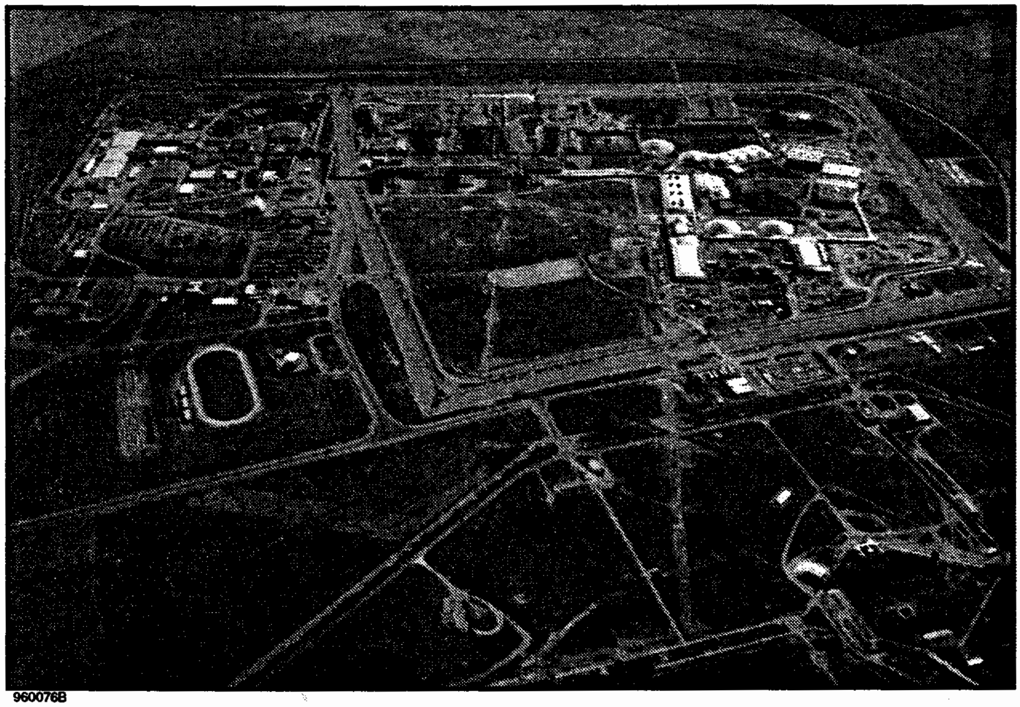
EIS 0225

Safety Information Document

The Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components Environmental Impact Statement



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FOREWORD

Pantex Plant personnel have assembled baseline data on Pantex Plant and its surroundings, needed to support the Site-Wide Environmental Impact Statement (SWEIS), into three information documents: Environmental Information Document (EID), Programmatic Information Document (PID), and Safety Information Document (SID). These documents are also intended to help streamline the preparation of future NEPA documents.

To avoid confusion, it is important to note that these information documents do not analyze impacts or present conclusions concerning the proposed action or alternatives—those are the objectives of the SWEIS.

- The Environmental Information Document (EID) describes the natural environment in the vicinity of Pantex, emphasizing current environmental concerns and issues, and contains a general description and discussion of the environmental setting at Pantex. The EID contains Pantex-specific information on geology and seismology, subsurface hydrology, surface hydrology, meteorology and air quality, ecology, socioeconomics, infrastructure, land use, noise, cultural resources, energy/natural resources, waste management, environmental restoration, and radiation and chemical environment.

- The Programmatic Information Document (PID) provides an overview of the various ongoing and projected programs conducted at Pantex. The PID contains information on weapons assembly/disassembly schedules, high explosive development, and construction projects (e.g., the Pit Reuse Facility) or programs that will be required in the future (e.g., waste management or environmental restoration).

- The Safety Information Document (SID) contains information about the safety and health aspects of operations at the Plant. It also discusses the safety of continuing operations at the Plant. The SID contains Pantex-specific information on facility and operation descriptions for all low and moderate hazard facilities (there are no high hazard facilities), unmitigated site-wide bounding and mitigated facility specific accident analyses for radioactive, explosive, and chemical materials, onsite and offsite transportation facilities and operations description, and past operational accident data including radiation exposure, industrial hygiene exposure, industrial safety summaries, and historical operational incidents.

The information documents are a three-volume set containing the baseline data to describe the Pantex environment, safety features, and future programs. The documents reference one another on areas of overlap. For example, the EID contains information on monitoring of radiation and hazardous chemicals to the environment whereas the SID contains similar information on monitoring of the employees. In regard to facility descriptions, the SID contains information on all facilities that are in operation, have been constructed but are not yet operational, or their design and NEPA documentation are complete. The PID contains information on those future projects where the design is still under consideration and the NEPA documentation is not yet completed; several of these projects are incorporated by reference or tiered from other DOE Programmatic Environmental Impact Statements (PEISs).

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UNITS OF MEASURE

°C	Degrees Centigrade
Ci	Curies
cm	Centimeter
cm/sec^2	Centimeters per second squared
°F	Degrees Fahrenheit
dB	Decibels
dps	disintegrations per second
fc	Foot Candles
ft/sec	Feet per second
ft	Foot/feet
ft^2	Square foot
gal	Gallon
gpm	Gallons per minute
g	Gram
g_o	Horizontal acceleration
hr	Hour
in.	Inch
kg	Kilogram
kg/m^2	Kilograms per square meter
km	Kilometer
Kw	Kilowatt
lb	Pound
L/m	Liters per minute
Ma	Millions of years ago
m	Meter
m^2	Square meter
mi	Mile
mi^2	Square mile
min	Minute
MeV	Megavolt (a.k.a. Million electron volts)
mrem/h	Millirem per hour
m/s	Meters per second
oz/ft^3	Ounces per cubic foot
ppm	Parts per million
psi	Pounds per square inch
psf	Pounds per square foot
μCi/g	Microcuries per gram
rem	Roentgen equivalent man
rm	Room
scfm	Standard cubic feet per minute
sec	Second
yr	Year
μ	Micro (10^{-6})

LIST OF ABBREVIATIONS AND ACRONYMS

ACGIH	American Conference of Government Industrial Hygienists
AEMS	Automated Energy Management System
AGV	Automated Guided Vehicle
AIHA	American Industrial Hygiene Association
ALARA	As Low As Reasonably Achievable
AN	Army Navy
BIO	Basis for Interim Operation
CAA	Clean Air Act
CASRN	Chemical Abstract Service Registry Number
CCTV	Closed-Circuit Television
CEDE	Committed Effective Dose Equivalent
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CG/MOI	Center of Gravity/Moment of Inertia
CHWSF	Classified Hazardous Waste Staging Facility
CO	Carbon Monoxide
CRADS	Control Room Automated Data System
CWA	Clean Water Act
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EA	Environmental Assessment
EID	Environmental Information Document
EIS	Environmental Impact Statement
EMR	Electromagnetic Radiation
EOC	Emergency Operations Center
EPI	Emergency Prediction Information
ERPG	Emergency Response Planning Guideline
ES&H	Environment, Safety & Health
FAA	Federal Aviation Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FM	Farm-to-Market Road
FMEA	Failure Mode and Effects Analysis
FWPCA	Federal Water Pollution Control Act
HE	High Explosive
HEPA	High Efficiency Particulate Air
HMX	High Melting Explosive
HNAB	Hexanitroazobenzene
HPFL	High Pressure Fire Loop
HVAC	Heating, Ventilating, and Air Conditioning
HWSF	Hazardous Waste Staging Facility
HWTPF	Hazardous Waste Treatment and Processing Facility
IHE	Insensitive High Explosive
LLNL	Lawrence Livermore National Laboratory
LLW	Low-level Radioactive Waste
M&H	Mason & Hanger - Silas Mason Co., Inc.
MAA	Material Access Area
MCS	Maintenance Communications System
MIP	Maintenance Implementation Plan
MR	Modified-Richmond Facility
MUDEMIMP	Multiple Missile Debris Impact Simulation Modeling Program
NEA	Nuclear Explosives Area
NDT	Nondestructive Testing
NEEP	Nuclear Explosive Engineering Procedure
NELAs	Nuclear Explosive-like Assembly
NEOP	Nuclear Explosive Operating Procedure
NEPA	National Environmental Policy Act
NESS	Nuclear Explosives Safety Study

GLOSSARY

Accident - 1) An event that may cause (a) injury, illness, or death to personnel or to the public (b) insult to the environment, or (c) damage to or loss of equipment or property. 2) An unplanned sequence of events that results in undesirable consequences.

Accident Scenario - A conceivable chronology of actions and occurrences leading to and resulting from an unplanned event that has the potential to result in an emergency.

Activation - The process of inducing radioactivity in a substance by bombardment, either with neutrons or with other forms of radiation, such that the nuclei of certain atoms are transformed to unstable isotopes.

Activity - A measure of the decay rate or disintegration of radioactive material, usually given in terms of the number of the number of nuclear disintegrations per unit of time. The special unit of activity is the curie (Ci); 1 Ci equals 3.7×10^{10} disintegrations per second (dps). activity per amount (weight) of material in units of Ci/g or dps/g is known as specific activity. See also specific activity.

Airborne Radioactive Material - Radioactive particulate, mists, and/or gases dispersed in air.

Alert - An emergency class within the category of operational emergencies. An alert represents events that have occurred or that are in progress and that involve an actual or potential substantial reduction in the level of facility safety and protection. An environmental release of a hazardous material is expected to be limited to a small fraction of the Protective Action Guideline (PAG) value or the Emergency Response Planning Guideline (ERPG) value onsite.

Algorithm - A problem-specific recurring mechanical or computational process.

Alpha Particle - A positively charged particle emitted from the nucleus of a radioactive atom. It consists of two protons and two neutrons and is identical to the nucleus of a helium atom. Generally, an alpha particle cannot penetrate a sheet of paper or a layer of dead skin.

As Low As Reasonably Achievable (ALARA) - The phrase and acronym used to describe an approach to hazard protection to control or manage exposures (both individual and collective to the work force and the general public) and releases of radioactive or other hazardous material to the environment as low as social, technical, economic, practical, and public policy considerations permit. ALARA is not a dose or exposure limit, but rather a process to attain dose/exposure levels as far as practicable below the applicable limits of DOE Orders.

Assembly Bay - A specially designed structure used for certain nuclear weapons operations, especially mechanical procedures such as the installation of electrical assemblies.

Assembly Cell - A specially designed structure used for certain nuclear weapons operations involving the mating of high explosive and nuclear materials (uranium and plutonium). Called "Gravel Gerties."

Atmospheric Stability - A condition resulting from the effect of atmospheric forces on a parcel of air following vertical displacement in an atmosphere otherwise in hydrostatic equilibrium. If the forces tend to return the parcel to its original level, the atmosphere is stable, if the forces tend to move the parcel farther in the direction of displacement, the atmosphere is unstable. If the air parcel tends to remain at its new level, the atmosphere has neutral stability.

NHPA	National Historic Preservation Act of 1966
NRC	Nuclear Regulatory Commission
O&I	Operations and Inspection Standard
ODTX	One-Dimensional Time-to-Explosion Test
ORO	Oak Ridge Ordnance
ORPS	Occurrence Reporting and Processing System
OSR	Operational Safety Requirements
OSHA	U.S. Occupational Safety and Health Administration
PA	Public Address System
PAG	Protective Action Guideline
PBAP	Performance Based Assessment Program
PBX	Plastic Bonded Explosive
PCB	Polychlorinated Biphenyl
PDS	Protected Distribution System
PEL	Permissible Exposure Limit
PHA	Preliminary Hazard Analysis
PID	Programmatic Information Document
PLAN	Pantex Local Area Network
PM	Preventive Maintenance
PPE	Personal Protective Equipment
PV	Pit Vault
PVC	Polyvinyl Chloride
RAMS	Radiation Alarm Monitoring System
RCRA	Resource Conservation and Recovery Act
RDX	Research Department Explosive (a.k.a. Royal Demolition Explosive)
RF	Rocky Flats
ROD	Record of Decision
RTG	Radioisotopic Thermoelectric Generator
SA	Safety Assessment
SAC	Steel Arch Construction
SAR	Safety Analysis Report
SDWA	Safe Drinking Water Act
SID	Safety Information Document
SNM	Special Nuclear Material
SSC	Safety Structures, Systems, and Components
SST	Safe-secure Trailers
SWEIS	Site-Wide Environmental Impact Statement
TATB	Triaminotrinitrobenzene
TDI	Toluene Diisocyanate
TID	Tamper Indicating Device
TLV-TWA	Threshold Limit Values-Time-Weighted Average
TNRCC	Texas Natural Resources Conservation Commission
TNT	Trinitrotoluene
TPQ	Threshold Planning Quantity
TQ	Threshold Quantity
TSCA	Toxic Substances Control Act
TSCM	Technical Surveillance Countermeasure
UPS	Uninterruptible Power Supply
USACE	U.S. Army Corps of Engineers
UST	Underground Storage Tank
USQD	Unreviewed Safety Question Determination
WQA	Water Quality Act
XREFRAC	Explosive Release Fraction
XTX	Extrudable Explosive

Curie (Ci) - A unit of radioactivity defined as the amount of a radioactive material that has an activity of 3.7 × 10^{10} disintegrations per second (dps).

Decay Chain - The sequence of radioactive disintegrations from one nuclide to another until a stable daughter product is reached.

Decay Product - A nuclide formed by the radioactive disintegration of a parent or first nuclide. In many cases, decay products are also radioactive.

Decontamination - The act of removing chemical, biological, or radiological contaminants, or neutralizing their potential effects on people, objects, or the environment, by washing, chemical reaction, mechanical cleaning, or other techniques.

Demilitarization - In the context of the Atomic Energy Act of 1954, as amended (the AEA) and the DOE's nuclear weapons program, demilitarization is the irreversible modification or destruction of a component or part of a component to the extent required to prevent use in its original weapon purpose.

Depleted Uranium - Uranium having a smaller percentage of the isotope uranium-235 than the 0.7% found in natural uranium. (See Natural Uranium.)

Design Basis - Design basis means the set of requirements that bound the design of systems, structures, and components within the facility. These design requirements include consideration of safety, plant availability, efficiency, reliability, and maintainability. Some aspects of the design basis are important to safety, others are not.

Design Basis Accident (DBA) - DBA means accidents that are postulated for the purpose of establishing functional requirements for safety significant structures, systems, components, and equipment.

Design Basis Earthquake - A Design Basis Accident postulated as an earthquake. The most severe earthquake that a facility and its associated systems must withstand. It produces the vibratory ground motion for which safety class items are designed to remain functional.

Design Basis Fire - A Design Basis Accident postulated as an fire. That fire is the most severe of its type that a facility and its associated systems must withstand. It produces the heat for which safety class items are designed to remain functional.

Design Response Spectrum (DRS) - An envelope of the maximum responses (deflection, velocity, or acceleration) that may be induced in a linear elastic system as a function of the system's frequency or period of vibration.

Dismantlement - The total disassembly of a nuclear weapon no longer required by DOD. This process takes place at Pantex Plant.

Dispersion - (air pollution) The sum effect of diffussion and both horizontal and vertical transport of a pollutant plume or puff.

DISPRE - A general purpose explosives computer modeling code used by the U.S. Department of Defense.

DOE Explosives Safety Manual - This manual describes the DOE safety rules used to implement DOE safety policy for operations involving explosives. It provides guidelines for operational safety, explosives and personnel limits, personal protective equipment and clothing, training, quantity-distance and level-of-protection criteria for explosives activities, operating procedures, formulation scale-up and IHE qualifications.

Dose Commitment - The cumulative dose equivalent that results, or is projected to result, from exposure to radioactive materials over a discrete time period. Dose commitment is expressed in units of rem.

Atomic Energy Commission (AEC) - A predecessor to the DOE, no longer in existence.

Background Radiation - The radiation normally present in the natural environment. Background radiation results from cosmic rays, from the naturally radioactive elements of the earth, including those within the human body, and from worldwide fallout from above ground nuclear weapons tests.

Beta Particle - An electron that is emitted from a nucleus during a radioactive transformation. Generally, beta particles can penetrate a sheet of paper but cannot penetrate a sheet of aluminum foil.

Calibration - The process of establishing and quantifying the accuracy of measurement standards or measurement and test equipment, in terms of a value(s) plus an uncertainty. Calibration can be accomplished by comparing one device with a second one of higher accuracy.

Caliche - Gravel, sand or desert debris cemented by porous calcium carbonate; also the calcium carbonate itself. Found in Mexico and Southwest U.S. Calcium carbonate precipitated as surface or near-surface crusts by the evaporation of moisture in the pore spaces of soils.

Category 1 Hazard - See Facility Hazard Categorization.

Category 2 Hazard - See Facility Hazard Categorization.

Category 3 Hazard - See Facility Hazard Categorization.

Chemical High Explosive - Chemical compounds and mixtures that react violently to release energy; primarily gas products at high temperatures and pressures. The term includes high explosives and insensitive high explosives.

Class I, Division 1 - See National Electric Code.

Class I, Division 2 - See National Electric Code.

Class II, Division 2 - See National Electric Code.

Committed Effective Dose Equivalent (CEDE) -The sum of the committed dose equivalents to various tissues in the body, each multiplied by an appropriate weighting factor. A CEDE is expressed in units of rem. It does not include contributions from external doses.

Confinement Factor - The fraction of radiological material released from a structure. It is applied to material in respirable aerosol form, and thus, after an appropriate release fraction has been applied to the mass of material, it is directly involved in offsite planning. (See Release Fraction.)

Consequence - The results (especially projected doses or dose rates) of a release of a hazardous material to the environment. For example, if a release results in a radiation dose, then any illness or injury arising from the dose is the consequence.

Contamination - The deposition or infiltration of hazardous material on or into an object, material, or area where it is not desired.

Credible Event - An event for which the probability of occurrence is above a specified threshold. In this application only, an event is deemed credible if its probability of occurrence is one in a million years or more, that is, a probability greater than or equal to 1.0×10^{-6} per year.

Critical Excursion - An event that produces direct radiation and fission-product radioactivity that may lead to lethal consequences to nearby personnel.

Criticality - A self-sustaining fission chain reaction. Criticality occurs when the rate of production of neutrons in a system is greater than or equal to the loss of neutrons from the system.

reasonably anticipate observing the following health effects:

(a) ERPG-1 - The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing other than mild, transient adverse health effects or perceiving a clearly defined objectionable odor.

(b) ERPG-2 - The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.

(c) ERPG-3 - The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

Emergency Response Planning - The development and preparation of emergency plans and procedures and the determination of the availability of resources to provide an effective response to an emergency situation.

Enriched Uranium - Uranium having a higher percentage of uranium-235 than the 0.7% found in natural uranium. (See Natural Uranium.)

Environmental Assessment (EA) - A concise public document for which a Federal agency is responsible. An environmental assessment provides brief but sufficient evidence and analysis for determining the need for an environmental impact statement.

Environmental Impact Statement (EIS) - A document required of Federal agencies by the National Environmental Policy Act for major programs or legislation that may significantly affect the environment. A tool for decisionmaking, an environmental impact statement describes the positive and negative effects of proposed and alternative actions.

Environmental Receptor - Any organism or material down gradient or down wind of a release of hazardous material, including air, water, soil, plants, animals, and humans.

Energy Research and Development Administration (ERDA) - A predecessor to the DOE, no longer in existence.

EPI Code - The Emergency Prediction Information (EPI) code, is a computer model designed for determining airborne release of hazardous materials under various atmospheric conditions. (See HOTSPOT)

Event Scenario - A conceivable chronology of actions or occurrences leading up to and including an event.

Event - For this application only, any real-time occurrence or significant deviation from planned or expected behavior that could endanger or adversely effect people, property, or the environment.

Explosive - Any chemical compound or mixture that, when subjected to heat, impact, friction, shock, or other suitable initiation stimulus, undergoes a very rapid chemical change with the evolution of large volumes of highly heated gases that exert pressures in the surrounding medium. The term applies to materials that either detonate or deflagrate.

Explosive Area - At Pantex Plant, areas containing limited quantities of explosive material.

Dose Equivalent - The product of absorbed dose in tissue in units of rad, a quality factor, and other modifying factors. Dose equivalent is expressed in units of rem, or as a rate in units of rem or millirem per year.

Dose Exposure Pathway - The route of transfer of a toxic substance from the environment into the body. Examples of dose exposure pathways are: inhalation, ingestion, immersion, forage cow milk, and leafy vegetable.

Dose Rate - The radiation dose per unit time measured, for instance, in rad per hour or rad per year.

Dose - The quantity of radiation or energy absorbed per unit of mass expressed in units of "radiation absorbed dose" (rad). A rad is equivalent to 100 ergs of absorbed energy per gram of material such as tissue.

Dosimeter - A device that measures the amount of radiation received, most commonly referred to when addressing measurement of personnel individual doses.

Effective Dose Equivalent - The sum of the products of the dose equivalent received by specified tissues of the body and a tissue-specific weighting factor. This sum is a risk-equivalent value that can be used to estimate the health-effects risk of the exposed individual. The tissue-specific weighting factor represents the fraction of the total health risk resulting from uniform whole-body irradiation that would be contributed by that particular tissue. The effective dose equivalent includes the committed effective dose equivalent from internal deposition of radionuclides and the effective dose equivalent due to penetrating radiation from sources external to the body. Effective dose equivalent is expressed in units of rem or mrem.

Emergency - An emergency is any unwanted operational, civil, natural-phenomenal, or security-related occurrence that could endanger or adversely affect people, property, or the environment.

Emergency Action Level (EAL) - The concentration level of toxic chemicals above which emergency action is required.

Emergency Class - A subset under the categories of emergency (Operational, Energy, Continuity of Government). The class further differentiates an emergency by degree of severity, depending on the actual or potential consequence of the emergency situation. For the operational emergency subcategory, the classes are: alert; site area emergency; and general emergency.

Emergency Plan - A brief, clear, and concise description of the overall emergency organization, designation of responsibilities, and descriptions of the procedures, including notifications, involved in coping with any or all aspects of a potential credible emergency.

Emergency Planning Zone (EPZ) - A geographic area surrounding a DOE facility for which planning and preparedness efforts are carried out to ensure that prompt and effective protective actions can be taken to reduce or minimize the impact to onsite personnel, public health and safety, and the environment in the event of an operational emergency.

Emergency Power System - An auxiliary power system that provides power to safety- and security-related equipment during periods of partial or total primary power failure.

Emergency Response Planning Guidelines (ERPG) - ERPG values, developed by the American Industrial Hygiene Association are atmospheric concentrations of chemicals developed for use in evaluating the health consequences of exposure of the general public to accidental releases of extremely hazardous chemicals. These values represent airborne chemical concentrations below which one could under common management, and contribute to a common programmatic mission. If a single building or structure contains several tenant activities or units, such as process lines, hot cells, or hazardous material staging, it may be reasonable to consider the entire structure as one facility even though the constituent units may have little to do with one another.

Facility Hazard Categorization - The process of determining the hazard type a facility may present and the effects of accidents on workers, the public, and the environment. Facility hazard categorization is also used to determine design features that mitigate hazards to workers, the public, and the environment.

> **Category 1 Hazard** - As defined in DOE Order 5480.23 "Nuclear Safety Analysis Reports," for non-reactor nuclear facilities, the hazards analysis conducted in the Safety Analysis Report shows the potential for significant offsite consequences.
>
> **Category 2 Hazard** - As defined in DOE Order 5480.23 "Nuclear Safety Analysis Reports," for non-reactor nuclear facilities, the hazards analysis conducted in the Safety Analysis Report shows the potential for significant onsite consequences, excluding normal industrial hazards addressed under Occupational Safety and Health Administration regulations.
>
> **Category 3 Hazard** - As defined in DOE Order 5480.23 "Nuclear Safety Analysis Reports," for non-reactor nuclear facilities, the hazards analysis conducted in the Safety Analysis Report shows the potential for only significant localized consequences, excluding normal industrial hazards addressed under Occupational Health and Safety regulations.

Facility Limit - The upper limit (quantity) of all types of chemical HE or radioactive material a facility can have within its boundaries, whether staged or in use.

Failure Mode - Any type of failure that could affect a system element; for example, failure of equipment to actuate upon demand.

Fire Rating - The time in minutes or hours, that materials or assemblies have withstood a fire exposure as established in accordance to test procedures of NFPA 251 "Standard Methods of Fire Tests of Building Construction and Materials."

Fire Wall - A barrier designed and constructed to prevent the passage of fire from one area to another under most fire conditions with sprinklers out of service. All openings and penetrations are protected with devices (fire doors and fire dampers) capable of maintaining the integrity of the wall.

Fissile Materials - Nuclides such as uranium-235 and plutonium-239 that can sustain a nuclear chain reaction. Fissile materials are capable of undergoing fission by interaction with neutrons of any energy.

Fission - See Nuclear Fission.

Fission Products - The nuclides, particulates, and energy formed by nuclear fission.

Fissionable Materials - Nuclides capable of fission by neutrons. Fissionable materials include materials such as uranium-238, which require high-energy neutrons, as well as all fissile materials. (See Fissile Materials.)

Flame Spread Rating - A measurement of the propogation of flame over a surface based on test results from NFPA 255, "Standard Method of Test of Surface Burning Characteristics of Building Materials."

FRAGHAZ - A general purpose explosives computer modeling code used by the DOD.

FRANG - A general purpose explosives computer modeling code used by the DOD.

Explosives Hazards Class I (per DOE Explosives Safety Manual) - Class I consists of those explosives activities involving a high accident potential; any personnel exposure is unacceptable for Class I activities, and they thus require remote operations. Class I includes activities where energies that may interface with the explosives are approaching the upper safety limits, or the loss of control of the interfacing energy is likely to exceed the safety limits for the explosives. This category includes those research and development activities where the safety implications have not been fully characterized. Examples of Class I activities are dry screening, dry blending, pressing, extrusion, drilling of holes, dry machining, machining explosives and metal in combination, new explosives development and processes, and explosives disposal.

Explosives Hazards Class II (per DOE Explosives Safety Manual) - Class II consists of those explosives activities that involve a moderate accident potential because of the explosives type, the condition of the explosives, or the nature of the operations involved. This category consists of activities where the accident potential is greater than for Class III, but the exposure of personnel performing contact operations is acceptable. Class II includes activities where the energies that do or may interface with the explosives are normally well within the safety boundaries for the explosives involved, but where the loss of control of these energies might approach the safety limits of the explosives. Examples of Class II activities are weighing, some wet machining, assembly and disassembly, and environmental testing.

Explosives Hazards Class III (per DOE Explosives Safety Manual) - Class III consists of those explosives activities that represent a low accident potential. Class III includes explosives activities during storage and operations incidental to placing in storage or removal from storage.

Explosives Hazards Class IV (per DOE Explosives Safety Manual) - Class IV consists of those explosives activities with IHE or IHE subassemblies. This explosive type is so insensitive that a negligible probability exists for accidental initiation or transition from burning to detonation. IHE explosions will be limited to pressure ruptures of containers heated in a fire. Although the fire hazards of IHE or IHE subassemblies are not as great as those of other explosives, they are classified as hazard class/division 1.3 (mass fire) to be consistent with DOD 6055.9 STD. Most processing and storage activities with IHE and IHE subassemblies are Class IV except Class I activities such as pressing, some machining, dry blending, dry milling, and dry screening.

Exposure - In this application only, exposure is the condition of being made subject to hazardous chemicals or radioactivity, or both.

Exposure Level - The concentration of an airborne toxic chemical or radiation that a person or other animal comes in contact with.

Facility - Any equipment, structure, system, process, or activity that fulfills a specific purpose. Examples of facilities include accelerators, staging areas, fusion research devices, nuclear reactors, production or processing plants, coal conversion plants, magnetohydro-dynamics experiments, windmills, radioactive waste disposal systems and burial grounds, testing laboratories, research laboratories, transportation activities, and accommodations for analytical examinations of irradiated and non-irradiated components.

Facility Boundary - According to the DOE *Emergency Management Guide, Guidance for Hazards Assessment*, a facility boundary should consider both material processing operation boundaries and physical boundaries (e.g., structural or geographical). For emergency planning purposes, several structures of component units with a common or related purpose may constitute a single facility. On the other hand, a complex of dissimilar buildings, processes, and equipment may be considered as a single facility if they are physically adjacent, [illegible] mixed together and forced through a cement [illegible] by pneumatic pressure. Gunite is used to [illegible] earthen slopes to cap the gravel and earth overburden of gravel gertie assembly cells. This cap prevents the erosion of the overburden.

H-3 - See Tritium.

Half-Life - The time required for a radioactive substance to lose 50% of its activity by decay. It is used as a measure of the persistence of radioactive materials. Each radionuclide has a characteristic, constant half-life.

Hazard - Hazard means a source of danger (i.e., material, energy source, or operation) with the potential to cause illness, injury, or death to personnel or damage to a facility or to the environment (without likelihood or credibility of accident scenarios or consequence mitigation).

Hazard Classification - Designation for an operation which determines the minimum level of Safety Analysis Report review and approval. The hazard class of a facility also affects its design criteria. A tentative hazard class (low, moderate, or high) is presented by the M&O contractor to DOE for approval. Hazard classes are:

> **Low** — Those which present minor onsite and negligible offsite impacts to people or the environment.
>
> **Moderate** — Those which present considerable potential onsite impacts to people or the environment, but at most only minor offsite impacts.
>
> **High** — Those with the potential for onsite or offsite impacts to large numbers of person or for major impacts on the environment.

Hazardous Material (Substance) - As defined by 29 CFR 1910.120, any solid, liquid, or gaseous material that is toxic, explosive, flammable, corrosive, or otherwise physically or biologically threatening to health. Oil is excluded from this definition.

Hazardous Waste - Defined by 40 CFR Part 261, as any material that a) is a solid waste, and b) is a listed hazardous waste (Subpart D), or c) exhibits any of the characteristics of ignitibility, corrosivity, reactivity or toxicity (Subpart C).

Hazards Assessment - The process of identifying and analyzing those hazards that are significant enough to warrant consideration in the operational emergency management program of a facility. At the Pantex Plant, the process includes a screening step through which small quantities of hazardous materials can be excluded from consideration. Hazards Assessments are also used for emergency planning purposes.

Hazards Assessment Document - The report or document resulting from a hazards assessment.

High Explosive (HE) - Any chemical compound or mechanical mixture which, when subjected to heat, impact, friction, shock or other suitable initiation stimulus, undergoes a very rapid chemical change with the evolution of large volumes of highly heated gases that exert pressure in the surrounding medium. Defined by 40 CFR Part 261.23 as any material that exhibits the characteristic of reactivity.

High Hazard - Hazards with the potential for onsite and offsite impacts to large numbers of persons or with the potential for major impacts to the environment or national security.

High Hazard Facility - A facility whose hazards present the potential for significant onsite and offsite impacts to people or to the environment.

High-Efficiency Particulate Air (HEPA) Filters - A filter with a fibrous medium that can remove from an air stream at least 99.97 percent of particulate material that is greater than 0.3 micrometers in diameter.

Fujita Scale - In the late 1960's T. Theodore Fujita, Professor of Meteorology at the University of Chicago, invented the tornado wind damage scale that carries his name. It was developed from his ground and aerial studies of storm damage and the force that would be needed to cause that damage. The scale numbers range from F-0 (light damage caused by winds up to 72 mph or 32.1 mps) to F-5 (incredible damage from winds above 261 mph or 116.5 mps). There are two general kinds of tornadoes: 1) light ones that usually last less than 5 minutes and have winds that rarely exceed 150 mph or 67 mps (F-2 on the Fujita Scale), and 2) strong ones whose fastest winds may reach 300 mph or 134 mps (F-5). Short-lived tornadoes (lasting only a few seconds) can have a Fujita wind damage number of F-0. Another phenomenon, downbursts can be ranked as high as F-3 (severe damage from winds between 158 and 206 mph or 70.5 and 91.9 mps) on the Fujita Scale.

Gamma Ray - A high-energy photon emitted by a nucleus in transition between two energy levels. Generally, gamma rays can penetrate the human body but cannot penetrate lead or thick concrete.

Gaussian Dispersion Model - A widely used mathematical computer model for estimating the diffusion of atmospheric pollutants. Its form for a continuous point-source (plume) is given by:

$$\chi(x,y,z)/Q = \frac{\exp(-y^2/2\sigma_y^2)[\exp(-(z-h_e)^2/2\sigma_z^2) + \exp(-(z+h_e)^2/2\sigma_z^2)]}{(2\pi\sigma_y\sigma_z u)}$$

where:

$\chi(x,y,z)$ = steady-state concentration at a point (x,y,z) in g/m^3 or Ci/m^3

Q = continuous release strength (g/s or Ci/s)

u = mean horizontal transport wind speed in x-direction (m/s)

σ_y, σ_z = horizontal and vertical standard deviation of concentration distribution (m)

h_e = effective source height (m).

The form presented above is an exact solution to the diffusion equation for stationary, homogeneous turbulent flow, i.e., flow for which statistical properties do not vary in time or space. It describes the ***near-field*** of diffusion exactly, based on statistical theory. It assumes a "Normal" distribution of pollutant both horizontally and vertically within the plume and it assumes that the wind velocity at the release point is the mean wind velocity over the computational grid and is non-variant. It further assumes that the plume is transported over homogeneous flat terrain. The non-continuous point-source or puff model assumes that a plume element (a puff) in the form of a three-dimensional Gaussian function is moved horizontally by the mean transport wind field u(x,y). The puff model attempts to simulate the instaneous plume spreading about its axial centroid, in the form of a sequence of overlapping puffs.

General Emergency - A general emergency represents events that have occurred or are in progress, or that involve actual or imminent catastrophic failure of facility safety systems. General emergency events have the potential for loss of confinement integrity, catastrophic degradation of facility protection systems, or catastrophic failure in safety or protection systems, which threatens the integrity of a weapon or test device and could lead to substantial offsite impacts. An environmental release of hazardous material can reasonably be expected to exceed its protective action guideline (PAG) value offsite.

Graded Response - During an emergency, the mobilization of personnel and resources in response to the perceived severity level of the events in progress or observed conditions.

Gravel Gertie - A heavily bunkered facility designed to minimize the blast effects and the release of hazardous materials from areas in which assembly and disassembly of nuclear devices are conducted. Gravel gerties are characterized by a cable-supported roof of wire mesh and a thick gravel overburden. (See Assembly Cell.)

Gunite - Tradename for a construction material composed of cement, sand, crushed slag, and

Limited Access Area - A security area for the protection of classified matter where guards, security inspectors, or other internal controls can prevent access by unauthorized persons to classified matter.

Linac - Linac is the trade name for a Varian linear accelerator. However, "Linac" is used in the generic sense in this document as an abbreviation for "linear accelerator" rather than as a specification for a particular manufacturer.

Liquefaction - The process of becoming liquid. In the emergency management context, the temporary transformation of unconsolidated materials into a liquid mass during an earthquake.

Llano Estacado - Spanish for "staked plain", used to refer to the Southern High Plains.

Low Hazard - A hazard that presents minor onsite and negligible offsite impacts to people, the environment, or national security.

Low Hazard Facility - A facility whose hazards present the potential for only minor onsite and negligible offsite impacts to people or the environment.

Low-Level Radioactive Waste (LLW) - Waste containing radioactivity not classified as high-level, transuranic waste, spent nuclear fuel, or special by-product material.

Magazine - An earth-covered facility used to hold high explosives, nuclear weapons, or weapons components.

Maintenance - Work performed to repair equipment or to keep it operable.

Material Access Area - At Pantex Plant, an area containing significant quantities of special nuclear material specifically defined by physical barriers and located within a protected area.

Maximum Credible Earthquake - The largest earthquake that can affect a site. For the Pantex Plant site, the maximum credible earthquake is defined in terms of peak horizontal and vertical accelerations (0.33 g_0 and 0.2 g_0, respectively).

Maximum Credible Event - All accident initiating events other than DBAs. Maximum Credible Events include both natural phenomena that have a greater magnitude (and a correspondingly lower probability) than DBAs, and any other reasonably conceivable accident scenario that could affect a facility and its contents.

Millirem (mrem) - A unit of radiation dose to the body equivalent to one one-thousandth of a rem. (See rem.)

Mixed Waste - Waste containing both radionuclides as defined by the Atomic Energy Act, and hazardous constituents as defined by 42 USC 6901 et seq. and 40 CFR 261.

Mock High Explosive - An inert compound that is formulated to resemble the physical properties of high explosives but that does not explode. Mock high explosives are used for training and research purposes.

Moderate Hazard - Hazards that represent considerable potential onsite impacts to the people or the environment, but at most only minor offsite impacts to people, the environment, or national security.

Moderate Hazard Facility - A facility whose hazards present the potential for significant onsite impacts but, at most, only minor offsite impacts to people or the environment.

Monte Carlo Simulation - A computer analysis technique that uses random selection of choices in the simulation of decisionmaking.

National Electric Code (NEC) - NFPA 70, "National Electric Code" provides an industrial

High Pressure Fire Loop (HPFL) - This system consists of a looped, well-gridded, valved underground water distribution main ranging from 8 to 14 in., two ground storage reservoirs, and two fire pump stations that supplies fire protection water to buildings at Pantex Plant.

HMX (Cyclotetramethylenetetranitramine) - A sensitive chemical high explosive used in nuclear weapons and prevalent at Pantex Plant; high melting explosive.

HOTSPOT - A gaussian computer code used to estimate dispersal of radioactive materials and attendant dose.

Immediately Dangerous to Life or Health (IDLH) - An IDLH value is the maximum concentration of a chemical in the air from which a person could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects. IDLH values were developed by the National Institute for Occupational Safety and Health only for the purpose of respirator selection.

Incredible Event - An event that is unanticipated and not sufficiently credible to warrant consideration. Quantitatively, the probability of such an event is less than one in a million years, that is, a probability less than 1.0×10^{-6} per year.

Inert Areas - At Pantex Plant, areas containing materials that are compatible with each other and do not have energetic capabilities.

Inhalation Exposure Pathway - The collection of mechanisms by which hazardous or radioactive material is internally deposited through nasopharyngeal, tracheobronchial, and pulmonary intake. The principal exposure through this pathway would be from inhalation of particulate radioactive material, radioactive gas, or tritiated water vapor. The duration of principal exposures could range in length from minutes to years.

Insensitive High Explosive (IHE) - High explosives that, although mass detonating, are so insensitive that there is negligible probability of accidental initiation or transition from burning to detonation.

Inspection - An examination of a system or part of a system to verify that it appears to be in operating condition and free from physical damage.

Internal Operating Procedure (IOP) - Formal written document containing detailed directions on how to perform specific functions and activities. IOPs are sufficiently detailed for qualified individuals to perform functions without direct supervision, but do not necessarily provide a complete description of a system or process.

Ionizing Radiation - Any electromagnetic or particulate radiation that can produce ions, directly or indirectly, as it passes through matter.

Isotope - Any of two or more species of atoms of a chemical element with the same atomic number and position in the periodic table and nearly identical chemical behavior but with differing atomic mass number and different physical properties.

Joint Interface Test (JIT) - A weapon assembly that is shipped to the DOD for specific DOD tests and then returned to Pantex.

Joint Test Assembly (JTA) - A DOE-developed configuration based on DOE-DOD requirements for use in a joint flight test program comprised of a joint test subassembly and War Reserve weapon components. The physical appearance and characteristics of a Joint Test Assembly approximates a War Reserve configuration to the extent practicable.

KENO 5 - A Monte Carlo computer code used for criticality analysis. KENO 5 is known for producing reliable and accurate values for plutonium and uranium systems.

Nuclear Criticality Safety - Administrative measures that provide prevention or termination actions for inadvertent nuclear chain reactions in non-reactor environments. Pantex Plant is a non-reactor environment.

Nuclear Detonation - An very rapid energy release through nuclear fission or fusion processes, where large amounts of energy, equivalent to that energy released when chemical high explosives are detonated, is released.

Nuclear Explosive-Like Assembly (NELA) - A nonnuclear assembly that represents a nuclear explosive in its basic configuration (main charge high explosive and pit and any subsequent level of assembly up to its final configuration) or that represents a weaponized nuclear explosive such as a warhead, bomb, reentry vehicle, or artillery shell. This nonnuclear assembly does not contain an arrangement of high explosive and fissile material capable of producing a nuclear detonation.

Nuclear Facility - As designated by DOE, a facility whose operations involve radioactive materials in such form and quantity that a significant nuclear hazard exists to the employees or the public. Included are facilities that: produce, process, or store radioactive liquid or solid waste, fissionable materials, or tritium; conduct separations operations; conduct irradiated materials inspection, fuel fabrication, decontamination, or recovery operations; or conduct fuel enrichment operations. Incidental use of radioactive materials in a facility (e.g., check sources, radioactive sources, and x-ray machines) does not necessarily require nuclear designation facility. Nuclear facilities include reactors and nonreactor nuclear facilities.

Nuclear Fission - A nuclear transformation characterized by the splitting of a nucleus into at least two other nuclei and the release of a relatively large amount of energy.

Nuclear Materials Management and Safeguards System - The national database and information support system for nuclear materials controlled by the U.S. Government. The system was created to support national safeguards and management objectives in the domestic and foreign use of nuclear resources.

Nuclear Weapon - Any weapon with a nuclear device designed specifically to produce a large release of energy (nuclear explosion) from the fission and/or fusion of atomic nuclei.

Nuclear Weapons Operations - Collectively used to mean all operations associated with the production of new nuclear weapons, including the maintenance, modification, and quality assurance testing of existing nuclear weapons in the military stockpiles and the retirement or disassembly of nuclear weapons.

Nuclide - A species of atom characterized by the number of protons, number of neutrons, and energy content of the nucleus; to be regarded as a distinct nuclide, the atom must be capable of existing for a measurable time period, generally greater than 10^{-10} seconds.

Oak Ridge Ordnance (ORO) Components - Weapons components, which include primaries (pits), secondaries, or other components produced at the Oak Ridge Site. Oak Ridge ordnance components may contain uranium, lithium deuteride, or other material.

Off-Normal Conditions - A condition that could be expected to occur during the lifetime of the facility having a potential to result in at worst, marginal consequences, i.e., minor injuries or occupational illnesses, minor damage to the facility or the process, or minor damage to the environment.

Offsite - For this application only, the area outside the property lines of Pantex Plant.

guideline for safe use of electrical equipment and applications within industrial facilities.

Class I, Division 2 - A National Fire Code Class I, Division 2 location is a location: (1) in which volatile flammable liquids or flammable gases are handled, processed, or used, but in which the liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in the case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment; or (2) in which ignitible concentrations of gases or vapors are normally prevented by positive mechanical ventilation, and which might become hazardous through failure or abnormal operation of the ventilating equipment; or (3) that is adjacent to a Class I, Division 1 location, and to which ignitible concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided.

Class II, Division 2 - A National Electric Code Class II, Division 2 location is a location where combustible dust is not normally in the air in quantities sufficient to produce explosive or ignitible mixtures, and dust accumulations are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus, but combustible dust may be in suspension in the air as a result of infrequent malfunctioning of handling or processing equipment and where combustible dust accumulations on, in, or in the vicinity of the electrical equipment may be sufficient to interfere with the safe dissipation of heat from electrical equipment or may be ignitible by abnormal operation or failure of electrical equipment.

National Environmental Policy Act (NEPA) - Federal statute promulgated under 40 CFR part 1500 through 1508; requires Federal facility actions be evaluated for environmental impacts, usually in the form of Environmental Impact Statements or Environmental Assessments.

Natural Phenomenon - A geologic or meteorologic event, such as an earthquake, hurricane, or tornado, that has the potential to adversely affect people or structures.

Natural Radioactivity - The radioactivity exhibited by naturally occurring radioactive substances. (See Radioactivity).

Natural Uranium - Uranium, as found in nature, which is universally distributed in the lithosphere as radioactive metallic isotopes in varying concentrations and usually in equilibrium with its decay chain products. It contains mostly uranium-238 with minor amounts of uranium-235 and uranium-234 as isotopes.

NAVFAC - A general purpose explosives computer modeling code used by the DOD.

Neutron - A fundamental particle of matter existing in or emitted from an atomic nucleus. A neutron is electrically neutral and has a mass approximately equal to that of a stable hydrogen atom.

Nonnuclear Detonation - For this application only, a chemical reaction within the high-explosive components of a nuclear weapon that results in an explosion. The explosion can disperse the radioactive materials contained in the weapon component without nuclear detonation.

Nonreactor Nuclear Facility - A facility whose activities or operations involve radioactive and/or fissionable materials in such form and quantity that a nuclear hazard exists to employees or to the public.

Policy Directive - Documentation that provides general plant-wide guidance governing all lower level procedures and standards and that define goals and outline the overall policies of plant management.

Population Dose - The sum of the radiation dose (in rem) received by all individuals in a population group. This measure is used primarily for calculating total body dose in a population in units of person-rem.

Process - For Pantex Plant, the component and subsystem integration steps that contribute to the final assembly of nuclear weapons. At Pantex Plant, no processes involve chemical reactions with, or machining of, radioactive materials.

Projected Dose - An estimate of the radiation dose that affected individuals could potentially receive if protective actions are not taken.

Property Protection Area - A secure area set aside for the protection of property, as required by DOE order.

Protected Area - An area surrounded by physical barriers such as walls or fences to which access is controlled.

Protected Distribution System (PDS) - At Pantex Plant, the PDS utilizes data processing terminals and secure telephones to transmit information associated with the movement and control of special nuclear materials.

Protective Action - Action, such as evacuation or sheltering from a release of hazardous materials taken to prevent the accrual of adverse health effects to employees or the public.

Protective Action Guideline (PAG) - A radiation personnel exposure value or range beyond which protective action should be considered. PAG values reflect a balance of risks and costs to onsite personnel, public health and safety, and the environment weighted against the benefits obtained from protective actions.

Public Dose - For this application only, the dose received by the public from exposure to radiation or radioactive material released to the environment by a DOE facility or operation, whether the exposure is within a DOE site boundary or offsite. Public dose does not include doses received from occupational exposures, from naturally occurring background radiation, from medical procedures, or from consumer products.

Quality Assurance Testing - Inspecting and testing all or portions of products to ensure that design tolerances are not exceeded.

Quality Factor - The principal modifying factor by which absorbed doses are multiplied to obtain dose equivalents for radiation protection purposes, and thus expresses the effectiveness of absorbed doses on a common scale for all kinds of ionizing radiation; the quality factor depends on the type and the energy of the radiation being considered.

Quantity-distance - The quantity of explosives and the distance separation relationship that provides defined types of protection. These relationships are based on levels of risk considered acceptable for a stipulated exposure and are tabulated in the appropriate quantity-distance tables in DOD 6055.9-STD, "Ammunition and Explosives Safety Standard."

Rad - Radiation absorbed dose. An absorbed radiation dose of 100 ergs per gram of absorbing material. (See rem.)

Radiation - (1) The emission and propagation of radiant energy, for example, electromagnetic waves, subatomic particles, or sound. (2) The energy propagated through space or through a material medium, for example, alpha, beta, and gamma emissions from radioactive nuclei.

Ogallala - Geological formation containing the major aquifer for the Southern High Plains region and Pantex Plant.

Onsite - The physical area of a site over which the DOE has access control such that the public is or can be excluded. For Pantex Plant, onsite areas include those areas that have been established as national defense areas and national security areas.

Operational Failure Mode - Those hardware faults and operator errors directly associated with a facility that could cause undesired health and safety consequences.

Operations and Inspections (O&I) Standards - Instructions for safe, environmentally sound, efficient, and economical operations. Operations and inspections standards exist for high explosives, radioactive materials, toxic materials, nuclear explosives, and their related manufacturing processes.

Particulate Matter - Finely divided solid material, for example, minute particles of coal dust, fly ash, and oxides suspended in the atmosphere.

Pasquill Stability Classification - A categorization scheme used to estimate the intensity of turbulence near the ground using the wind speed at 10m, incoming solar radiation, cloud cover, and time of day. These categories of turbulent intensity, from "A" (most unstable) to "F" (most stable) are used in Gaussian plume models to estimate the lateral and vertical spread of a pollutant as a function of downwind distance from the source.

Permissible Exposure Limit (PEL) - A time-weighted average concentration for work place exposure to an airborne chemical that must not be exceeded during any 8-hour work day or 40-hour work week. PELs are listed in the Occupational Safety and Health Administration General Industry Air Contaminants Standard, 29 Code of Federal Regulations Part 1910.1000, Tables Z-1-A or Z-2.

Penetrating Radiation - Ionizing radiation of sufficient energy and proper form to pass through the skin. X-rays, gamma rays, energetic beta particles, and neutrons are types of penetrating radiation.

Permian - Of, belonging to, or designating the geologic time, system of rocks, and sedimentary deposits of the seventh and last period of the Paleozoic era.

Person-rem - A unit of population dose, calculated by summing each dose (expressed in rem) to an individual in a given population.

Personnel Assurance Program (PAP) - At Pantex Plant, a program that establishes the requirements and responsibilities for screening, selecting, and continuously evaluating employees considered for assignment or assigned to critical duties.

Physics Package - The cased, high explosive and nuclear material components of a nuclear weapon.

Planning Basis - In the context of emergency planning and emergency response, guidance for size of planning area (distance); time dependence of release; and radiological characteristics of releases.

Plant Standard - Document providing direction to implement a policy or to meet operational objectives in a consistent manner, and contain technical regulatory guidelines.

Playa - A natural depression acting as a detention basin receiving all surface runoff within a watershed area; an ephemeral lake.

Plutonium - A synthetic, radioactive, reactive metallic element in the transuranium series of elements. A plutonium atom has 94 protons. Plutonium is used as nuclear fuel, used to produce radioactive isotopes for research, and used as a fissile agent in nuclear weapons.

Release fractions apply particularly to compounds that have both toxic and non-toxic constituents.

Release Height - The distance above ground-level at which a release of material starts its dispersion.

Release - To set chemical or radiological material free into a pathway. Primarily, an airborne release, as this pathway typically represents the most time-urgent situation and requires a rapid, coordinated emergency response on the part of the facility, co-located facilities, and surrounding jurisdictions to protect workers, the public, and the environment. Releases to aquatic and ground pathways, although a matter of serious concern in terms of potential environmental and long-term public helath consequences, in most instances do not have the same time-urgency as an airborne release. When a release to an aquatic or ground pathway could have a near-term effect on the workers or the public (e.g., through a community water supply), then it is considered.

Rem - "Roentgen equivalent man." A unit of dose equivalent, the rem is numerically equal to absorbed dose times a quality factor and other modifying factors. It equates the biological effects produced by different ionizing radiations.

Respirable Aerosols - In general, small particles (usually between 2 and 10 microns in diameter) of solid material entrained with gas such that the material follows the bulk flow of the gases in which it is suspended.

Risk - The quantitative or qualitative expression of possible loss that considers both the probability that a hazard will cause harm and the consequence of that event.

Risk Analysis - In this application only, a systematic method to identify the failures and failure consequences of systems and their interrelated components and subcomponents.

Roentgen - A unit of radiation emission of X-rays or gamma radiation that produces, in air, ions carrying positive and negative charges totaling 2.58×10^{-4} coulombs per kilogram (5.7×10^{-4} coulombs/lb) of air.

Safe-Secure Trailer (SST) - A specially designed trailer for transporting nuclear weapons or nuclear weapon components.

Safety Analysis (SA) - A documented process of systematically identifying the hazards of an operation; describing and analyzing the adequacy of the measures taken to eliminate, control, or mitigate the hazards; and analyzing and evaluating potential accidents and their associated risks.

Safety Analysis Report (SAR) - Formal documentation of a safety analysis. A safety analysis report systematically identifies the hazards of an operation, describes and analyzes the adequacy of the measures taken to eliminate, control, or mitigate identified hazards, and analyzes and evaluates potential accidents and their associated risks.

Safety Class Items - A system, component, or structure, including a portion of a process system, whose failure could adversely affect the environment or the safety and health of the public. Determination of classification is based on analysis of the potential consequences of abnormal events and accidents as presented in the safety analysis report. Safety class items include those systems, components, and structures:

(a) Whose failure would produce consequences that exceed the existing guidelines at the point of maximum exposure

(b) That are required to maintain operating parameters within the safety limits specified in Pantex Plant's operational safety requirements or technical safety requirements during normal operations and anticipated operational occurrences

Radioactive Material - Any material or combination of materials that spontaneously emit ionizing radiation.

Radioactive Waste - Equipment and materials from nuclear operations that are radioactive, or are contaminated with radioactive material, and that have no further economic use or value.

Radioactivity - The property that certain nuclide have of spontaneously emitting particles or electromagnetic radiation or of undergoing spontaneous fission. The quantity of radioactivity, usually shortened to "activity," is the number of nuclear transformations occurring in a given quantity of material per unit time. (See also curie.)

Radiography - The technique of producing a photographic image of a relatively opaque object by transmitting a beam of X-rays or gamma rays through it onto an adjacent photographic film.

Radiological Assistance Team (RAT) - For this application only, DOE or DOE-contractor professionals who conduct offsite radiological emergency monitoring. Radiological Assistance Teams are located at DOE operations offices and national laboratories, and at most area offices and associated contractor sites.

Radiological Explosive Hazard Index - The reciprocal of the minimum quantity of a radioactive material at a facility that, if dispersed explosively, would be required to produce doses or dose commitments in excess of applicable protective action guideline values at 100 meters (328 ft) or at the site boundary. Similar incices are determined for fire.

Radiological Protection - Protection against the effects of internal and external exposure to radiation and radioactive materials.

Radionuclide - A nuclide that exhibits radioactivity.

Reasonably Conceivable Event - The spectrum of postulated emergency events, including accidents, hostile attacks, terrorism, sabotage, malevolent acts, seismic events, and other natural phenomena, ranging from minor accidents to beyond-the-design basis events, that are considered in the hazardous materials hazards assessment. (See Paragraphs 11.b(2) and 11.b(4) of DOE Order 5500.3A, "Planning and Preparedness for Operational Emergencies.") This includes events that are less likely and more severe than design-basis accidents but does not include extremely unlikely accidents or events such as collisions of multiple aircraft (three or more) with worst case scattering of debris, complex and time-consuming radiological sabotage events involving explosives, and accidental or malevolent nuclear detonation of a weapon or weapon component.

Receptor Location - The point or place where an exposure or dose of hazardous material or chemical high explosives is received by an organism or material.

Receptor - The organism or material of the down gradient dispersal of a release of hazardous materials or chemical high explosives. Receptors include homes or locations where people assemble.

Record of Decision (ROD) - A document, prepared by DOE in accordance with the requirements of the U.S. Environmental Protection Agency Rule 40 Code of Federal Regulations Part 1505.2, "Record of Decision in Cases Requiring an Environmental Impact Statement." The record of decision provides a concise public record of DOE's decision on a proposed action for which an environmental impact statement was prepared.

Release Duration - The length of time a substance is being released to the environment.

Release Fraction - That part of a release that is toxic and is available to threaten the receptor.

Isotope 235, and any other material which is determined to be SNM, pursuant to Section 51 of the Atomic Energy Act of 1954, but not including source material, or any material artificially enriched by any of the foregoing.

Specific Activity - A measure of the decay rate or disintegration of radioactive material. (See Activity.). Specific activity is activity per weight of material in units of curies per gram (ci/g) or disintegrations per second per gram (dps/g).

Stability - (Atmospheric) The ability of the atmosphere to produce and sustain vertical currents depends on the atmosphere's "stability." A ***stable*** atmosphere is one in which buoyancy forces ***oppose*** the vertical displacement of air parcels from their original levels. ***Unstable*** conditions exist when buoyancy forces ***abet*** the vertical displacement of airparcels. A neutral state exists when vertical displacement is neither opposed or abetted by buoyancy forces.

Staging - For this application only, holding or storing temporarily between process steps.

Standard Operating Procedure (SOP) - A document that directs work done within the Pantex Development Division. SOPs are similar to internal operating procedures (IOPs), and exist within the set of operations and inspections standards.

Standby Power - A reserve power generation or supply with switching devices that allow power to be supplied to selected loads. Standby power is used in the event of a normal power failure.

TATB (1,2,5-triamino-2,4,6-trinitrobenzene) - A very stable and relatively insensitive chemical high explosive used in more modern nuclear weapons and prevalent at Pantex Plant.

Technical Safety Requirement (TSR) - Those requirements that define the conditions, safe boundaries, and management or administrative controls required to assure the safe operation of a nuclear facility and to reduce the potential risk to the public and facility workers from uncontrolled releases of radioactive materials or from radiation exposure due to inadvertent criticality. A TSR consists of operating limits, surveillance requirements, administrative controls, use and application instructions, and the bases thereof.

Tertiary - The first period of the Cenozoic era (after the Cretaceous of the Mesozoic era and before the Quaternary) thought to have covered the span of time between 65 and 2 Ma; also, the corresponding system of rocks.

Testing - Conducting periodic physical checks on a system to assure that it functions as designed.

Texas Air Control Board - A former State of Texas agency that administered standards for prevention and control of air emissions. Now a part of the Texas Natural Resources Conservation Commission (TNRCC).

Texas Natural Resources Conservation Commission (TNRCC) - The state agency responsible for the environmental quality of Texas. TNRCC has the lead regulatory role for RCRA regulated waste generated at Pantex Plant.

Threshold Limit Value-Time-Weighted Average (TLV-TWA) - Developed by the American Conference of Governmental Industrial Hygienists, TLV-TWAs are concentration values of chemicals developed for use in evaluating workplace safety. These values represent chemical concentrations to which healthy workers may be exposed repeatedly, for 8 hours per day, without experiencing any adverse health effects.

Threshold Limit Value - Ceiling (TLV-C) - Developed by the American Conference of Governmental Industrial Hygienists, TLV-C values are concentration values of chemicals developed for use in evaluating workplace safety. These values represent chemical concentrations

(c) That are required for nuclear criticality safety

(d) That are required to monitor the release of radioactive materials into the environment during and after a design basis accident

(e) That are required to achieve and maintain the facility in a safe shutdown condition

(f) That control the safety class items described above.

Safety Class Structures, Systems, and Components - Those systems, structures, or components whose functioning is necessary to keep exposure of the maximally exposed offsite individual below a dose of 25 rem or an exposure level of ERPG-2 for decision basis accidents and evaluation based accidents.

Safety-Significant Structures, Systems, and Components - Those systems, structures, and components not designated as safety-class, but whose preventive or mitigative functions are major contributors to prevention of uncontrolled material releases (defense in depth) and/or worker safety.

Safety Structures, Systems, and Components - The structures, systems, and components of a facility that are designed to prevent, detect, or mitigate accidents with consequences to employees, the public, or the environment.

Sanitization - The irreversible modification or destruction of a component or part of a component of a nuclear weapon, device, trainer or test assembly as necessary t prevent revealing classified or otherwise controlled information (e.g., unclassified information that is restricted from the standpoint of export control because of its significance for nuclear explosive's research, development, fabrication or proliferation purposes) as required by the Atomic Energy Act of 1954, a amended.

Shielding - Material used to absorb radiation and thus protect personnel or equipment.

SHOCK - A general purpose explosives computer modeling code used by DOD.

Single-Degree-of-Freedom System (SDOF) - A mathematical system that models the physical behavior of the structure being analyzed. The parameters of the model are selected such that the energy required to displace a single point on the structure and its representation in the model are the same. The point selected is typically the point of maximum deflection.

Site Area Emergency (SAE) - One of the classes of emergency within the categories of operational and emergency categories. In the context of an operational emergency, a site area emergency represents events that have occurred or that are in progress and that involve actual or likely major failure(s) of facility safety or safeguards systems needed for the protection of onsite personnel, public health and safety, the environment, or national security. Any environmental release of chemical high explosives are not expected to exceed their emergency response planning guideline (ERPG) values offsite.

Site Boundary - The perimeter of DOE-owned and controlled land.

Site - DOE-owned and controlled land comprising the Pantex Plant.

Somatic - Pertaining to the whole-body of an individual, excluding germ cells (cells with only one set of chromosomes).

Source Term - The amount of material available for release or dispersion.

Special Nuclear Material (SNM) - Plutonium, tritium, uranium enriched in the isotope 233 or in and mechanical hardware, e.g., fusing and/or guidance hardware.

Weapons Maintenance - The periodic checking of all systems on a weapon for operability and replacement of components as necessary.

Weapons Retirement - The total disassembly and disposition of parts of weapons no longer required by DOD.

Wet-pipe System - A fire mitigation system employing automatic sprinklers installed in a piping system containing water and connected to a water supply. In wet-pipe systems, water discharges immediately from sprinklers opened by a fire.

Worst Case - For this application only, a hazard assessment scenario where all factors considered are assumed to be conducive to causing the most damage or greatest environmental or health consequences.

XREFRAC - A general purpose explosives computer modeling code used by DOD.

Zone 4 - A staging and interim storage area at Pantex Plant containing a variety of earth-covered magazines.

Zone 11 - An area at Pantex Plant for the development, manufacturing, staging, testing, and evaluation of explosives for nuclear assemblies.

Zone 12 - The nuclear weapons assembly and dissassembly production area at Pantex Plant.

that should not be exceeded in the workplace under any circumstances.

Threshold Limit Value - Short-Term Exposure Level (TLV-STEL) - Developed by the American Conference of Governmental Industrial Hygienists, TLV-STEL values represent chemical concentrations to which healthy workers may be exposed for up to 15 minutes, 4 times per day, without experiencing any adverse health effects, so long as the TLV-TWA values are also not exceeded.

Threshold Limit Value (TLV) - Developed by the American Conference of Governmental Industrial Hygienists, TLVs are concentration values of chemicals in air developed for use in evaluating workplace safety.

TNT (2,4,6-trinitrotoluene) - A chemical high explosive used for a variety of purposes at Pantex Plant.

TNT equivalent - A measure of the blast effects from explosion of a given quantity of material expressed in terms of the weight of TNT that would produce the same blast effect when detonated.

Toxicological Occupational Medicine and Environmental Series (TOMES) Database - A compact disc-based, comprehensive database containing chemical, physical, and toxicological data on hazardous and industrial chemicals.

TRAJ - A general purpose explosives computer modeling code used by DOD.

Tritium (H^3) - The radioactive hydrogen isotope having a mass number 3. It is constantly produced by cosmic rays in the atmosphere and can be produced by neutron absorption.

Two-Person Concept - A concept in which a minimum of two authorized persons, each capable of detecting incorrect or unauthorized operations with respect to a task to be performed and familiar with pertinent safety and security requirements, are required to be present during all operations that afford access to strategic quantities of special nuclear material or vital equipment.

Type A Packaging - Packaging that is designed in accordance with general U.S. Department of Transportation (DOT) packaging requirements and that is adequate to prevent the loss or dispersal of radioactive contents and to retain the efficiency of its radiation shielding properties if the package is subjected to tests prescribed by the DOT. These tests represent the normal, rough handling conditions of transport.

Type B Packaging - Packaging for radioactive materials that meets the standards for Type A packaging under U.S. Department of Transportation (DOT) regulation and, in addition, meets the standards for the hypothetical accident conditions of transport prescribed in 49 Code of Federal Regulations Part 173.398(c).

Uncased High Explosive - Bare or exposed high explosive.

Uninterruptible Power Supply (UPS) - A power supply that provides automatic, instantaneous power, without delay or transients, on failure of normal power. It may consist of batteries or full-time operating generators and may be designated as standby or emergency power, depending on the application.

Uranium - A silvery, heavy, radioactive, polyvalent metallic element that is found especially in pitchblende and uraninite and exists naturally as a mixture of three isotopes of mass number 234, 235, and 238 in the proportions of 0.006 percent, 0.71 percent, and 99.28 percent, respectively (U, Atomic Number: 92).

Weapons Assembly - Any nuclear explosive device, including warheads, bombs, re-entry vehicles, and artillery shells, or nuclear explosive-like assemblies. A weapon assembly contains both primary and secondary nuclear components

1.0 EXECUTIVE SUMMARY

In January 1994, the U.S. Department of Energy (DOE) issued an Environmental Assessment (EA) that addressed the impact on the environment of interim storage of up to 20,000 plutonium components (pits) removed from nuclear explosives during disassembly at Pantex Plant[1]. As a result of this EA, DOE concluded that interim storage would not have a significant impact on the environment. In response to comments from state and local officials and other stakeholders, DOE also agreed to store no more than 12,000 pits at Pantex Plant until a Site-Wide Environmental Impact Statement (SWEIS) is completed in accordance with 10 CFR 1021[2]. The Pantex Plant SWEIS will cover all current and foreseeable future facilities and activities at Pantex Plant.

The Pantex Plant, near Amarillo, Texas, is the site at which the Department of Energy (DOE) fulfills a part of its national security mission.

Historically the Department's national security mission for the Pantex Plant included primarily the assembly of, and delivery to the Department of Defense (DOD), a variety of nuclear weapons. Today the Pantex Plant mission is to anticipate and satisfy U. S. Department of Energy (DOE) requirements by providing competitive, quality, on-time products and services which exceed expectations and are achieved in a manner that protects the environment, ensures the safety and health of employees and the public, and protects our national security. Pantex Plant's primary mission is to[3]:

- **Assemble** nuclear weapons for the nation's stockpile,
- **Disassemble** nuclear weapons being retired from the stockpile,
- **Evaluate, repair and retrofit** nuclear weapons in the stockpile,
- **Demilitarize and sanitize** components from dismantled nuclear weapons,
- **Provide interim storage** for plutonium pits from dismantled nuclear weapons.
- **Develop, fabricate and test** chemical explosive and explosive components for nuclear weapons and to support DOE initiatives.

Two very important Department of Energy programs are key to the Department's success in conducting its principle national security mission at the Plant. They are environmental management and the conduct of operations in a manner that is safe and poses minimal health risk for the public or Plant employees. The Pantex Plant SWEIS is being prepared in compliance with the requirements of these programs and other applicable federal and state guidelines.

The Pantex Plant SWEIS will address all the activities associated with its national security missions including interim storage requirements and activities at Pantex, such as alternative storage locations for plutonium, highly enriched uranium, tritium, and classified components that result from dismantlement activities at the Plant over a period of approximately 10 years. Decisions regarding sites and facilities for the long term storage and ultimate disposition of weapon components and material will be made based upon Programmatic Environmental Impact Statements (PEISs), currently being prepared. A Record of Decision (ROD) will be prepared by the DOE when a final SWEIS is issued, in the fall of 1996.

To conduct the analyses needed for a SWEIS, a large quantity of information about the Pantex Plant site is required. This information to be assembled is primarily related to health, safety, environment, and management programs at the Plant. In the past, this information was usually included in large appendices attached to EISs.

procedures for determining consequences of worst-case accident/event scenarios that may occur at Pantex Plant.

- Information about transportation operations onsite and offsite, including transportation facilities, processes, and containment (Chapter 5.0).

- Ordinary operational accident information, including radiation exposure data, industrial hygiene exposure data, industrial safety summaries, and historical data on operational incidents (Chapter 6.0).

- A list of safety-related regulatory requirements for the Pantex Plant, facility limits for the radiological, hazardous, and explosive materials at Pantex Plant, a summary of the safety documentation for all Pantex Plant facilities, a summary of information on each facility at Pantex Plant, a summary of the safety analyses conducted for facilities, a justification summary of potential natural phenomena and other external events, and a summary of incident reports (Appendices A through F).

This SID, as well as the EID and the PID, are supporting documents for the Pantex Plant SWEIS. They are technically based and contain information specific to the proposed action that will be evaluated. The information they provide will be used to address alternatives to the proposed action and issues identified during the scoping process for the Pantex Plant SWEIS[9]. They will also be used to prepare future NEPA documents that involve the Pantex Plant site.

The alternatives that will be discussed in the Pantex Plant SWEIS are:

- DOE's "proposed action" is to meet the Department's national security responsibility by continuing to operate the Pantex Plant to perform the type of national security missions and related activities it currently performs, i.e., assembly/disassembly of nuclear weapons, HE development and other activities as listed previously. This alternative includes storing up to 20,000 plutonium pits at the Pantex Plant. DOE also proposes to fund a new plutonium resource center (managed by a consortium of Texas universities), construct a new Hazardous Waste Treatment and Processing Facility, a Pit Reuse Facility, a Gas Analysis Laboratory, a Materials Compatibility Assurance Facility, a Nondestructive Evaluation Facility and a Metrology and Health Physics Calibration and Acceptance Facility. Additionally, DOE will continue environmental cleanup and restoration activities, cooperative agreements with local colleges and universities, activities associated with the technology transfer program, and routine activities such as maintenance and landscaping.

- The "no action" alternative is to continue to operate the Pantex Plant as it is currently operated and to continue to store nuclear components at various DOE sites as is currently done. This alternative includes storing up to 12,000 plutonium pits at Pantex Plant. It does not include any other new projects or changes in general facilities except those authorized and funded through FY95.

- The "relocation alternative" will consider alternative sites for the interim storage of plutonium pits from disassembled weapons at Pantex pending decisions on their disposition. This alternative contains two options:

  1) Relocating interim storage of up to 20,000 plutonium pits to alternate sites.

  2) Relocating interim storage for 8,000 plutonium pits to alternate sites.

Alternate sites to be considered are; the Nevada Test Site, the Hanford Reservation, the Savannah River Site, and DOD's Manzano Facility at Kirtland Air Force Base in New Mexico.

However, National Environmental Policy Act (NEPA) implementing regulations call for reducing the amount of time and paperwork involved in preparing an EIS[4]. To meet this requirement, three information documents about Pantex Plant have been prepared: an environmental information document (EID), a programmatic information document (PID), and a safety information document (SID). These information documents are technical documents and they neither evaluate impacts nor draw conclusions about operations at the Plant.

The EID contains a general description and discussion of the existing environmental setting and conditions at Pantex Plant. It describes the natural and physical environment in the vicinity of the Plant, emphasizing current environmental programs and issues.

The PID provides an overview of the operations, environmental safety and health, waste management and environmental restoration, DOE, and other on-going programs at Pantex Plant. These programs include weapon assembly and disassembly, high explosive (HE) development, risk management, new facilities, decontamination and decommissioning, conduct of operations, configuration management, onsite transportation of weapons and components, training, emergency preparedness, waste operations, safeguards and security, quality, environmental safety and health, waste management and environmental restoration.

The SID contains information about the safety and health aspects of operations at the Plant. It also discusses the safety of continuing operations at the Plant.

The technical information provided in the SID will be used to assist in developing conclusions and impacts of operations for the SWEIS and the ROD. This document contains the following types of information about Pantex Plant:

- Facility and operations descriptions for low and moderate hazard Plant facilities (Chapter 3.0). (There are no high hazard facilities at Pantex Plant.)

  Only facilities classed as low or moderate hazard are discussed in the SID. There are no high hazard facilities at Pantex Plant. Generally, facilities that presented hazards commonly accepted by the public (i.e., offices, cafeterias, etc.) are not discussed in the SID. However, they are listed in Appendix D.

- Information from existing hazards assessments, accident analyses, Safety Analysis Reports (SARs), and other studies that address the potential risk to people both on and off the Plant site (Chapter 4.0).

  Information was obtained from four types of hazards assessments conducted to categorize incidents by their degree of severity and to help determine the response needed to protect workers, the public, and the environment[5,6,7,8]. The hazards assessments are material-specific and provide general information related to the hazards of various facility types. They include radiological hazards assessments, hazardous materials hazards assessment, chemical high explosives hazards assessment, natural phenomena hazards assessments.

  SARs provided facility-specific hazard assessments, accident analyses, and consequences. They also describe the controls in place to mitigate unacceptable consequences, that is, those consequences that result in offsite and onsite hazards. Building-specific SARs provided further analysis of accident probabilities based upon specific operational information.

  The hazards assessments and SAR accident analyses from which information for the SID was obtained are documents that use up-to-date regulatory guidelines and

1.1 References

1. DOE, *Environmental Assessment for Interim Storage of Plutonium Components at Pantex and Department of Energy Response to Comments on the Pre-Approval Environmental Assessment and Public Meeting*, Volumes 1 and 2, DOE/EA-0812, January 1994.

2. U.S. Code of Federal Regulations, Title 10, Energy. Part 1021, National Environmental Policy Act Implementation Procedures.

3. *Pantex Plant Mission Statement*, agreed to by G. W. Johnson and W. A. Weinreich, February, 1996.

4. U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 1500, "Purpose, Policy, and Mandate - NEPA."

5. Jacobs Engineering Group, Inc., *Recalculation of Potential Deposition Levels and Dose Exposure Levels for the Pantex Radiological Hazards Assessment for the Pantex Plant*, Prepared in conjunction with Ogden Environmental and Energy Services Co., Inc., October 1993.

6. Jacobs Engineering Group, Inc., *Hazardous Materials Hazards Assessment for the Pantex Plant, Amarillo, Texas*, Prepared in conjunction with Ogden Environmental and Energy Services Co., November 1992.

7. Jacobs Engineering Group, Inc., *Chemical High Explosives Hazards Assessment for the Pantex Plant, Amarillo, Texas*, Prepared in conjunction with Ogden Environmental and Energy Services Co., October 1993.

8. Jacobs Engineering Group, Inc., *Natural Phenomena Hazards Assessment for the Pantex Plant, Amarillo, Texas*, Prepared in conjunction with Ogden Environmental and Energy Services Co., October 1993.

9. "Notice of Intent to Prepare an Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components," *Federal Register*, Vol. 59 No. 98, May 23, 1994, p 26635. Revised June 22, 1995 *Federal Register*, Doc. 95-15469.

10. DOE, Implementation Plan—*The Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components Environmental Impact Study, DOE/EIS-0225-1P, December 1994.*

Pantex has been identified as a reasonable alternative location for actions being analyzed in other DOE PEISs. These include the long-term storage of weapons-usable fissile material and the disposition of plutonium under consideration in the Storage and Disposition of Weapons-Usable Fissile Material PEIS, and other defense missions under consideration in the Stockpile Stewardship and Management PEIS. Decisions regarding the location of these missions will be made based on the PEISs, not on the Pantex SWEIS.

Issues identified as within the scope of the Pantex Plant SWEIS include:

- The inclusion of U.S. DOD sites as possible alternatives for storing nuclear components that result from nuclear explosives disassembly. DOD and other agencies will be included in the scoping process. The DOE requested that the DOD become a cooperating agency. The U.S. Air Force agreed to become a cooperating agency and is participating in the preparation of the SWEIS;

- Potential effects on the public and workers from releases of radiological and other hazardous materials during normal operations and from potential accidents, including aircraft crashes;

- Potential effects of natural disasters including floods, tornados, and earthquakes;

- Potential effects on air and water quality and other environmental consequences of normal operations and potential accidents;

- Potential cumulative effects of operations at the Pantex Plant and the storage activities at other sites, including relevant impacts from onsite and interstate transportation activities, environmental restoration, present operations, and reasonably foreseeable activities at the sites;

- Potential socioeconomic impacts on communities near the Pantex Plant, including demography, economic bases, labor pools, housing, transportation, utilities, public services/facilities, education, and environmental justice;

- Potential effects on endangered species, economically and recreationally important species, floodplains, wetlands, and cultural resources including paleontological sites and Native American resources;

- Potential effects on future decontamination and decommissioning decisions;
- Potential impacts from energy requirements and conservation alternatives;

- Potential effects on near- and long-term waste management practices and activities including pollution prevention and waste minimization and waste stream characterization;

- Potential effects on agricultural lands and practices;

- Potential impacts of noise levels on the surrounding resident population and environment;

- Potential impacts on scenic and visual resources;

- Potential impacts on land use plans, policies, and controls;

- Short-term uses of the environment versus long-term productivity and potential irretrievable and irreversible commitment of resources.

Additional information on alternatives and issues is available in the SWEIS Implementation Plan[10].

2.0 PANTEX PLANT DESCRIPTION

Pantex Plant is a government-owned, contractor-operated facility managed by Mason & Hanger - Silas Mason Co., Inc. since 1956. Approximately [illegible] people are employed full time at the Plant. The Pantex site was established in 1942 by the U.S. Army for conventional shell and bomb loading. At the end of World War II, the Plant was deactivated, and the property eventually reverted to the War Assets Administration. In 1949, the entire installation was sold to Texas Tech University to be used for experimental farming, subject to recall, if necessary. Following an extensive survey of World War II ordnance plants, the Atomic Energy Commission in 1951 chose the Pantex site for expansion of its nuclear weapons assembly facilities. The Army Ordnance Corps reclaimed the site for the Atomic Energy Commission and contracted with the Silas Mason Company to rehabilitate it. The Proctor & Gamble Co. was awarded the first 5-year management and operating contract but declined to renew the contract in 1956[1,2].

2.1 MISSION AND ORGANIZATION

Initially, in the early 1950's, the primary mission of Pantex Plant was fabricating non-nuclear high explosive components of nuclear weapons. These components were assembled with prefabricated nuclear and non-nuclear components, mainly from other U.S. Department of Energy (DOE) plants, into finished nuclear weapons. Today the Plant's primary mission is the assembly and disassembly of nuclear weapons for the nation's stockpile, evaluation, repair, and retrofit of nuclear weapons in the nation's stockpile, demilitarization and sanitization of components from dismantled nuclear weapons, providing interim storage for plutonium pits from dismantled weapons and the development, fabrication and testing of chemical explosives and explosive components for nuclear weapons and to support DOE initiatives. These activities involve handling (but not processing) highly enriched uranium, plutonium, tritium, and classified components that result from dismantling nuclear explosives, as well as a variety of non-radioactive toxic chemicals.

The organizational inter-relationships with other DOE organizations and the Pantex organizational structure are depicted in Figures 2.1.-1. and 2.1.-2., respectively. Activities at Pantex Plant are administered by the following 13 contractor divisions:

- Administrative Services
- Applied Technology
- Capital Projects
- Engineering and Design
- Environment, Safety & Health
- Facility Operations
- Human Resources
- Information Management
- Manufacturing
- Operational Support
- Quality
- Safeguards, Security and Fire Protection
- Waste Management & Environmental Restoration.

2.2 PANTEX PLANT AREA

Located in the Texas Panhandle in Carson County, Pantex Plant is approximately 27 km (17 mi) northeast of Amarillo (Figure 2.2.-1.). The

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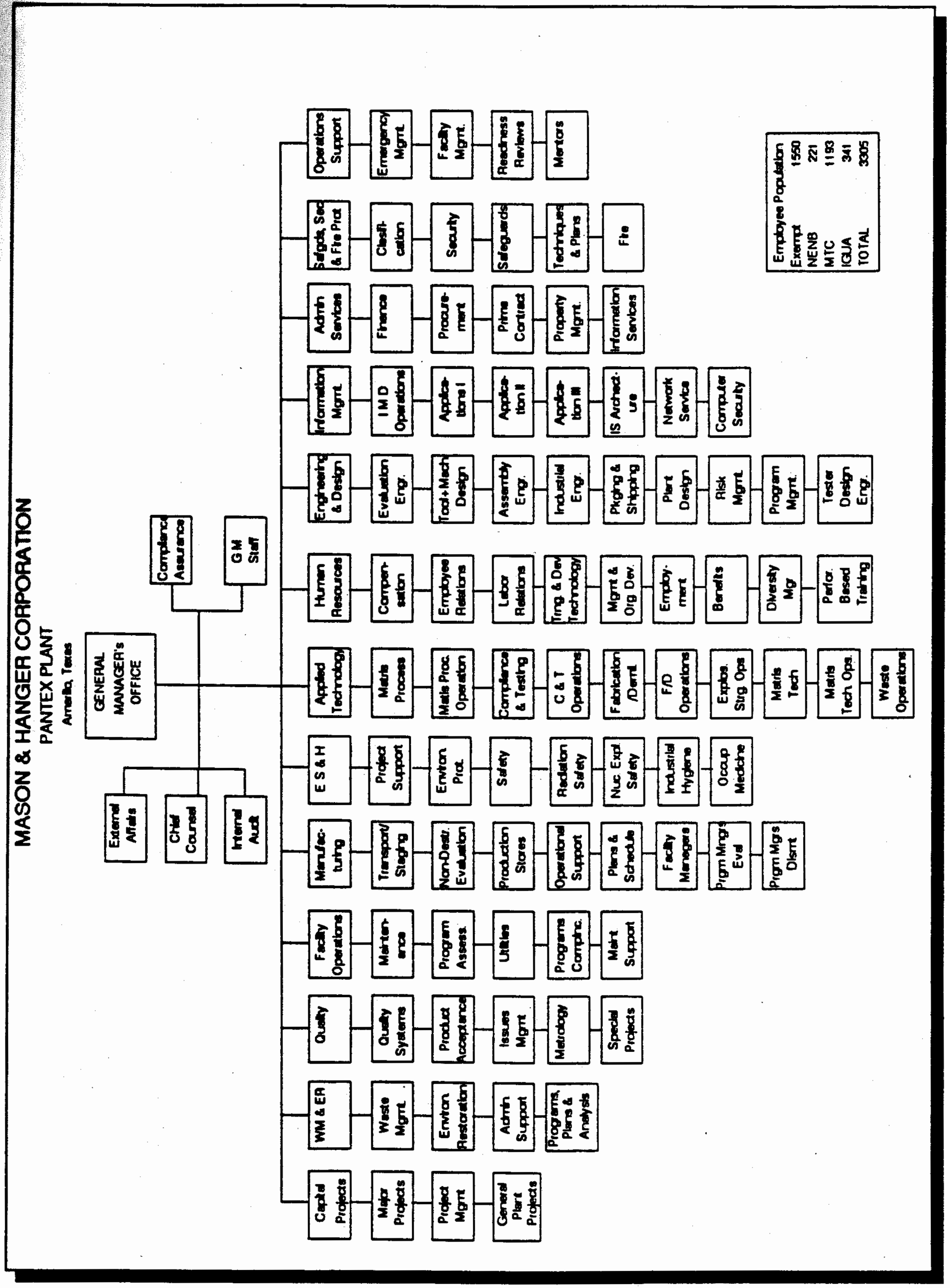

FIGURE 2.1-2.—Operating Organizational Structure of Pantex Plant M & O Contractor.

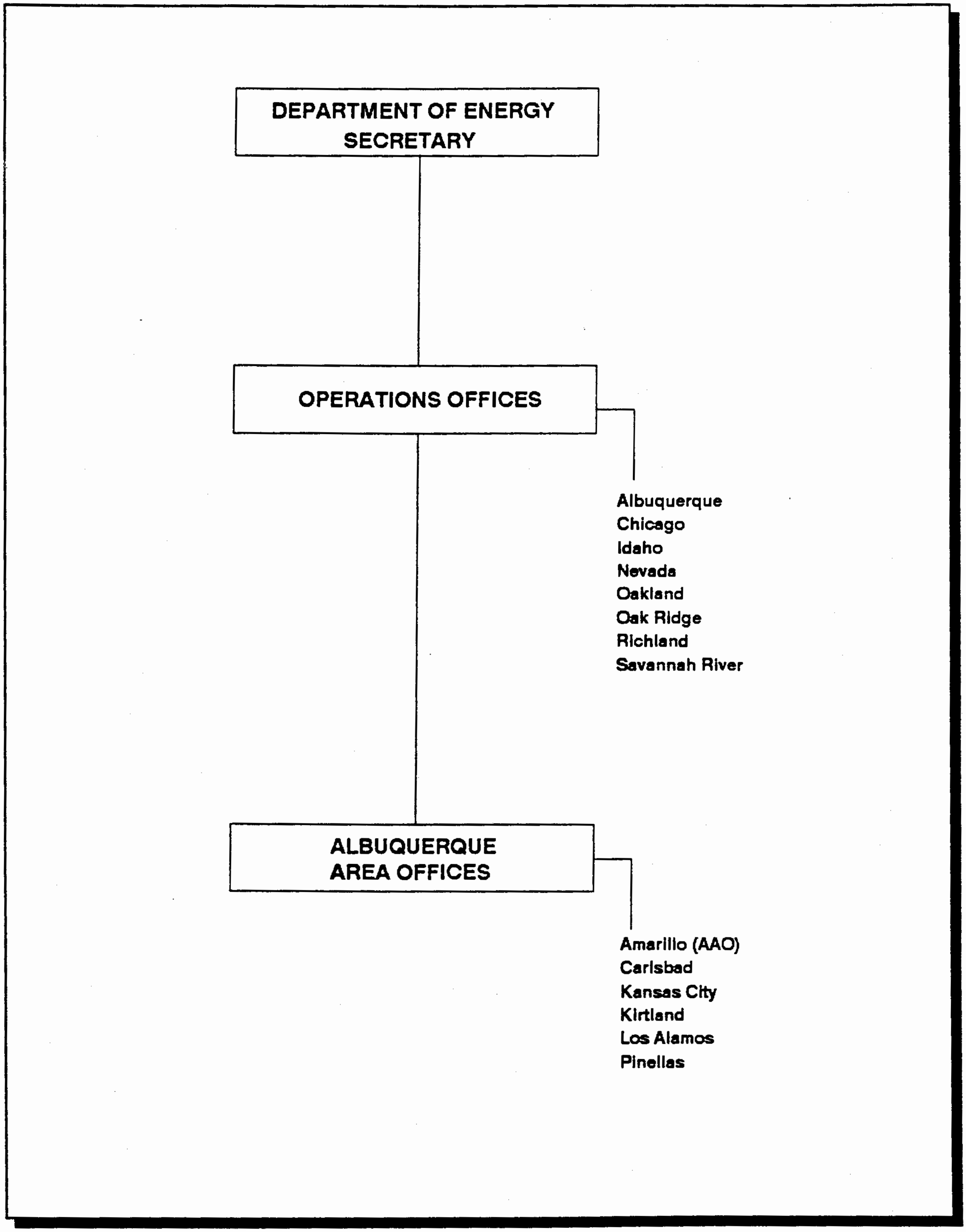

FIGURE 2.1-1.—*DOE Organizations.*

Plant site is bounded on the north by Texas Farm-to-Market Road (FM) 293, on the east by FM 2373, and on the west by FM 683. To the south, DOE-owned property on the site extends to within 1.6 km (1 mi) of U.S. Highway 60.

DOE PROPERTY AND LAND USE

Owned Lands

DOE owns approximately 3,683 hectares (9,100 acres) at Pantex Plant (Figure 2.2.-2.). Just over 809 hectares (2,000 acres) of the DOE-owned property are used for industrial operations at Pantex Plant excluding the burning ground, firing sites, and other outlying areas. The burning ground and firing sites occupy approximately 198 hectares (489 acres). Remaining DOE-owned land serves safety and security purposes. DOE also owns a detached piece of property, called "Pantex Lake," approximately 4 km (2.5 mi) northeast of the main Plant site. This property, comprising 436 hectares (1,077 acres), includes the playa lake wetland itself, which occupies approximately 136 hectares (337 acres[3]). Currently, no government industrial operations are conducted at the Pantex Lake property.

As of April 1996, approximately 2,596 hectares (6,421 acres) of DOE-owned land were being used by Texas Tech University for agricultural purposes through a service agreement. The DOE-owned acreage used for agricultural purposes is variable and subject to periodic changes.

Leased Land

Adjacent to the 3,683 hectares (9,100 acres) owned by DOE, approximately 2,347 hectares (5,800 acres) are leased from Texas Tech University. DOE uses these lands for safety and security buffer areas. DOE also leases a small facility at the Amarillo International Airport for its own transportation use.

Pantex Plant Land Use

Pantex Plant industrial operations are conducted for the DOE by Pantex Plant management and operating contractor, the U.S. Army Corps of Engineers (COE), and Sandia National Laboratory. Seventy-six kilometers (47 mi) of roads exist within Pantex Plant boundaries.

A spur of the Burlington Northern Santa Fe Railroad, formerly known as the Atchison, Topeka, and Santa Fe Railroad, extends through the leased land into the DOE-owned property on the southwest area of the Plant site.

Historically, the Pantex Plant Site was divided into functional areas commonly called zones. Some maps may still show where the old functional areas were located. The only current functional areas that retain their "zone" designation are Zone 12, which is the fabrication, assembly/disassembly, technical/administrative support area; Zone 11, which is the high explosive development area; Zone 10, which is an excess property storage site; and Zone 4, which is the weapon/high explosive magazines and interim pit storage area (Figure 2.2.-3.).

The following four Security Control Areas (Figure 2.2.-4.) occur over both leased and DOE-owned land:

- Property Protection Area
- Limited Area
- Pantex Plant Protected Area
- Material Access Area (MAA).

The Property Protection Area is the entire 3,683 hectares (9,100 acres) of DOE land and the 2,347 hectares (5,800 acres) of leased Texas Tech land, exclusive of the Pantex Lake area and is commonly referred to as the "Pantex Plant Site." The Limited Area includes the east half of Zone 4, all of Zone 11, portions of the main Plant, and the north part of Zone 12. The Pantex Plant Protected Area is the major portion of the south end of Zone 12

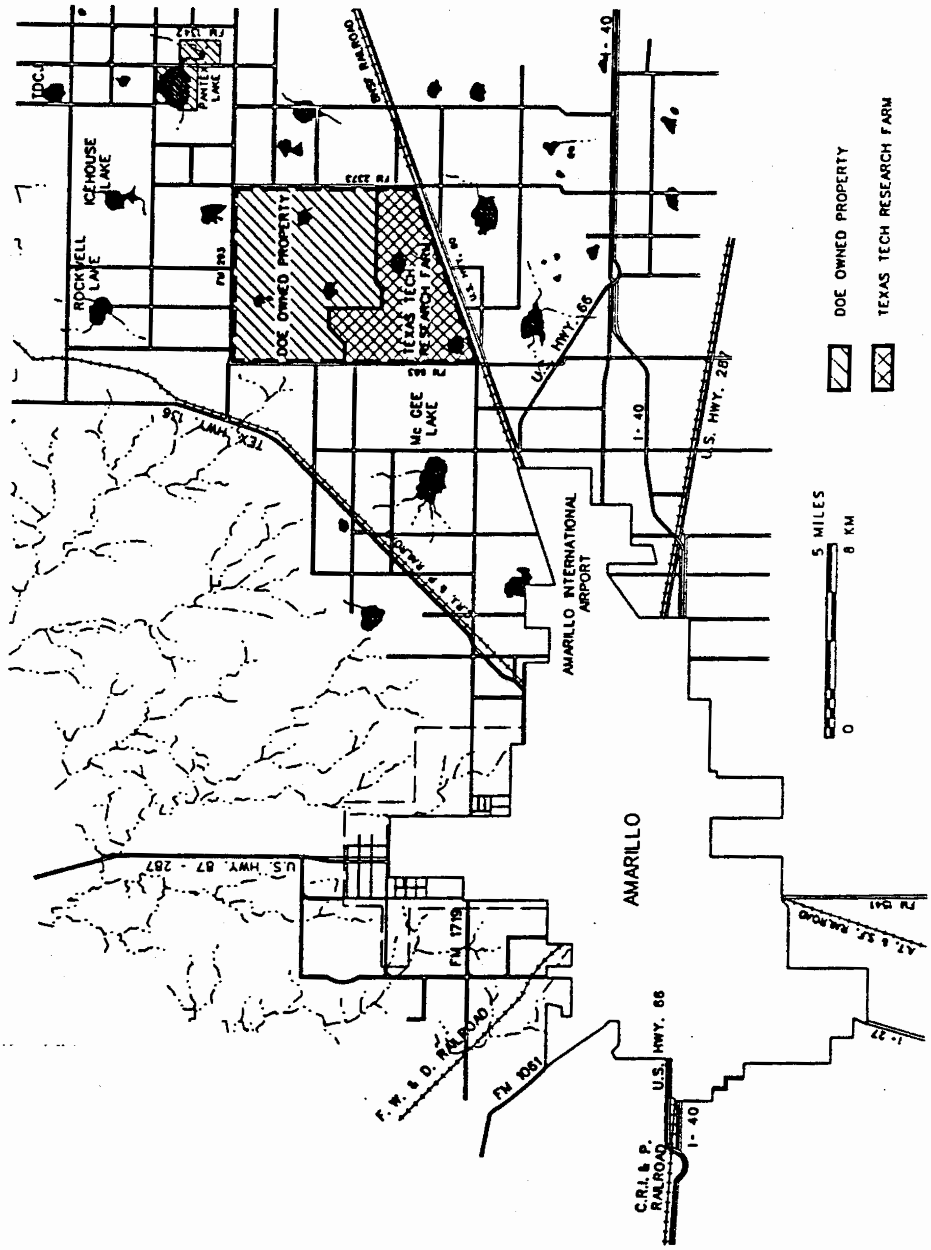

FIGURE 2.2.1 —Pantex Plant Site Location.

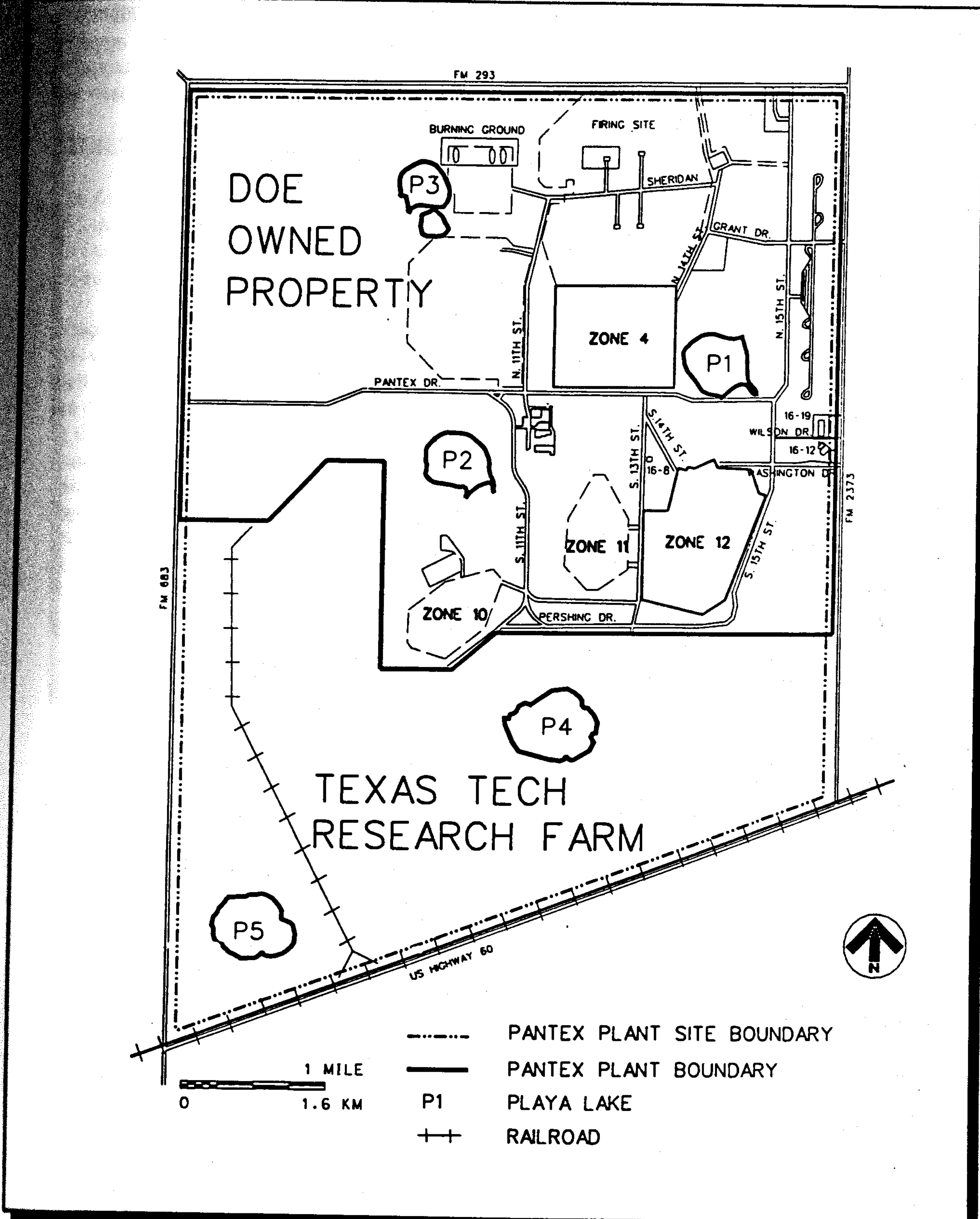

FIGURE 2.2-3.—*Principal Features of Pantex Plant Site.*

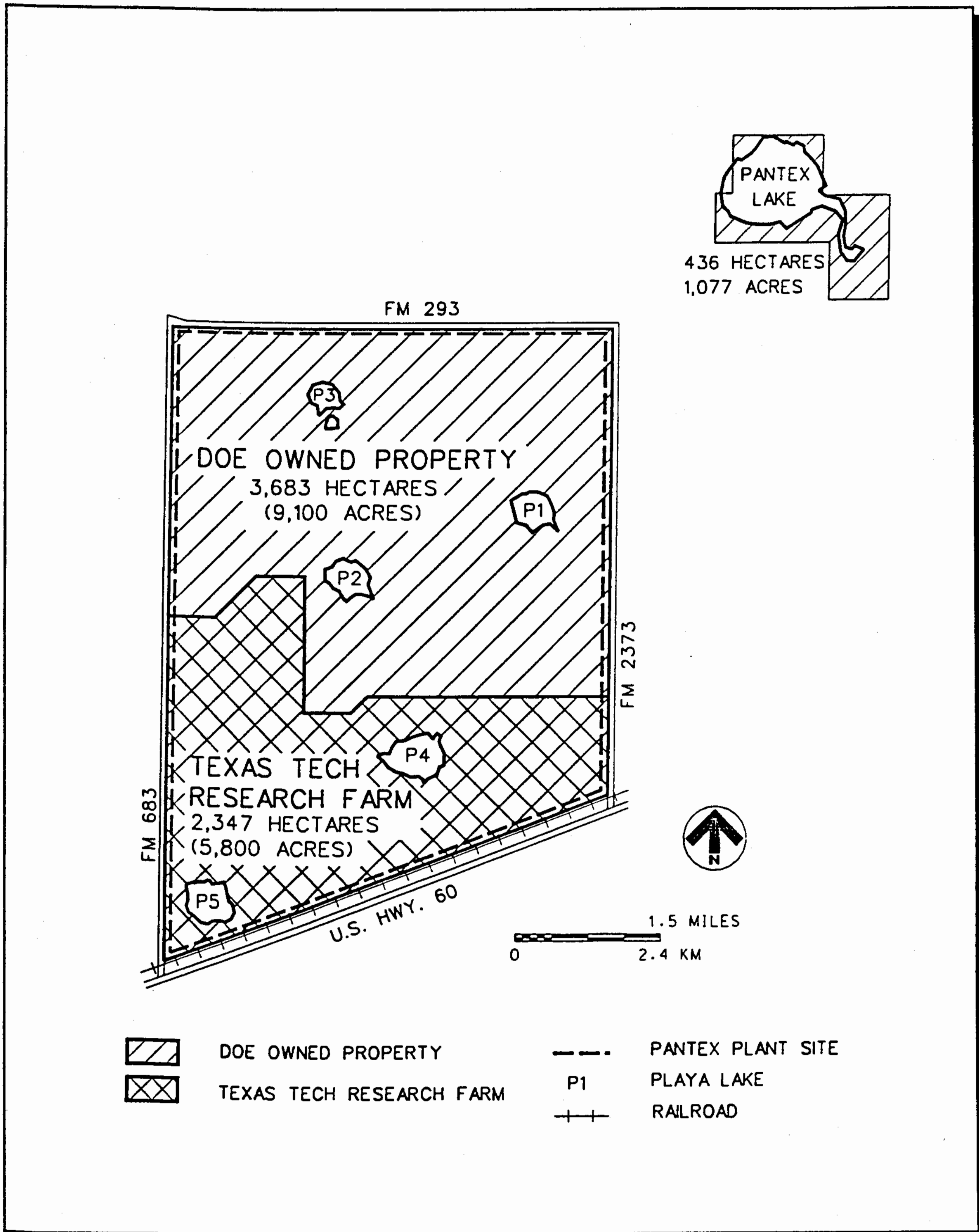

FIGURE 2.2-2.—*Pantex Plant Site Including Pantex Lake.*

(excluding the MAA). The MAA includes the Weapon Assembly Area in Zone 12 and the Weapon/Special Nuclear Material Staging Area in the west half of Zone 4.

OTHER LOCAL LAND USE

The Amarillo International Airport, located 12 km (7.5 miles) southwest of the Plant, is primarily used for commercial aviation and is equipped for international commerce.

Weapon/Special Nuclear Material Staging Area in the west half of Zone 4. The major industrial facilities in the immediate vicinity of Pantex Plant are the Iowa Beef Packing Plant about 3 km (2 mi) to the southwest, an industrial park adjoining the Amarillo International Airport, two electrical generating plants 16 km (10 mi) to the west and a copper refinery 16 km (10 mi) to the NNW. Forty grain elevators are within an 80 km (50 mi) radius of the Plant[4].

2.3 TOPOGRAPHY

Pantex Plant lies on the Llano Estacado (staked plains) portion of the Great Plains, at an elevation of more than 1,067 meters (3,500 ft). The plains around the Plant were formed mostly by Tertiary deposits that were carried eastward from the Rocky Mountains between 10 and 60 million years ago. Three to 6 km (2 to 4 mi) north of the Plant, the relatively flat plains become rolling breaks that form the escarpment above the Canadian River, which is 27 km (17 mi) north and flows in a generally eastward direction. The Canadian River bed lies about 244 meters (800 ft) below the elevation of the plains. The river is impounded by a dam 40 km (25 mi) north of the Plant, forming Lake Meredith[5].

2.4 METEOROLOGY

The climate in the area is classified as semi-arid and characterized by hot summers and relatively cold winters. The skies are clear to partly cloudy 70 percent of the time. The mean daily minimum temperature in January is -5.7°C (21.8°F) and the mean daily maximum temperature in July is 32.8°C (91.1°F). The area is subject to rapid temperature changes, especially in winter, when cold fronts pass through the area[6].

The average annual rainfall is 49.7 cm (19.56 in). Seventy-five percent of the total annual precipitation falls between April and September[6]. Severe local storms are infrequent, although a few thunderstorms with damaging hail, lightning, and wind occur. The average annual snowfall is 42.9 cm (16.9 in). The snow usually melts in a few days. Heavy snowfalls of 25 cm (10 in) or more, usually with near blizzard conditions, occur on an average of once every 5 years and last 2 to 3 days[6].

Pantex Plant is located in an area with a relatively high frequency of tornados. Seven hundred and eighty six tornados were recorded in the 26 counties of the Texas Panhandle between 1950 and 1993[7]. Sixty five tornados were recorded in the Texas Panhandle during 1995[8]. Section 6.3.1 of the EID contains more information on tornados.

The potential gross lake surface evaporation in the area is estimated to be about 350 percent of the annual rainfall, or about 178 cm (70 in). The region is classified as windy, with wind speeds of more than 11 kilometers per hour (7 mph) more than 95 percent of the year[6]. The wind blows predominately from the south from May to September and from the southwest the remainder of the year.

2.5 HYDROLOGY

Surface water in the vicinity of Pantex Plant includes the Canadian River 27 kilometers (17 mi) north of the facility, Sweetwater Creek 80 km (50 mi) east of the Plant, the Salt Fork of the Red River 32 km (20 mi) east of the Plant, and the Prairie Dog Fork of the Red River 56 km (35 mi) south of the Plant. Some water from Lake Meredith, which was formed by damming of the Canadian River, is diverted, or may be mixed with groundwater pumped from the Ogallala Formation and used to

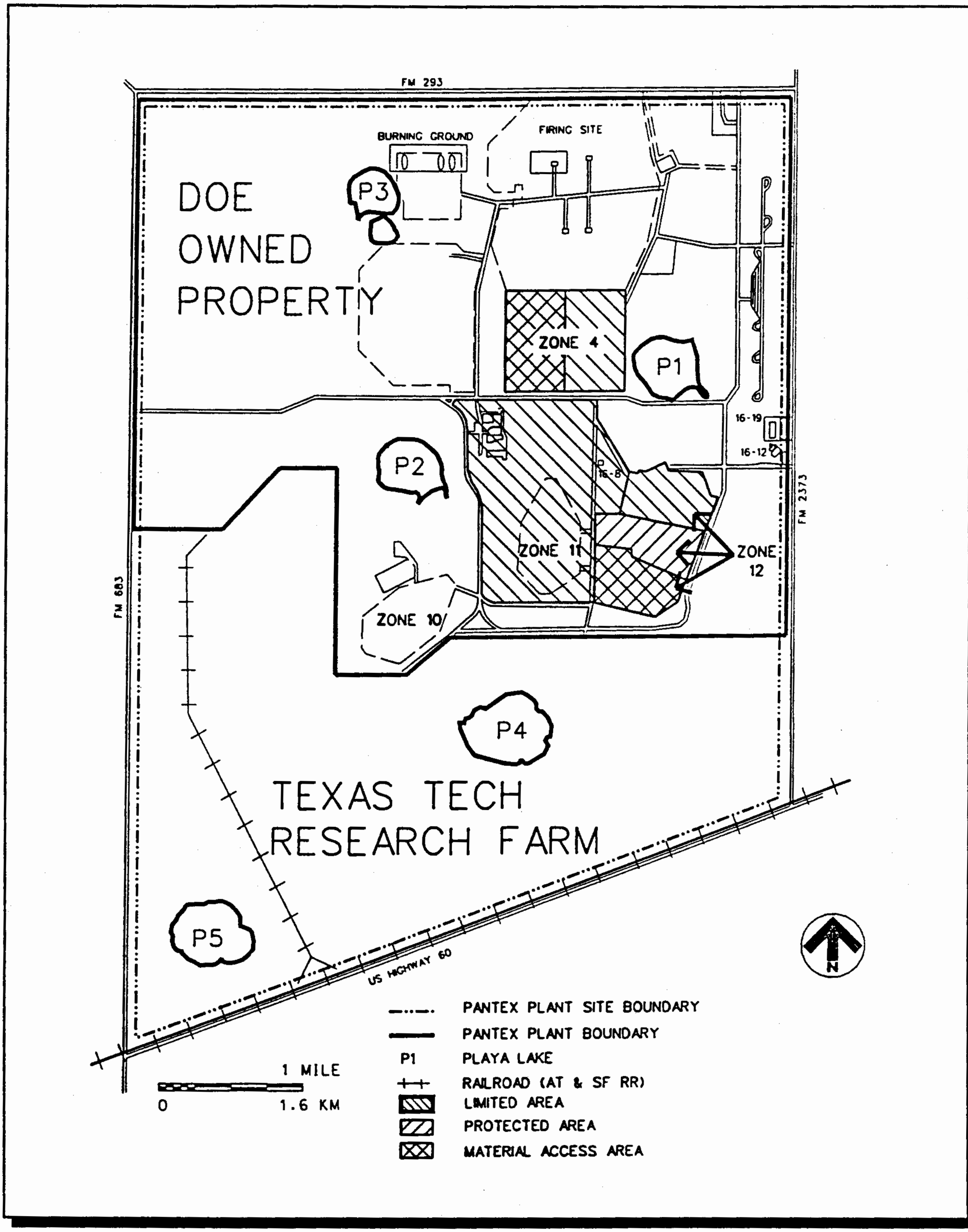

FIGURE 2.2-4.—*Pantex Plant Security Areas.*

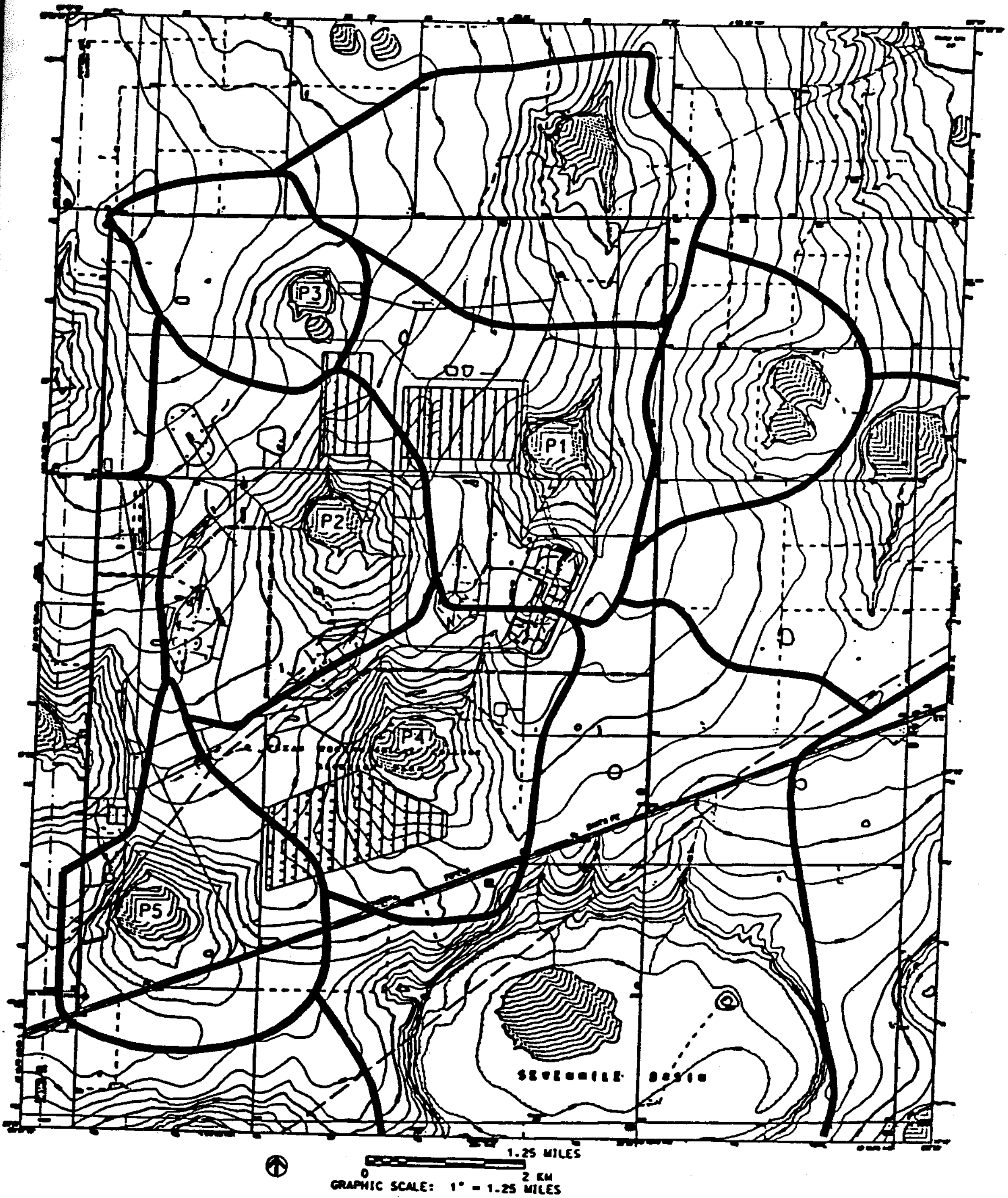

FIGURE 2.5-1.—*Surface Drainage at Pantex Plant Site.*

supply municipal and industrial water to the cities and towns in the Southern High Plains.

All of the surface water runoff resulting from precipitation at the site drains into nearby playas. However, playas are frequently dry because of the high evaporation rate. Playas in the area may be as large as 1,220 meters (4,000 ft) in diameter and more than 9.1 meters (30 ft) deep. Most playas are floored with a lens-shaped accumulation of clay, sometimes 9.1 meters (30 ft) thick near the center, but much thinner toward the edges. The soils that develop on these clay floors when dry may contain desiccation cracks up to 1.8 m (6 ft) deep.

For the most part, the surface water at Pantex Plant drains into three onsite playas (Figure 2.5.-1.) and a fourth playa located south of the Plant on land leased from Texas Tech University. Storm water from undeveloped areas on the periphery of the Plant drains into offsite playas. Pantex Lake, a playa located approximately 4 km (2.5 mi) northeast of the main portion of the Plant site, is also owned by DOE. This playa once received treated wastewater discharged from the facility; however, this discharge is now directed into Playa One. Playa Five is located on Texas Tech University property in the southwest corner of the Plant's buffer zone. Surface water from Pantex Plant does not drain into Playa Five. Figure 2.5.-1., which shows the surface drainage at Pantex Plant, was developed using the U.S. Army Corps of Engineers "HEC-1 Flood Hydrographic Package"[9].

General flooding of some low-lying portions of Pantex Plant could occur as a result of runoff associated with precipitation and the subsequent ponding in playas; although, historically, there has been no major flooding on the Pantex site.

2.6 GEOLOGY

The primary surface deposits at the Pantex Plant site are Pullman soils on the plains surface and Randall soils in the playas. The Pullman soils grade downward into the Blackwater Draw Formation which overlies the Ogallala Formation. Underlying the Ogallala Formation are the sedimentary rocks of the Dockum Group which are themselves underlain by Permian rocks.

The Ogallala Formation, which consists of interbedded sands, silts, clays, and gravels, is the primary source of groundwater for Amarillo, Pantex Plant, and the Southern High Plains. The Blackwater Draw Formation, which overlies the Ogallala, consists of interbedded silty clays with caliche and very fine sands with caliche. The Randall and Pullman soils top the Blackwater Draw Formation.

The soil in the Pantex Plant area is primarily Pullman silty clay loam, which is finely textured and easily eroded. However, the relatively level landscape, combined with natural vegetation and modern agricultural practices, limits erosion caused by wind or rainfall.

Three major subsurface faults and one minor surface fault occur in the Plant site area[10]. The longest fault, approximately 250 km (155 mi) long, is located about 40 km (25 mi) north of the site. A 70 km (43 mi) long fault is located about 8 km (5 mi) south of the site and a 64 km (40 mi) long fault is located about 11 km (7 mi) north of the site. The minor fault is surficial and about 6 km (4 mi) long, located about 32 km (20 mi) northwest of the site.

The area is relatively free from earthquakes. Only five earthquakes with magnitudes of six on the Modified Mercalli Intensity Scale have been recorded since seismic observation of the region began[11].

2.7 SOCIOECONOMICS

The Panhandle region in which Pantex Plant is located is sparsely populated. The city of Amarillo, with a 1990 population of 157,615, is the largest urban area. Amarillo is located in Potter and Randall Counties, to the west and south of Pantex Plant. The population within an 80 km (50

11. Pennington, W.D., and S.D. Davis, 1984. Historic Seismicity In and Around the Texas Panhandle. Report OF-WTWI-1984-14, prepared for the Department of Energy, University of Texas at Austin, Austin, Texas.

mi) radius of the site is estimated to be 240,000. The population density in the counties within the 80 km (50 mi) radius ranges from 108 persons per square mile in Amarillo to 1 person per square mile in rural areas. The economy of the Panhandle region depends mainly on agriculture and oil and gas mining. Diversification in the region includes manufacturing, distribution, food processing, and medical services. Pantex Plant, with a full-time workforce of approximately 3,800, is a key component in the economy of the Amarillo metropolitan area. The workforce-age (persons aged 18 to 64) makes up 55 percent of the total population of the area. Most members of the workforce have high school degrees. The median household income reported in 1990 ranged from $12,200 to $29,500 in the counties within an 80 km (50 mi) radius of the Plant.

The cultural and ethnic origins in the region are diverse, although historical trends are still reflected in the overall population composition. The population is predominantly white, with origins back to early settlers who relocated from the eastern U.S. and who were primarily European. Persons of Hispanic origin comprise the second largest group in the area. Ten Native American tribes have been identified as "potentially interested parties" related to the proposed action at the Pantex Plant. Prior to the 1500's, numerous Native American tribes, both nomadic and agrarian, had used the area. These Native American tribes included Apaches, Cheyennes, Arapahos, Kiowas, and Comanches.

2.8 References

1. DOE, *Predecisional Draft Programmatic, Environmental Impact Statement, Appendixes A Through H*, Volume II, U.S. Department of Energy, Office of Reconfiguration, June 2, 1994.

2. DOE, *1993 Environmental Report for Pantex Plant*, U.S. Department of Energy, Albuquerque Operations Office, Amarillo Area Office, June 1994.

3. Pantex Lake and Playas 1, 2, 3, and 4, Herrera Environmental Consultants, Inc., Seattle, WA, for Mason & Hanger - Silas Mason Co., Inc., May 1995.

4. Revised Land Use Census Pantex Plant, Burns & McDonnell Engineers-Architects-Consultants, Kansas City, MO, Project 94-451-4 for Mason & Hanger - Silas Mason Co., Inc., June 1995.

5. LA-9445-PNTX-I, Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant - Geohydrology. Los Alamos National Laboratory, December 1982.

6. U.S. DOC, 1993 Local Climatological Data, Annual Summary with Comparative Data, Amarillo, Texas. National Oceanic and Atmospheric Administration, Environmental Data Services.

7. National Severe Storms Forecast Center Tornado Data Base. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Severe Storms Forecast Center, March 13, 1992.

8. Telephone conversation, March 1996 with Mr. Douglas Crowley, U. S. National Weather Service, 1900 English Road, Amarillo, TX 79107.

9. "Flood Plain Delineation Report, Department of Energy Pantex Plant, Amarillo, Texas." U. S. Army Corps of Engineers, Tulsa District Flood Plain Management Services, Planning Division, Tulsa, OK, January 1995.

10. "Natural Phenomena Hazards Assessment for the Pantex Plant, Amarillo, Texas." Jacobs Engineering Group, Inc. and Ogden Environmental and Energy Services Co. Prepared for the U.S. Department of Energy, October 1993.

3.0 PANTEX PLANT FACILITY AND OPERATIONS DESCRIPTION

This chapter describes the structural design and operation of facilities at Pantex Plant. Facility and operation descriptions were obtained from many different resources, including, the basis for interim operation (BIO), safety analysis reports (SARs), safety assessments (SAs), and preliminary hazards analyses (PHAs). DOE Order 5480.23, "Nuclear Safety Analysis Reports," provides the most recent guidance to determine the safety basis for facilities discussed in this document[1]. However, safety analyses have been conducted at Pantex Plant for more than a decade using a gradually evolving chain of guidance documentation. Therefore, the safety analyses used as the basis for this document represent a continuum of products written to satisfy the guidance in effect at the time. Appendix A provides a list of DOE Orders, statutory and regulatory requirements, codes, and other applicable standards relevant to the design and safe operation of the Pantex Plant.

This chapter discusses predominately low or moderate hazard facilities at Pantex Plant. The Plant has no high hazard facilities. Facilities that present hazards typically encountered by the public (e.g., offices, cafeterias, etc.) are not discussed. Definitions of facility hazard classifications are given in DOE AL Order 5481.1B[2]. The hazard classifications depend on the effects of accidents on workers, the public, and the environment[3]. The hazard classifications in DOE AL Order 5481.1B are consistent with the facility "usage" classifications in UCRL-15910 "Design and Evaluation guidelines for Department of Energy Facilities Subject to Natural Phenomena Hazards"[4]. They are listed in Table 3-1. Prior to 1992, all SARs were written to the requirements of DOE Order 5481.1B. All DOE approved SARs to date were written to DOE Order 5481.1B guidelines[5].

After 1992, SARs for nuclear facilities were required to be written using the guidance in DOE Order 5480.23. For consistency in the analysis and presentation of risk, all new non-nuclear facility SARs are also written using DOE Order 5480.23, rather than DOE Order 5481.1B. The level of new safety documentation required for each facility is based upon the graded approach defined in DOE Order 5480.23. The graded approach allows the SAR preparer to adjust the magnitude of the preparation effort to the characteristics of the facility, based on three attributes: facility hazard magnitude or severity; facility complexity; and facility life-cycle stage. Chapter 4.0 provides further information on the Pantex SAR Upgrade Program.

A review of DOE-STD-1027-92 determined that all facilities at the Pantex Plant where nuclear materials are present are Hazard Category 2 Facilities or less (Hazard Category 3). DOE-STD-1027-92 does not address hazards associated with high explosives/insensitive high explosives (HE/IHE) operations at non-nuclear facilities. Pantex Plant explosives facilities were determined not to require SARs per DOE-STD-1027-92. However, SARs are still required for these facilities per DOE Order 5481.1B, as the risk of personnel injury or death is as high in explosive facilities as it is in nuclear staging facilities. With the exception of explosive facilities, application of hazard classification guidance in DOE-STD-1027-92 yields results comparable to those obtained by the Pantex Risk Management Department.

Appendix B provides the facility limits and/or inventories of chemical HE, chemical and hazardous materials, and radioactive materials for each facility discussed in this chapter. Each facility was assigned a "type" identifier and a "function" identifier to organize the facilities into logical groups with common characteristics. Table 3-2. lists the type identifiers and Table 3-3. lists the function identifiers.

Because they present only routine hazards to workers and no potential for off-site consequences,

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TABLE 3-2.—*Facility Type Identifier*

Facility Type	Type Designator	Facility Description
High Explosive	HE	Processes, stages, or otherwise deals with explosives (HE and/or IHE) in the absence of Nuclear Material
Nuclear Material	NM	Processes, stages, or otherwise deals with nuclear material in the absence of explosives.
Nuclear Explosives	NE	Processes, stages, or otherwise deals with explosives and nuclear material in combination.
Support	SU	Contains neither explosives nor nuclear material, although other hazardous materials may be present.

TABLE 3-3.—*Facility Function Identifier*

Facility Function	Function Designator	Description of Function
Operations	OPS	Full assemblies are broken down into their component parts; component parts are assembled into weapons.
Processing	PRO	Materials are acted upon directly (e.g., explosive being formulated or fabricated).
Staging	STA	Process storage of materials and components of all kinds, including warehousing activities for common supplies.
Test & Evaluation	T&E	May involve a test on an end item or an intermediate product, or the quality testing of raw materials.
Shops	SHP	All standard crafts (e.g., carpentry, pipe fitting), as well as some special purpose activities.
Utility (e.g., electric)	UTL	Normal utility services (e.g., gas, electric), as well as heating, air conditioning, and ventilation.
Security	SEC	Full range of site security activities, including training operations.
Administration	ADM	Administrative activities, such as clerical, accounting etc.

TABLE 3-1.—***Facility Hazard Classification for Facilities and Operations*** [1]

Classification Class	Description
High Hazard Facilities	Facilities for which confinement of contents and public and environment protection are of paramount importance (e.g., facilities handling substantial quantities of in-process plutonium or fuel reprocessing facilities). Facilities in this category represent hazards with potential long term and widespread effects.
Moderate Hazard Facilities	Facilities for which confinement of contents is necessary for public or employee protection (e.g., uranium enrichment plants, or other facilities involving the handling or storage of significant quantities of radioactive or toxic materials).
Low Hazard or Important Facilities	Facilities that have mission-dependent use (e.g., laboratories, production facilities, and computer centers) and emergency handling or hazard recovery facilities (e.g., hospitals, fire stations)
General Use Facilities	Facilities that have a non-mission dependent purposes, e.g., administration buildings, cafeterias, storage, maintenance and repair facilities that are Plant- or grounds-oriented.

[1] Table adapted from UCRL-15910. Equivalencies between Hazard Categories and Hazard Classes/Usage Categories are approximate, though generally accepted.

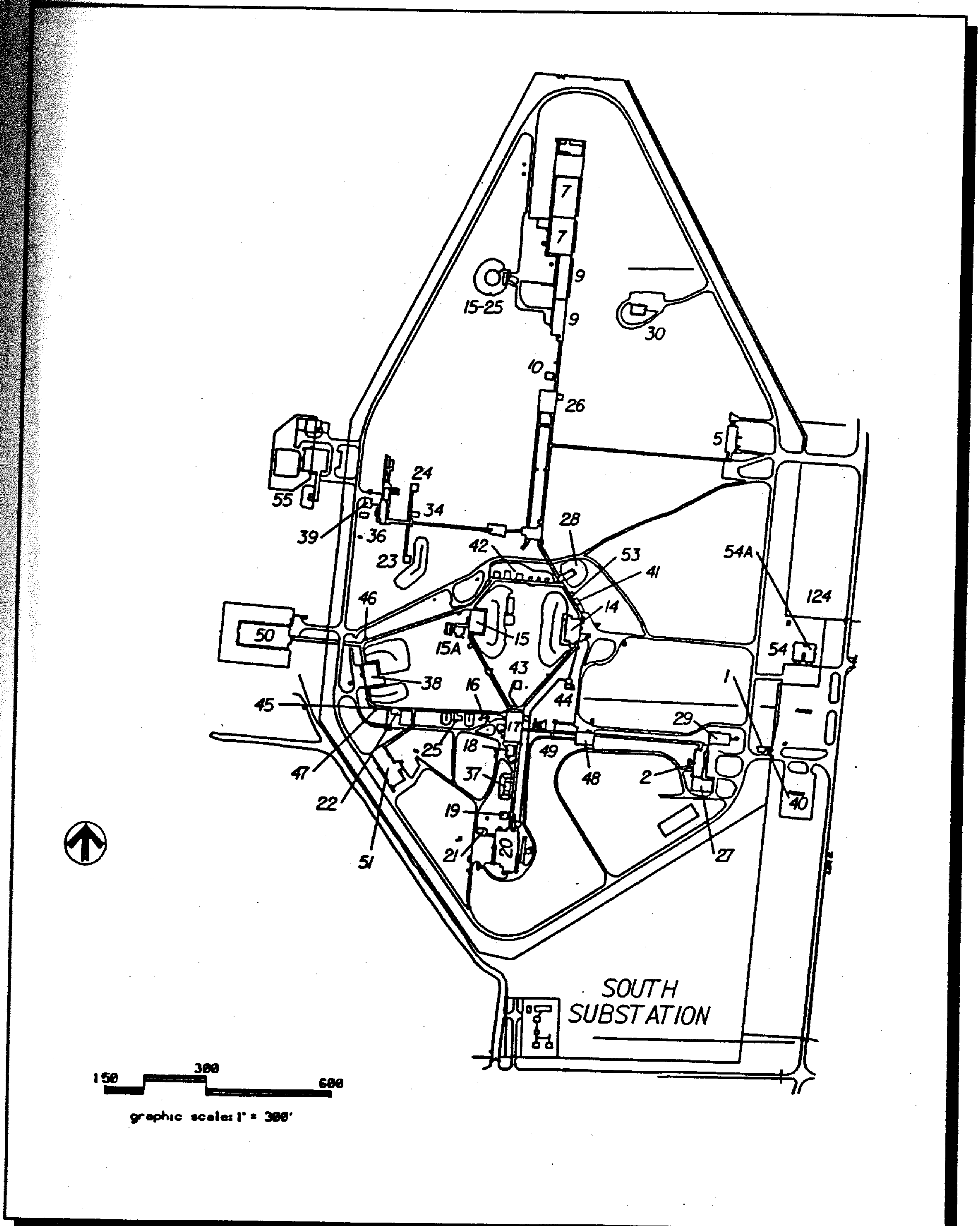

FIGURE 3-1.—*Map of Zone 11.*

support areas were combined (e.g., equipment rooms) with the operating facilities they supported and were not considered in the prioritization process. Buildings with multiple functions were combined if there were logical connections between the functions (e.g., HE fabrication and pressing).

Pantex Plant facilities were then divided into those that present hazards routinely and commonly encountered by the general public and those that present hazards uncommonly encountered. Hazards commonly encountered by the general public are those hazards typical of industrial operations, such as warehouses, sanitary waste treatment operations, and gas stations. The facilities described in this chapter are those that were ranked as moderate or low hazard facilities that present hazards uncommonly encountered.

Appendix C provides a summary of all Pantex Plant facilities. Appendix D provides a brief description of each current and planned facility at Pantex Plant. The entries in Appendix C represent the facilities in Appendix D, and include facilities proposed or under construction. Thus, some facilities are included in more than one entry. For example, the Modified-Richmond magazines in Zone 4 are represented by four entries (4-19, 4-21, 4-25, and 4-30/44). All entries are ranked as low and moderate hazard facilities with hazards uncommonly encountered.

With regard to the state of the safety analyses at Pantex Plant, a short discussion regarding the presentation of information in this chapter is in order. Two issues affect the facility and operations descriptions in Chapter 3.0. First, many of the older approved (and unapproved) SARs upon which this document is based contain less information than is expected of newer SARs written to current guidance. As a result, the discussions regarding those facilities may contain less detail than may be found in discussions of facilities which have been analyzed using the new safety analysis guidance. Upgrading the pool of available information to current expectations is beyond the scope of the Safety Information Document. Hence, there are places in this document where limited information is provided for Pantex facilities.

Second, as discussed above, the new safety analysis guidance provides for a "graded approach" to analyzing facilities. As a result, to the casual observer there is an apparent difference between the descriptions of facilities and the amount of detail presented in newer SARs. However, these differences are based upon a rationale which represents the current philosophy for analyzing facilities. Resources are devoted to facilities with greater hazards, to managing the long-term impacts of operations on the environment, and to maintaining the health and safety of workers and the public. Thus, the SAR for a facility which may present minor hazards to facility workers is treated differently in terms of the amounts of detail required when compared to the SAR for a facility which may present hazards to the public or the environment. These differences shall become apparent as the reader progresses through this chapter.

Throughout this chapter, metric units are used and do not necessarily reflect those most commonly used at Pantex Plant. For example, quantities of plutonium are generally given in kilograms (kg) while quantities of chemical high explosives are provided in pounds (lb).

The facilities described in this chapter can be located on the following six maps. Figure 3-1. shows facilities and ramps in Zone 11. Figure 3-2. shows facilities and ramps in Zone 12 South. Figure 3-3. shows facilities and ramps in Zone 12 North. Figure 3-4. shows facilities in Zone 4. Figures 3-5. and 3-6. show facilities in the burning grounds and firing sites, respectively.

3.1 NUCLEAR EXPLOSIVE FACILITIES

The following sections describe the structural design and operations for nuclear explosive facilities at Pantex Plant. These moderate hazard

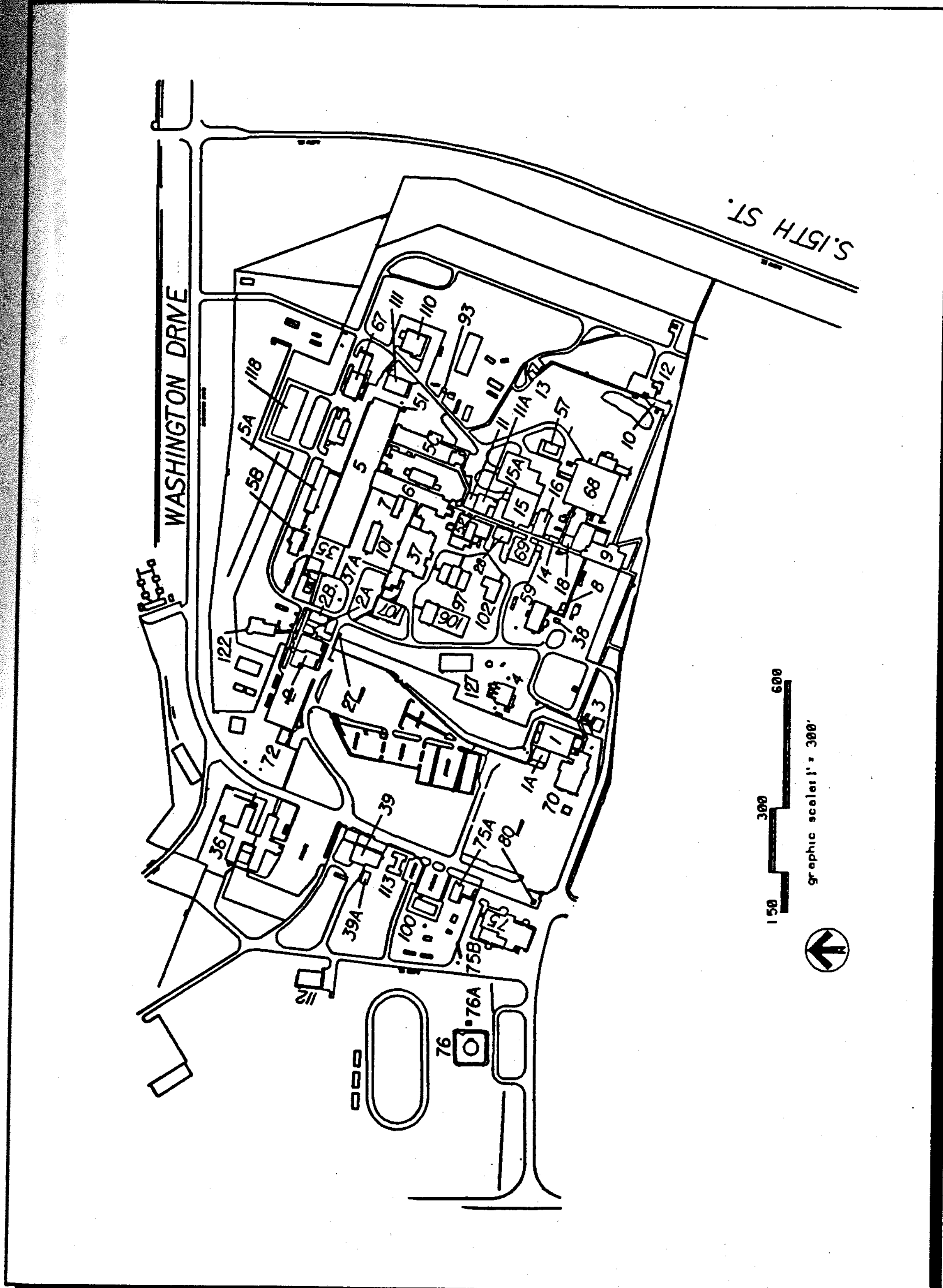

FIGURE 3-3.—*Map of Zone 12 North*

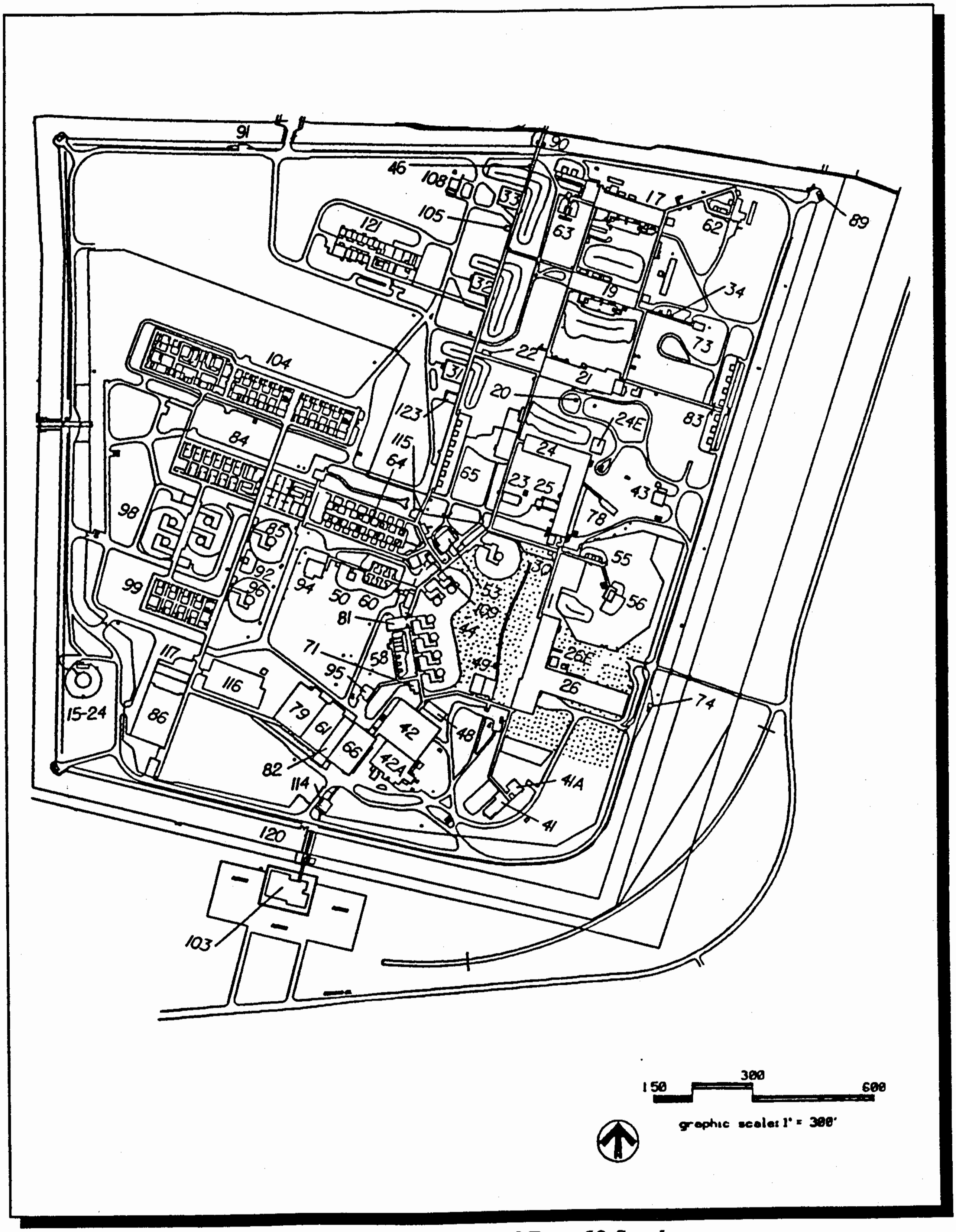

FIGURE 3-2.—*Map of Zone 12 South.*

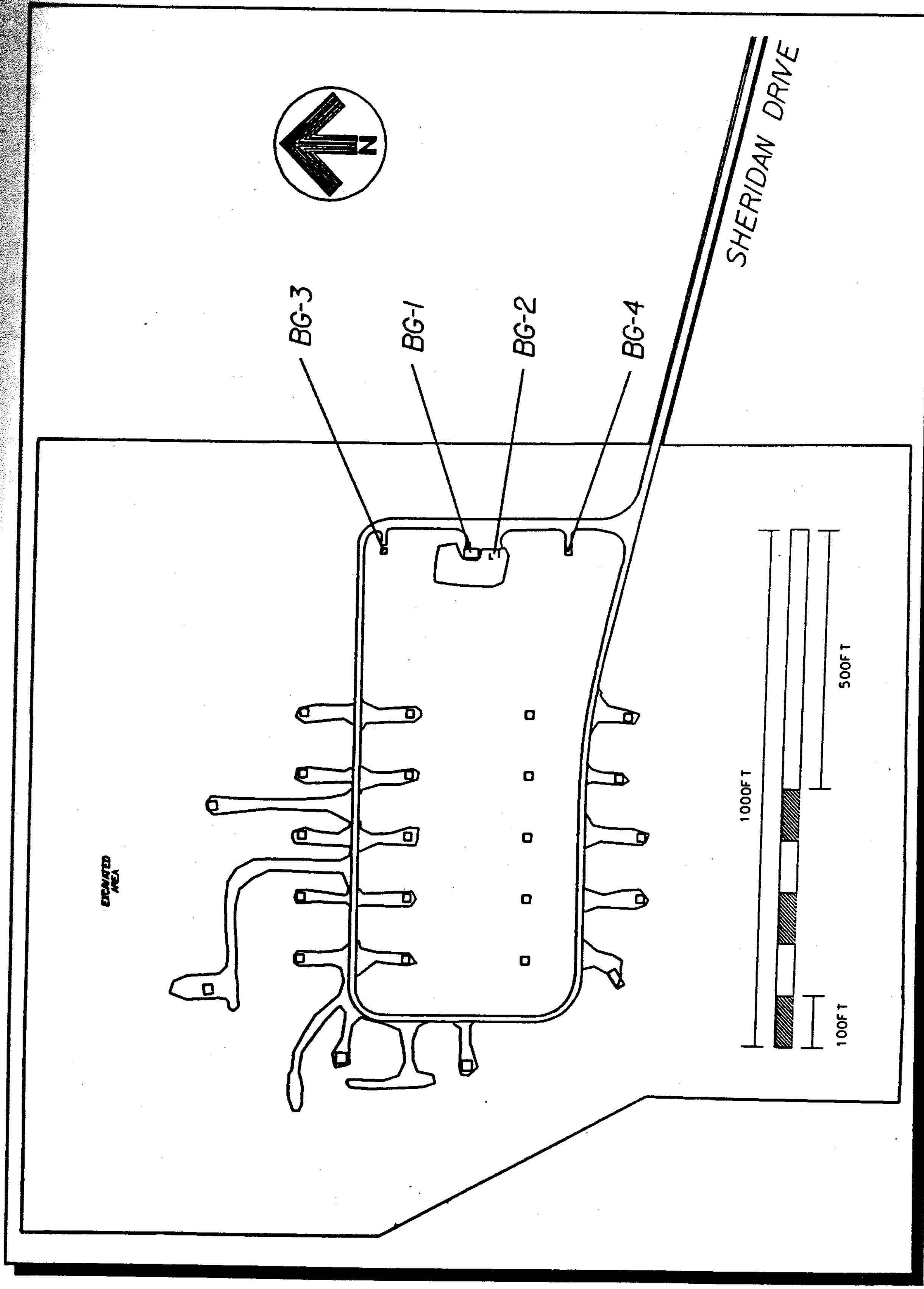

FIGURE 3-5.—*Map of Burning Ground.*

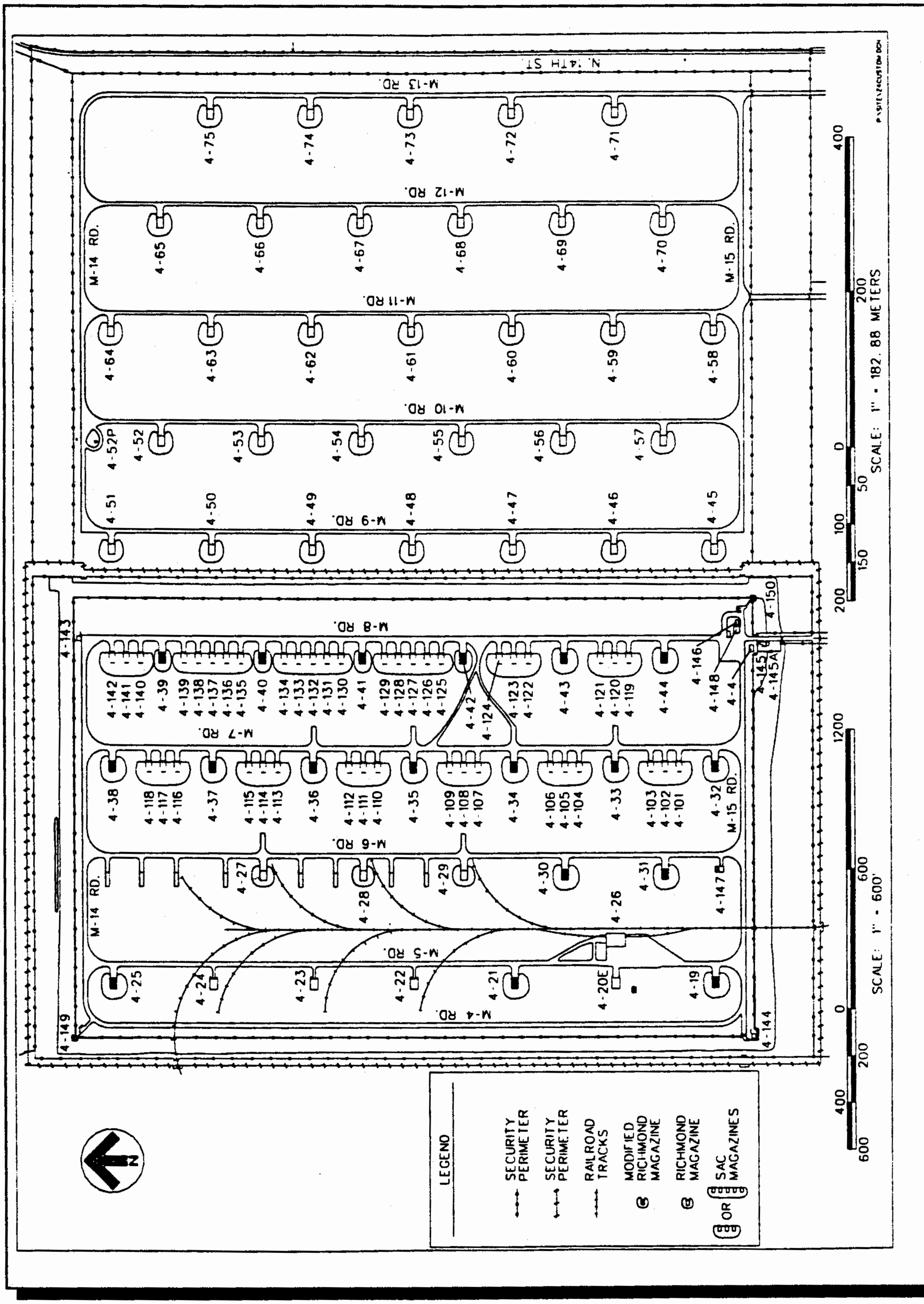

FIGURE 3-4.—*Map of Zone 4.*

facilities are primarily assembly/disassembly facilities and special purpose facilities that handle complete nuclear explosives and components. They include:

- Bays (Section 3.1.1)
- Cells (Section 3.1.2)
- Special Purpose Facilities (Section 3.1.3).

The facilities discussed in these sections are all non-reactor nuclear facilities. SARs are currently being developed and upgraded for these facilities to meet DOE Order 5480.23 requirements.

3.1.1 Bays

The bay facilities typically contain more than 900 grams (1.98 lb) of plutonium and are therefore categorized as Hazard Category 2 facilities, as specified in DOE-STD-1027-92. The principal function of the assembly bays is the assembly and disassembly of nuclear explosives, particularly the mechanical portion of the operations, which includes the electrical components and reservoirs. The major operations conducted in the assembly/disassembly bays are the partial assembly/disassembly of nuclear weapons containing high explosives (HE) and the complete assembly/disassembly of nuclear weapons containing insensitive high explosives (IHE). Physics package assembly and disassembly, where bare HE and pit operations occur, do not take place within the bays. During the process of assembly of a nuclear explosive, operations would begin in an assembly cell then move to an assembly bay for completion. The reverse would hold true for the disassembly process of a nuclear explosive. Disassembly would begin in a bay and conclude in a cell facility.

Buildings 12-64, 12-84, 12-99, and 12-104 are located on the western side of Zone 12 South (Figure 3-2.)[6,7,8,9,10]. Building 12-64 was constructed in 1971; Building 12-84 East in 1983; Building 12-84 West and Building 12-99 in 1986; and Building 12-104 in 1989. The four facilities contain a total of 62 bays. Building 12-64 contains 17 bays; Building 12-84 contains 20 bays, including two radiography bays; Building 12-99 contains 9 bays; and Building 12-104 contains 16 bays, including one vacuum testing bay. All but three bays in these four buildings are constructed as assembly/disassembly bays. These three bays include Linac[2] facilities (two bays) located in Building 12-84 (East and West) and a vacuum testing facility located in Building 12-104. In addition, several of the assembly/disassembly bays are currently used for special operations such as Savannah River Ordnance (SRO) component packaging, safeguards verification, laser sampling, W79 preparation for disposal, and additional vacuum testing bays. The four buildings also contain break/office areas and a number of supporting storage, electrical, and mechanical equipment rooms.

The bays in Building 12-84 (East) are separated by reinforced concrete walls 1.4 m (4½ ft) thick. The rest of the bays are separated by reinforced concrete walls 0.5 m (1½ ft) thick and sand fill. The purpose of the sand fill is to mitigate blast effects on adjoining bays. Except for 10 bays in Building 12-64, all the assembly/disassembly bays have floor dimensions of 8.5 m x 9.1 m (28 ft × 30 ft). The 10 bays in Building 12-64 have floor dimensions of 8.5 m x 7.3 m (28 ft × 24 ft). The two Linac bays in Building 12-84 have floor dimensions of 12.5 m x 6.1 m (41 ft × 20 ft). The assembly/disassembly bays and Linac bays are covered with anywhere from 0.6 m to 3.4 m (2 ft to 11 ft) of earth.

The floors of most of the bays in Building 12-64 are bare concrete. The floors of the bays in the other buildings are covered with a variety of materials, including radial tile and seamless urethane flooring.

Buildings 12-64, 12-84, 12-99, and 12-104 are constructed of noncombustible materials, except for the limited use of wood trims and forklift bumpers. Emergency lighting is provided for safe emergency egress and to bring hazardous operations to a safe, stable condition as required. Separate passageways are provided for personnel

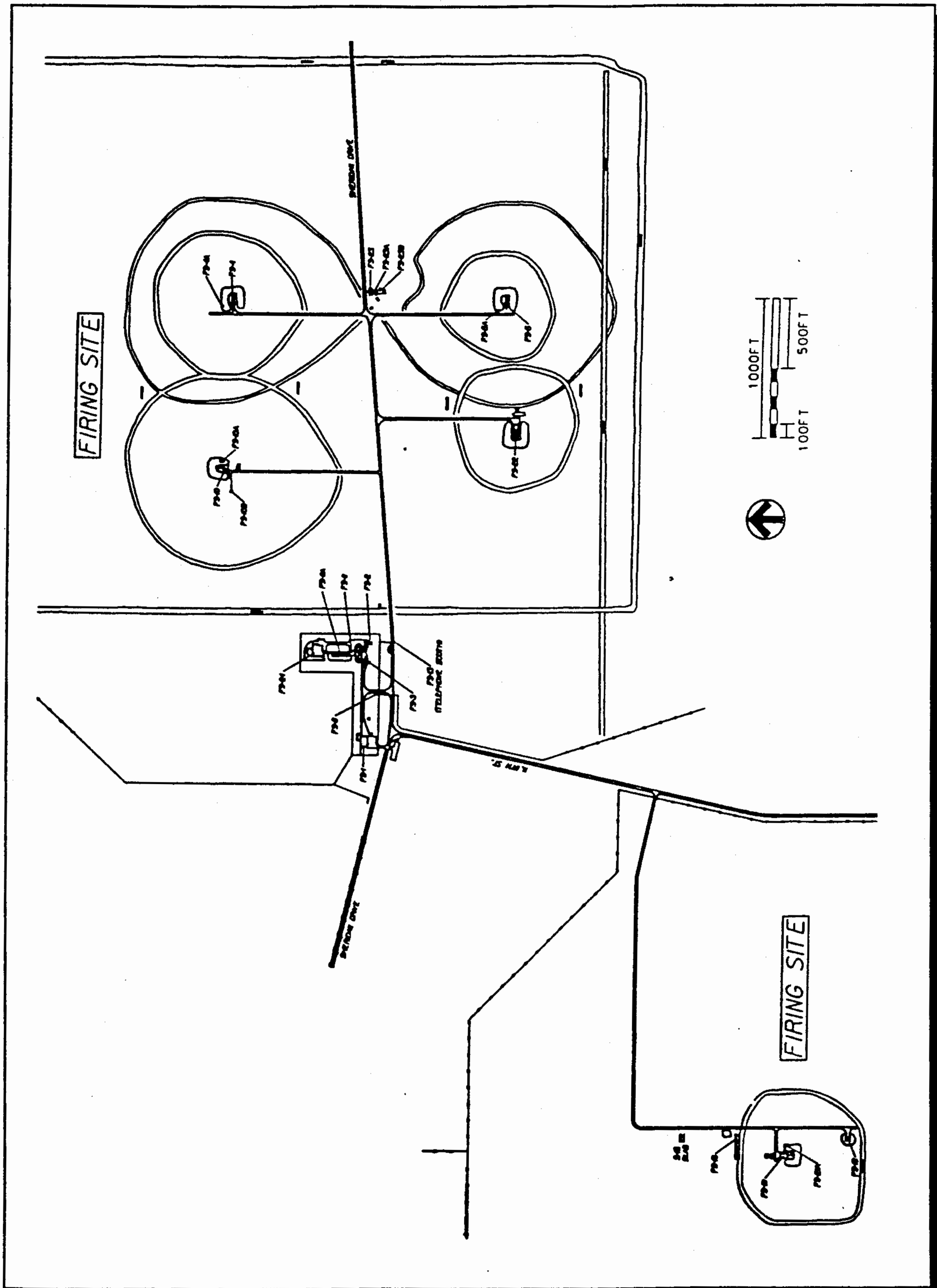

FIGURE 3-6.—*Map of Firing Sites.*

12-104. In the event of failure of normal electric power, emergency electric power is supplied by diesel generators and/or by batteries for these buildings.

Underwriters Laboratory (UL) Class II filters are provided upstream of the air handling units in Building 12-64. Local point/hood exhaust systems are not provided in the assembly/disassembly bays of Building 12-64. The HVAC system is provided with automatic controls for normal operations, but contains no interlocks that respond automatically to fire or radiation detection. Fire dampers are not provided in the HVAC exhaust lines or air ducts leading to the elevated dehumidifier houses where the air lines penetrate the bay boundaries.

HVAC systems are provided in Buildings 12-84, 12-99, and 12-104 for heating and cooling building air, for humidity control, and for local point/hood or task exhausts. Humidity control is provided to the assembly/disassembly bays for nuclear explosives quality control purposes. All inlet fresh air, return/recirculation air, and exhaust air is filtered by high efficiency particulate air (HEPA) filters with prefilters. The UL combustibility ratings of the filters are UL Class I for the HEPA filters and UL Class II for the pre-filters. Point/hood exhaust systems are provided in the assembly/disassembly bays to remove hazardous fumes from local operations. The HVAC system has automatic controls for normal operations and interlocks that respond to fire and radiation detection. Fire dampers have not been installed in the HVAC ducts in locations where bay fire walls are penetrated. The point/hood exhaust systems are started manually, but respond automatically to fire and radiation detection.

Buildings 12-64, 12-84, 12-99, and 12-104 contain communications systems that include the telephone, public address system, maintenance communications system, protected distribution system, and the Pantex local area network. Emergency communications could potentially be provided by the telephone, public address system, or protected distribution system.

Domestic water is provided to the break/office areas for drinking, lavatories, and janitorial use.

Criticality concerns apply to the fissile materials transported into the bays. Typically, weapon parts or assemblies that contain fissile material are kept in a one-high array and are located on or attached to assembly fixtures. This configuration prevents one fissile component from being pushed or rolled closer than 0.9 m (3 ft) center-to-center to another fissile component. Specific tests are reviewed individually, and approval of modified controls (e.g., configuration in other than one-high arrays) for certain programs is possible. In general, fissile material in shipping containers, however, may be spaced closer than 0.9 m (3 ft) center-to-center.

The operations conducted in the bays are under the purview of DOE Order 5610.11 "Nuclear Explosive Safety"[3]. Under this order, nuclear explosive safety studies are performed on each nuclear explosive system before operations on that system begin. The major operations conducted in the bays are partial assembly/disassembly of nuclear explosives containing HE and complete assembly/disassembly of nuclear explosives containing IHE. Operations (cased, components of the nuclear explosives themselves provide the primary containment) involving uncased HE are not allowed in bays which contain plutonium (Operations involving uncased HE are allowed in bays that <u>do not</u> contain plutonium). Specialized operations supporting quality assurance activities are also performed in the bays. The bays may be used for the temporary staging of weapons or weapon components awaiting transfer to appropriate staging areas.

Nuclear explosives, Rocky Flats (RF) components, Oak Ridge Ordnance (ORO) components, SRO components, radioisotopic thermoelectric generators (RTGs), HE, and IHE are transferred to and from the bays using electric forklifts or manually operated transfer carts. Only weapons containing IHE main charges can be completely assembled or disassembled in the bays. For pit-HE-IHE disassembly, employees wear and equipment access to the assembly/disassembly bays in Buildings 12-84, 12-99, and 12-104. The doors are interlocked to prevent opening more than one door in a given passageway at a time. A single passageway, enclosed by double doors, is provided for access to the bays in Building 12-64. The equipment doors in this building are interlocked. The personnel doors are pneumatically operated and are not interlocked.

The bay structures are designed to resist the effects of an explosive accident in an adjoining bay, to capture primary missiles originating in the bay of explosive occurrence, and to provide controlled release of the blast pressures associated with internal explosions. The roofs of the bays are in sections and are designed to open in the event of accidental explosives detonation. The massive roof structures and thick concrete and earth-filled walls surrounding the two Linac bays provide radiation shielding for the interior working areas and for the outside corridors. Alpha and/or beta continuous air monitors are connected to the plant-wide Radiation Alarm Monitoring System (RAMS) and are used to detect airborne radiological contamination in the bays. The Rad-Safe system in the radiography bays in Building 12-84 provides interlocking safety devices to protect workers from accidental exposures. Interlocks are provided between the operating controls and gamma radiation detectors, panic switches, warning lights, warning chimes and horns, passageway door switches, RAMS alarms, and fire alarms.

Automatic sprinkler protection is provided for all areas of Building 12-64 by wet-pipe fusible link systems with a sprinkler density in the assembly/disassembly bays of 0.20 $L/sec/m^2$ (0.30 gpm/ft^2) and a coverage area of ~5.95 m^2(~64 ft^2) per head. Sprinklers are also provided in the ramp area, the mechanical/electrical room, and the office/break room. Water is supplied from the wet-pipe sprinkler riser in the mechanical room.

Deluge systems with approved deluge nozzles are used in the assembly/disassembly bays in Buildings 12-84, 12-99, and 12-104. These systems have a sprinkler density in the assembly/disassembly bays of up to 0.34 $L/sec/m^2$ (0.50 gpm/ft^2) and a coverage area of up to ~8.3 m^2 (~90 ft^2) per head. Wet-pipe systems with fusible-link closed sprinkler heads are used elsewhere in each building, including the building corridors, bay passageways, and other nonassembly/disassembly bays. The deluge systems are automatically activated by heat detectors located at ceiling level in the bays. The heat detectors are 60° C (140°F), rate-compensated detectors and require electric power for operation. The wet-pipe systems have 74° C (165°F) temperature ratings.

Automatic fire detection in Building 12-64 is provided by detection of water flow in the sprinkler piping. Water flow for the wet-pipe systems in Building 12-64 is initiated by the melting of fusible links in the sprinkler heads. Fire detection in Buildings 12-84, 12-99, and 12-104 is provided by heat and UV detectors, detection of water flow in the sprinkler piping, and smoke detectors.

The blast door interlock system in Buildings 12-84, 12-99, and 12-104 prevents both the inner and outer doors of a passageway entrance to a bay from being open simultaneously. The interlock system allows simultaneous opening of the doors only during emergency situations by manual override or response to fire or radiation detection. In Building 12-64, only the equipment leaf of the doors on the entrance passageway is interlocked, and no interlocks with fire or radiation detection are provided.

Utility and service systems in Buildings 12-64, 12-84, 12-99, and 12-104 include electric power; heating, ventilating, and air conditioning (HVAC); process compressed air and vacuum systems; communications systems; domestic water supply; drain systems in the mechanical rooms; and the automated energy management system (Buildings 12-84 [East] and 12-104 only). The automated energy management system is provided to control and monitor the operating status of some mechanical systems in Buildings 12-84 (East) and

Building 12-99 provides facilities for the environmental testing of small weapons components. Environmental testing involves subjecting components to test conditions that simulate the actual environments they will be exposed to during transport or deployment. The environmental testing bay is equipped with two environmental chambers and a vibration testing system. The two environmental chambers are used for thermal testing prior to vibration testing. These operations are remote and are monitored from a control room.

Any generic 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 or special testing operations or in preparation for off-site transportation.

3.1.2 Cells

The cell facilities typically contain more than 900 g (1.98 lb) of plutonium and are therefore categorized as Hazard Category 2 facilities, as specified in DOE-STD-1027-92. The cell area consists of a round room, staging cubicles, a corridor area, and a unit equipment/mechanical room. 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. (Nuclear explosives that contain IHE may be assembled/disassembled in the bays [see Section 3.1.1]). In the future, most of the operations in the cells are expected to involve the dismantlement of weapons that are being retired from the stockpile[13,14,15].

There are 13 assembly/disassembly cells at Pantex Plant. The oldest cells are Cells 1 through 6 in Building 12-44. These cells began operations in the late 1950s. Cell 1 is no longer in use because of an accidental tritium gas release in 1989 (See Section 6.4 for further details). There is also a Cell 8 within the Building 12-44 complex. It is currently dedicated to the staging of pits. Cell 8 does not have several of the safety systems discussed in this section, (see Section 3.2.1.4 for further information). However, it could be renovated for use as an assembly/disassembly cell in the future. The next oldest cells are in Buildings 12-85 and 12-96. These cells are essentially identical. They began operations in 1983. The newest cells are Cells 1 through 4 in Building 12-98. They began operations in 1985. All of the cells are located in the production area of Zone 12 South within the Material Access Area (MAA) (Figure 3-2.). Assembly/disassembly cells were designed as assembly and inspection areas with the capability to process uncased HE and nuclear explosive components that contain plutonium. The design of the cells is intended to reduce the external effects of blast pressures and to minimize the release of radioactive materials in the event of accidental HE detonation. The cell structures are referred to as "gravel gerties" because of the mound of gravel above the cell designed to mitigate the release of radioactive materials in the event of an explosive detonation.

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.

The round room walls are constructed of 30.5-cm thick (12-in. thick) reinforced concrete. The floor slab in the round room ranges from 15.2-cm thick (6-in. thick) in Building 12-44 to 38.1 cm (15 in.) in Buildings 12-85 and 12-96. The other walls (i.e., those of the cubicles, passageways, etc.) are 30.5-cm to 45.7-cm thick (12-in. to 18-in. thick) reinforced concrete. The cubicle and corridor floors are reinforced concrete ranging in thickness from 45.7 cm (18 in.) in Building 12-44 to 50.8 cm (20 in.) in Buildings 12-85 and 12-96.

Equipment passageways and personnel corridors provide access to the working areas of the assembly/disassembly cells from ramp areas. The entrance passageways are constructed of reinforced concrete and are 12.2 m (~40 ft) long.

lead-lined aprons, safety glasses, and vinyl gloves to handle uncased pits. A safety net is also used during pit-HE-IHE disassembly. All assembly and disassembly operations are performed in the designated bay according to the written procedures and the O&I Standards specific to a weapons program.

Buildings 12-64, 12-84, 12-99, and 12-104 contain radiological hazards, chemical, and other safety hazards associated with nuclear explosives. Appendix B lists facility limits of radiological, chemical, and explosive materials. The types and quantities of these materials vary depending on the assembly/disassembly operations and the specific weapon program.

The radiography bays in Building 12-84 (Bays 1 and 10) provide radiographic inspection and certification of nuclear explosive assemblies and sub-assemblies. Bay 1 houses an 8 MeV Linac and Bay 10 is equipped with a 9 MeV Linac. Both have the capability to examine completed nuclear explosives in addition to nuclear explosive components and subassemblies. The radiography bays also contain manipulator systems, turntables, alignment lasers, and closed-circuit television (CCTV) systems. The control room areas for the two radiography bays include a process/service room that provides for the development and processing of film from the Linac operations, film storage, and film viewing and interpretation.

In addition to the large, fixed Linac units, a portable X-ray machine is also used periodically in the bays to radiograph pits. The X-ray machine is completely portable and is removed from the bays when needed in other locations.

Process flow is similar in the two radiography bays. Assemblies are brought to the radiography bay in fixtures that can be used for radiography, or they are removed from their fixtures and placed in ones suitable for radiography work. The operator then positions the film with respect to the Linac and 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 while the exposure is being made. There are numerous kill switches located on the walls inside the radiography bays which will disable or prevent the operation of the radiography equipment in the event personnel are accidentally trapped inside the bay before a shot. 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 mrem/hr. During operation of the portable unit, the operator retreats to the vestibule portion of the bay, where the exposure rates to personnel again do not exceed 0.25 mrem/hr. The portable X-ray machine is operated via a control console connected to it by cables running along the floor. The operator, after making the radiographic exposure, develops the film in the process/service room. After developing, the operator views the film, makes the appropriate verifications of internal structure, and completes the necessary forms to release the unit for further work by other departments.

Vacuum testing operations are conducted in four bays. The vacuum chamber bay in Building 12-104 provides facilities for leak checking, volume determination, backfilling, and sampling of assembled weapons and containers for weapons components. Bays in Building 12-84 and 12-99 serve as manifold bays. The activities in the manifold bays are limited to evacuation and backfilling of the unit under test. The purge and backfill manifolds in these bays have six stations with a choice of backfill gases.

The laser sampling bay houses a laser welding system and an X-ray inspection system. A pit is placed on a fixture in a leak-tight chamber in the laser welding cabinet. The chamber is depressurized and a laser is used to make a small opening in the pit tube stem. A gas sample is collected. The pit tube is then welded shut and moved to the X-ray system for inspection of the weld. The sample is sent to the gas analytical laboratory for analysis.

12-104. In the event of failure of normal electric power, emergency electric power is supplied by diesel generators and/or by batteries for these buildings.

Underwriters Laboratory (UL) Class II filters are provided upstream of the air handling units in Building 12-64. Local point/hood exhaust systems are not provided in the assembly/disassembly bays of Building 12-64. The HVAC system is provided with automatic controls for normal operations, but contains no interlocks that respond automatically to fire or radiation detection. Fire dampers are not provided in the HVAC exhaust lines or air ducts leading to the elevated dehumidifier houses where the air lines penetrate the bay boundaries.

HVAC systems are provided in Buildings 12-84, 12-99, and 12-104 for heating and cooling building air, for humidity control, and for local point/hood or task exhausts. Humidity control is provided to the assembly/disassembly bays for nuclear explosives quality control purposes. All inlet fresh air, return/recirculation air, and exhaust air is filtered by high efficiency particulate air (HEPA) filters with prefilters. The UL combustibility ratings of the filters are UL Class I for the HEPA filters and UL Class II for the pre-filters. Point/hood exhaust systems are provided in the assembly/disassembly bays to remove hazardous fumes from local operations. The HVAC system has automatic controls for normal operations and interlocks that respond to fire and radiation detection. Fire dampers have not been installed in the HVAC ducts in locations where bay fire walls are penetrated. The point/hood exhaust systems are started manually, but respond automatically to fire and radiation detection.

Buildings 12-64, 12-84, 12-99, and 12-104 contain communications systems that include the telephone, public address system, maintenance communications system, protected distribution system, and the Pantex local area network. Emergency communications could potentially be provided by the telephone, public address system, or protected distribution system.

Domestic water is provided to the break/office areas for drinking, lavatories, and janitorial use.

Criticality concerns apply to the fissile materials transported into the bays. Typically, weapon parts or assemblies that contain fissile material are kept in a one-high array and are located on or attached to assembly fixtures. This configuration prevents one fissile component from being pushed or rolled closer than 0.9 m (3 ft) center-to-center to another fissile component. Specific tests are reviewed individually, and approval of modified controls (e.g., configuration in other than one-high arrays) for certain programs is possible. In general, fissile material in shipping containers, however, may be spaced closer than 0.9 m (3 ft) center-to-center.

The operations conducted in the bays are under the purview of DOE Order 5610.11 "Nuclear Explosive Safety"[3]. Under this order, nuclear explosive safety studies are performed on each nuclear explosive system before operations on that system begin. The major operations conducted in the bays are partial assembly/disassembly of nuclear explosives containing HE and complete assembly/disassembly of nuclear explosives containing IHE. Operations (cased, components of the nuclear explosives themselves provide the primary containment) involving uncased HE are not allowed in bays which contain plutonium (Operations involving uncased HE are allowed in bays that do not contain plutonium). Specialized operations supporting quality assurance activities are also performed in the bays. The bays may be used for the temporary staging of weapons or weapon components awaiting transfer to appropriate staging areas.

Nuclear explosives, Rocky Flats (RF) components, Oak Ridge Ordnance (ORO) components, SRO components, radioisotopic thermoelectric generators (RTGs), HE, and IHE are transferred to and from the bays using electric forklifts or manually operated transfer carts. Only weapons containing IHE main charges can be completely assembled or disassembled in the bays. For pit-HE-IHE disassembly, employees wear and equipment access to the assembly/disassembly bays in Buildings 12-84, 12-99, and 12-104. The doors are interlocked to prevent opening more than one door in a given passageway at a time. A single passageway, enclosed by double doors, is provided for access to the bays in Building 12-64. The equipment doors in this building are interlocked. The personnel doors are pneumatically operated and are not interlocked.

The bay structures are designed to resist the effects of an explosive accident in an adjoining bay, to capture primary missiles originating in the bay of explosive occurrence, and to provide controlled release of the blast pressures associated with internal explosions. The roofs of the bays are in sections and are designed to open in the event of accidental explosives detonation. The massive roof structures and thick concrete and earth-filled walls surrounding the two Linac bays provide radiation shielding for the interior working areas and for the outside corridors. Alpha and/or beta continuous air monitors are connected to the plant-wide Radiation Alarm Monitoring System (RAMS) and are used to detect airborne radiological contamination in the bays. The Rad-Safe system in the radiography bays in Building 12-84 provides interlocking safety devices to protect workers from accidental exposures. Interlocks are provided between the operating controls and gamma radiation detectors, panic switches, warning lights, warning chimes and horns, passageway door switches, RAMS alarms, and fire alarms.

Automatic sprinkler protection is provided for all areas of Building 12-64 by wet-pipe fusible link systems with a sprinkler density in the assembly/ disassembly bays of 0.20 L/sec/m^2 (0.30 gpm/ft^2) and a coverage area of $\sim$5.95 m^2($\sim$64 ft^2) per head. Sprinklers are also provided in the ramp area, the mechanical/electrical room, and the office/break room. Water is supplied from the wet-pipe sprinkler riser in the mechanical room.

Deluge systems with approved deluge nozzles are used in the assembly/disassembly bays in Buildings 12-84, 12-99, and 12-104. These systems have a sprinkler density in the assembly/disassembly bays of up to 0.34 L/sec/m^2 (0.50 gpm/ft^2) and a coverage area of up to $\sim$8.3 m^2 ($\sim$90 ft^2) per head. Wet-pipe systems with fusible-link closed sprinkler heads are used elsewhere in each building, including the building corridors, bay passageways, and other nonassembly/disassembly bays. The deluge systems are automatically activated by heat detectors located at ceiling level in the bays. The heat detectors are 60° C (140°F), rate-compensated detectors and require electric power for operation. The wet-pipe systems have 74° C (165°F) temperature ratings.

Automatic fire detection in Building 12-64 is provided by detection of water flow in the sprinkler piping. Water flow for the wet-pipe systems in Building 12-64 is initiated by the melting of fusible links in the sprinkler heads. Fire detection in Buildings 12-84, 12-99, and 12-104 is provided by heat and UV detectors, detection of water flow in the sprinkler piping, and smoke detectors.

The blast door interlock system in Buildings 12-84, 12-99, and 12-104 prevents both the inner and outer doors of a passageway entrance to a bay from being open simultaneously. The interlock system allows simultaneous opening of the doors only during emergency situations by manual override or response to fire or radiation detection. In Building 12-64, only the equipment leaf of the doors on the entrance passageway is interlocked, and no interlocks with fire or radiation detection are provided.

Utility and service systems in Buildings 12-64, 12-84, 12-99, and 12-104 include electric power; heating, ventilating, and air conditioning (HVAC); process compressed air and vacuum systems; communications systems; domestic water supply; drain systems in the mechanical rooms; and the automated energy management system (Buildings 12-84 [East] and 12-104 only). The automated energy management system is provided to control and monitor the operating status of some mechanical systems in Buildings 12-84 (East) and

Building 12-99 provides facilities for the environmental testing of small weapons components. Environmental testing involves subjecting components to test conditions that simulate the actual environments they will be exposed to during transport or deployment. The environmental testing bay is equipped with two environmental chambers and a vibration testing system. The two environmental chambers are used for thermal testing prior to vibration testing. These operations are remote and are monitored from a control room.

Any generic 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 or special testing operations or in preparation for off-site transportation.

3.1.2 Cells

The cell facilities typically contain more than 900 g (1.98 lb) of plutonium and are therefore categorized as Hazard Category 2 facilities, as specified in DOE-STD-1027-92. The cell area consists of a round room, staging cubicles, a corridor area, and a unit equipment/mechanical room. 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. (Nuclear explosives that contain IHE may be assembled/disassembled in the bays [see Section 3.1.1]). In the future, most of the operations in the cells are expected to involve the dismantlement of weapons that are being retired from the stockpile[13,14,15].

There are 13 assembly/disassembly cells at Pantex Plant. The oldest cells are Cells 1 through 6 in Building 12-44. These cells began operations in the late 1950s. Cell 1 is no longer in use because of an accidental tritium gas release in 1989 (See Section 6.4 for further details). There is also a Cell 8 within the Building 12-44 complex. It is currently dedicated to the staging of pits. Cell 8 does not have several of the safety systems discussed in this section, (see Section 3.2.1.4 for further information). However, it could be renovated for use as an assembly/disassembly cell in the future. The next oldest cells are in Buildings 12-85 and 12-96. These cells are essentially identical. They began operations in 1983. The newest cells are Cells 1 through 4 in Building 12-98. They began operations in 1985. All of the cells are located in the production area of Zone 12 South within the Material Access Area (MAA) (Figure 3-2.). Assembly/disassembly cells were designed as assembly and inspection areas with the capability to process uncased HE and nuclear explosive components that contain plutonium. The design of the cells is intended to reduce the external effects of blast pressures and to minimize the release of radioactive materials in the event of accidental HE detonation. The cell structures are referred to as "gravel gerties" because of the mound of gravel above the cell designed to mitigate the release of radioactive materials in the event of an explosive detonation.

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.

The round room walls are constructed of 30.5-cm thick (12-in. thick) reinforced concrete. The floor slab in the round room ranges from 15.2-cm thick (6-in. thick) in Building 12-44 to 38.1 cm (15 in.) in Buildings 12-85 and 12-96. The other walls (i.e., those of the cubicles, passageways, etc.) are 30.5-cm to 45.7-cm thick (12-in. to 18-in. thick) reinforced concrete. The cubicle and corridor floors are reinforced concrete ranging in thickness from 45.7 cm (18 in.) in Building 12-44 to 50.8 cm (20 in.) in Buildings 12-85 and 12-96.

Equipment passageways and personnel corridors provide access to the working areas of the assembly/disassembly cells from ramp areas. The entrance passageways are constructed of reinforced concrete and are 12.2 m (~40 ft) long.

lead-lined aprons, safety glasses, and vinyl gloves to handle uncased pits. A safety net is also used during pit-HE-IHE disassembly. All assembly and disassembly operations are performed in the designated bay according to the written procedures and the O&I Standards specific to a weapons program.

Buildings 12-64, 12-84, 12-99, and 12-104 contain radiological hazards, chemical, and other safety hazards associated with nuclear explosives. Appendix B lists facility limits of radiological, chemical, and explosive materials. The types and quantities of these materials vary depending on the assembly/disassembly operations and the specific weapon program.

The radiography bays in Building 12-84 (Bays 1 and 10) provide radiographic inspection and certification of nuclear explosive assemblies and sub-assemblies. Bay 1 houses an 8 MeV Linac and Bay 10 is equipped with a 9 MeV Linac. Both have the capability to examine completed nuclear explosives in addition to nuclear explosive components and subassemblies. The radiography bays also contain manipulator systems, turntables, alignment lasers, and closed-circuit television (CCTV) systems. The control room areas for the two radiography bays include a process/service room that provides for the development and processing of film from the Linac operations, film storage, and film viewing and interpretation.

In addition to the large, fixed Linac units, a portable X-ray machine is also used periodically in the bays to radiograph pits. The X-ray machine is completely portable and is removed from the bays when needed in other locations.

Process flow is similar in the two radiography bays. Assemblies are brought to the radiography bay in fixtures that can be used for radiography, or they are removed from their fixtures and placed in ones suitable for radiography work. The operator then positions the film with respect to the Linac and 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 while the exposure is being made. There are numerous kill switches located on the walls inside the radiography bays which will disable or prevent the operation of the radiography equipment in the event personnel are accidentally trapped inside the bay before a shot. 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 mrem/hr. During operation of the portable unit, the operator retreats to the vestibule portion of the bay, where the exposure rates to personnel again do not exceed 0.25 mrem/hr. The portable X-ray machine is operated via a control console connected to it by cables running along the floor. The operator, after making the radiographic exposure, develops the film in the process/service room. After developing, the operator views the film, makes the appropriate verifications of internal structure, and completes the necessary forms to release the unit for further work by other departments.

Vacuum testing operations are conducted in four bays. The vacuum chamber bay in Building 12-104 provides facilities for leak checking, volume determination, backfilling, and sampling of assembled weapons and containers for weapons components. Bays in Building 12-84 and 12-99 serve as manifold bays. The activities in the manifold bays are limited to evacuation and backfilling of the unit under test. The purge and backfill manifolds in these bays have six stations with a choice of backfill gases.

The laser sampling bay houses a laser welding system and an X-ray inspection system. A pit is placed on a fixture in a leak-tight chamber in the laser welding cabinet. The chamber is depressurized and a laser is used to make a small opening in the pit tube stem. A gas sample is collected. The pit tube is then welded shut and moved to the X-ray system for inspection of the weld. The sample is sent to the gas analytical laboratory for analysis.

Inside the cell, the concrete floors of the round rooms, corridors, and cubicles are covered with a seamless urethane flooring. The urethane flooring is resistant to tearing by movement of equipment and by cart traffic and facilitates cleanup of hazardous materials. Current Pantex Plant safety practice is to use approved floor mats in cell areas where operations involve uncased HE. The floors of the equipment passageway, personnel corridor, and the equipment/mechanical room are bare concrete.

The service area for Building 12-44 contains several rooms that support building operations. These rooms include a facility outside of Cell 8 for personnel decontamination in emergencies; a radiation monitoring equipment room outside of Cell 8; a building electrical/mechanical equipment room; building corridors, and ramps. Building 12-44E is the mechanical equipment support area for Cells 1 through 6 in Building 12-44. An office is located next to the mechanical room. These support areas are designed to provide protection from external explosions as specified in DOE Order 6430.1A "General Design Criteria"[17].

Before operations take place in a cell, the cell must be designated for the operation(s) by the production planners. The process that designates the particular operation to be carried out in a cell is called configuration. Configuration is based on current workload and the programs in process. Cells may be reconfigured for three different operations, assembly, disassembly, and testing.

Criticality concerns apply to the fissile materials transported into the cells. Typically, weapons parts or assemblies that contain fissile materials are kept in a one-high array located on or attached to assembly fixtures. This configuration prevents one fissile component from being pushed or rolled closer than 0.9 m (3 ft) center-to-center to another fissile component. Specific tests are reviewed individually, and approval of modified controls (e.g., configuration in other than one-high arrays) for certain programs is possible. In general, fissile material in shipping containers may be spaced closer than 0.9 m (3 ft) center-to-center.

The operations conducted in the cells are under the purview of DOE Order 5610.11 "Nuclear Explosive Safety." Under this order, nuclear explosive safety studies are performed on each nuclear explosive system before operations on that system can begin.

The cells were designed as assembly/disassembly and inspection areas with the capability to process uncased HE and nuclear explosive components that contain plutonium. 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 supporting quality assurance activities are also performed.

Other operations that take place in the cells are stockpile surveillance; limited life component exchange operations, which involve a nuclear explosive that must undergo disassembly, modification, and reassembly, and repair of nuclear explosives that have been damaged or have become nonoperational or nonfunctioning. In the latter case, the nuclear explosives are either returned to the stockpile or dismantled.

Partial assembly involving uncased HE and plutonium, is called pit-HE mating. In partial assembly plutonium pits are combined with HE components. Once combined, these assemblies are called "nuclear explosive assemblies." A nuclear explosive assembly is any assembly capable of producing a nuclear yield. It does not have to be a complete nuclear explosive. Complete nuclear explosive assemblies include all types of nuclear explosive devices (warheads, bombs, re-entry vehicles, or artillery shells).

To comply with DOE and Pantex Plant requirements, uncased plutonium-HE assembly and disassembly operations must be conducted in a gravel gertie-type structure where the design features of the facility afford an added margin of safety. Partial assembly may 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

Equipment passageways are 2.7-m x 2.6-m high (9-ft wide × 8½-ft high). The doors are 2.4-m wide x 2.1-m high (7-ft 10-in. wide × 7-ft high). The doors are hinged on one side and closed against rubber gaskets around the top and side of the wall jamb. The doors are designed to withstand the blast from accidental detonation of 250 kg (550 lb) of TNT equivalent located in the round room of the cell. The two blast doors are interlocked so that only one door can be opened at a time.

The personnel corridor is closed by a revolving door at one end and a hinged steel door on the other end. The revolving door is currently being re-designed to reduce the gap size around the edges of the door.

A hinged, steel door is located at the opposite end of the personnel passageway from the revolving door. The door is designed to withstand an internal pressure of 12,656 kg/m² (18 psi) and originally was sealed by an air-inflated gasket. The purpose of the gasket was to reduce leakage in the event of an accidental release of radioactive materials (plutonium or tritium) inside the cell. The air-inflated gasket is currently not functional and is undergoing a re-design. A "panic" bar is provided to release the gasket air seal and allow egress from the cell.

The design of the cells is based on gravel gertie experiments that show that the gravel gertie structure largely dissipates blast pressures. Minimal overpressures are measured outside the cell where the explosion occurs[16]. The mounded gravel roof over the round room is designed to lift and vent the gas pressures produced in an explosion. Plutonium is filtered from the vented gases by the gravel structure, and release to the environment is minimized. The equipment passageway doors are designed to remain intact in the event of accidental explosives detonation, and the doors are interlocked so that only one door can be opened at a time. The revolving door in the personnel passageway remains lodged in the passageway.

For the 12-44 Cells, a system of drain lines connected to a storage tank is provided for each cell to collect water that could potentially become contaminated with radioactive materials during fires or other accidents. Contaminated waste drains are provided for the contaminated waste sumps located in the corridor outside the round rooms. The drain line from the contaminated waste sump located outside the round room empties into an outside storage tank. Connections to the contaminated waste system are also made from the shower and drying room floor drains in the decontamination facility outside of Cell 8.

The contaminated waste storage tanks for Buildings 12-85, 12-96, and 12-98 have isolation valves that prevent gas leakage from the cells into the tanks in the event of accidental HE detonation. The contaminated waste storage tank for Building 12-44 does not have isolation valves. With the exception of water discharged from sprinkler system/deluge flow tests, the system is used only for accidental releases. Water contaminated in normal operations is collected in barrels for proper disposal.

Cell penetrations through the walls, floors, or ceilings are sealed to minimize the leakage of radioactive materials from the cells in the event of accidental HE detonation. Except for Cell 8 in Building 12-44, HVAC ducts for all the cells are provided with pressure actuated poppet-type blast valves designed to close in the event of HE detonation. The equipment passageway and personnel doors have door seals and gaskets. The door seals mitigate leakage from the cells, but are not designed to be completely air-tight.

In addition to the round room, a cell contains a number of supporting areas. The supporting areas include staging cubicles, a corridor, and an 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.

during disassembly. ORO components are staged in a Pantex Plant facility until they can be packaged and sent back to Oak Ridge. Certain explosive devices removed during disassembly are sent to the Pantex Plant Burning Ground for burning and detonation. The electronic, mechanical, and plastic components that are removed are checked for contamination and sent to the proper staging facility for storage, demilitarization, sanitization, reprocessing, recycle, reuse, waste management or disposal.

3.1.3 Special Purpose Facilities

These facilities typically contain more than 900 g (1.98 lb) of plutonium and are therefore categorized as Hazard Category 2 facilities, as specified in DOE-STD-1027-92. This section discusses the structural design and operations in facilities that handle weapon components and complete weapons with both HE and radiological materials. These facilities include:

- Building 12-26, Bays 27 and 28 (Section 3.1.3.1)
- Building 12-41, Paint Facility (Section 3.1.3.2)
- Building 12-50, Separation Testing Facility (Section 3.1.3.3)
- Building 12-60, Mass Properties Facility (Section 3.1.3.4)
- Building 12-94, Weapons Aging Facility (Section 3.1.3.5)
- Building 12-104A, Weapons Special Purpose Bay Replacement Complex (Section 3.1.3.6).

3.1.3.1 *Building 12-26, Bays 27 and 28*

Building 12-26 was built in 1944 as a part of the WWII construction of the Pantex Army Ordnance Plant[18]. It was originally used for shipping and staging ordnance, but is now used for component accelerated aging, tritium reservoir testing and inspection, weapons vacuum and leak testing, tool storage, and pits vault storage. Facility and operations descriptions for Bay 28, Tritium Reservoir (Bottle) Testing and Inspecting Bay, and Bay 27, Weapon Vacuum and Leak Testing Bay, are provided in this section. Facility and operations descriptions of the Pit Vault are discussed in Section 3.2.1.1, and Bays 22 and 26 are discussed in Section 3.3.4.10.

Building 12-26 is a two-story, T-shaped building located in the southeastern quadrant of Zone 12 South. There have been several modifications and additions to the facility, including additions to the east wing which have more than doubled the tooling storage capabilities. The facility is now 7,246 m^2 (78,000 ft^2). Additions to the Tooling Warehouse were made in the early 50s, mid-70s, and early 80s.

The leg of the building is approximately 131.9 m x 31.3 m (433 ft × 103 ft) that runs in a north-south direction. The leg that runs in an east-west direction is approximately 119.8 m x 31.3 m (393 ft × 103 ft). The east-west leg of the building houses the Office Area, the Tooling Warehouse, and the Pit Vault. The north-south leg of the building houses the operational areas including the component accelerated aging bay (Bay 22), the tritium reservoir testing and inspecting bay (Bay 28), and the weapon vacuum and leak testing bay (Bay 27). On the second floor (penthouse) is the monitor room (penthouse) which runs almost the full length of the north-south leg of the building. It is constructed on the eastern half of the leg. The monitor room is approximately 118.9 m x 5.8 m (390 ft × 19 ft), and houses the heating and cooling air handling equipment.

The north-south leg of Building 12-26 is divided into 30 bays of two different sizes. The dimensions of the bays are 5.8 m x 6.7 m (19 ft × 25 ft) and 8.8 m x 9.1 m (29 ft × 30 ft). The bay walls are constructed of noncombustible, 30.5-cm thick (12-in. thick) reinforced concrete and are substantial dividing walls. The exterior walls are pressure relieving walls, constructed of 30.5-cm thick (12-in. thick) hollow clay tile bricks. The flooring is constructed of 30.5-cm thick (12-in.

performed in the assembly bay facilities in Zone 12 South (See Section 3.1.1).

During nuclear explosive assembly operations, pits are transferred to the cells from any designated special nuclear material (SNM) staging facility at Pantex Plant. ORO components are transferred from SNM staging facilities and from the bays used for staging in Buildings 12-64, 12-84, 12-99, and 12-104. RTGs and tritium reservoirs are transferred from SNM staging facilities. HE comes from an in-process HE staging facility for HE.

Components, parts, and materials are transferred to the cells using electric forklifts or transfer carts. All nuclear explosive or SNM movements must be scheduled with the SNM Control Center to assure an orderly flow of materials and components into the cells. A computer terminal and secure telephone in each cell assures that the documentation about the location of SNM is current at all times. Strict accountability also assures that the administrative controls applicable to the cells (e.g., limits on the amounts of plutonium and explosives inside each cell) are monitored.

All components for a particular program are sent to the operating cell performing the assembly. All assembly operations are performed in designated cells according to Nuclear Explosive Operating Procedures and other written procedures specific to a nuclear explosives program. Quality assurance inspections and audits are performed to ensure that design specifications are met. Acceptance inspections are performed by the Mason & Hanger Quality Division and by DOE inspectors. During all phases of assembly, nuclear explosive-specific procedures are followed and checklists are initialed as each procedure is completed. Once the nuclear explosive assembly is complete, it is sent to radiography to verify the presence of SNM and to confirm the position of the safing device. If required, it 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 high explosives. 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 system.

Cells are also used extensively for the disassembly or partial disassembly of nuclear explosives that have been returned to the DOE by the U.S. Department of Defense. Many of these nuclear explosives were designed and built without the added safety benefit of IHE. Therefore, disassembly operations must be initiated in a cell prior and later moved to other facilities for component disassembly.

Complete nuclear explosives may be brought to the cells from the Zone 4 staging magazines. They may also be temporarily staged in other Zone 12 facilities prior to transport to one of the cells. Plutonium pit-HE assemblies are brought to the cells from other facilities in Zone 12. Special tools and equipment are supplied from warehouse stocks. Some disassembly operations require a portable glove box or other specialized equipment. For these operations, equipment is brought into the cell. For plutonium pit-HE disassembly, a safety net or safety latches must be used, and lead-lined aprons, safety glasses, and vinyl gloves must be worn by personnel handling pits. Some operations require that portions of the round room floor be covered with a barrier paper or cloth that is taped to the floor with duct tape. Thus, in the event of an accident or unanticipated spill of hazardous material, this cloth can be peeled from the floor and disposed of as contaminated waste. Thus, floor cleanup is facilitated.

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

Nuclear Explosive Operating Procedures (NEOPs) and other written procedures are followed closely electric vacuum motor located in the Monitor Room draws a constant stream of air past the sensors, which is analyzed by the alpha monitoring system. The alpha continuous monitors are stand-alone units and are not interfaced with the exhaust louvers.

The radiation alarm monitoring system for Building 12-26 consists of tritium continuous air monitors connected to micro-processors, which are further connected to a mini-computer. The mini-computer processes the information from the air monitors. It indicates the status of each location at remote terminals and is capable of actuating bay alarm conditions. If the signal from a monitor indicates an alarm condition count rate, the mini-computer actuates the local alarms, initiates opening and closing of the two sets of louvers of each emergency tritium exhaust system, and indicates alarm conditions at the remote terminal locations. Each tritium continuous air monitor is also capable of actuating a local alarm independently if it senses an alarm condition. The system can also actuate warning alarms to indicate equipment malfunctions or an increased, but not alarm condition, count rate. Equipment malfunctions which would initiate warning alarms vary depending on the equipment model.

Portable fire extinguishers of the proper type and size are conspicuously located throughout the facility where they can be accessed in the event of a fire. A combination emergency station with safety shower and eyewash fountain is located in the corridor just outside of Bays 22 and 26. Also, emergency eyewash fountains are located in Bays 27 and 28.

The activities currently conducted in Bay 28 include staging, disassembling, testing, assembly, and inspecting tritium reservoirs and valve assemblies. The valves are separated from the reservoir (bottle) and either assembled or disassembled, checked, and reassembled for use. The valve disassembly operations involving the separation of connections are conducted in ventilated rooms within glove boxes to minimize personnel exposure in case of an accidental release. Safety tests conducted include pressure checking seals and measuring electrical resistance.

Operations conducted in Bay 27 involve inspection of partial assemblies, complete nuclear explosives, and SNM. The inspection consists of filling the unit with helium or argon gas, placing it in the chamber(s), exhausting the chamber atmosphere to a pre-established level and then sealing the chamber. The internal atmosphere of the chamber is then checked and compared with pre-set standard leaks and leak rate is determined. If any leak occurs that causes a decrease in chamber vacuum and change in content, the content is evaluated by comparing mass spectrometer readings taken at the beginning and end of the test.

3.1.3.2 *Building 12-41, Paint Facility*

Building 12-41, located in the center of the MAA (Figure 3-2.), is currently used as a paint bay. It contains one sandblast booth, two painting booths, and two waterfall type filtration systems with approximately 68,137 L (18,000 gal) storage each. No SNM is stored overnight at this facility[19].

Building 12-41 is a one-story, 521 m^2 (5,610 ft^2) facility built in 1952. The facility houses two paint spray rooms, a sandblasting booth, and an exhaust booth. The exterior walls are hollow clay tile with noncombustible insulation on the interior face. All floors are concrete. The roof is cemesto board on a steel frame. Both paint rooms incorporate waterfall filtration systems connected to the local exhaust system to remove flammable vapors and paint residue from the exhaust. Make-up air is provided in the paint rooms and sandblast booth by an air handling unit located at the north end of the building.

Emergency lighting is supplied for Building 12-41 by single lamp exit lights located in both paint rooms, the sandblast booth, and the main facility. The battery for these exit lights is located in the Mechanical Room. The battery charger is thick) reinforced-concrete slab over loose earth fill. The north-south leg has a clearance height of 5.8 m (19 ft) to the roof framing. The roofing system is composed of built up roofing over cemesto, supported by steel roof joists. The roof at the east corridor in the north-south leg is a concrete slab supported by steel beams and joists. It serves as the floor of the monitor room. The walls and roof of the monitor room are of the same construction as the walls and roof in the north-south leg. Steel columns are also provided along the perimeter of the building to support the roof of the monitor room.

The interior room construction of the east-west leg is primarily noncombustible. However, the break room has partitioned walls of gypsum board on wood studs and a ceiling of gypsum board on wood joist. The office area walls adjoining the break room are of gypsum board on metal studs. The exterior walls are reinforced concrete masonry. The roof system is composed of built up roofing over insulation board on metal supported by steel columns.

The 1974 addition to the tooling warehouse is of noncombustible construction. The roofing system is composed of insulated steel deck on steel joist.

The undersides of the joist are 1.6 cm (5/8 in.) gypsum board. The ceiling height is approximately 6.1 m (20 ft). A concrete block wall separates this portion of the warehouse from the original warehouse. The total floor area of this addition is approximately 1,177 m^2 (12,669 ft^2).

The 1983 addition is constructed of noncombustible concrete masonry. The exterior walls are reinforced concrete block with gypsum board covering. The built-up roofing system is composed of insulated steel deck on steel joists. The ceiling height is approximately 6.1 m (20 ft). This addition is completely steel framed, including the perimeter columns. The 1983 addition is approximately 574 m^2 (6,180 ft^2).

Electrical equipment and lighting located in the north and south wings, and in all the bays surrounding the corridors are equipped to meet National Electric Code (NEC) Class II hazardous locations. The east wing and outer interior areas of the facility electrical system are designed for general purpose. An emergency generator, located in the Building 12-26 Equipment Room, provides emergency power for the emergency lights, RAMS, and the alpha blowers. Emergency lighting units, each equipped with a 1½-hr battery supply, are located throughout the facility. They will automatically illuminate for means of egress in the event of an interruption in normal lighting. A lightning protection and grounding system is also provided.

Building 12-26 is protected by three automatic wet-pipe sprinkler systems; a local evacuation alarm sounds (inside fire alarm bells), and a coded fire alarm signal is transmitted to the Plant Fire Station (Building 12-39).

A protective signaling system is also provided for the facility, is electrically operated, and has a 24-hour emergency battery power supply. Upon activation of a manual fire alarm station or upon sprinkler water flow, evacuation alarm bells sound and a coded alarm signal is transmitted to the Plant Fire Station.

The local exhaust system in Bay 28 consists of room exhausts and a glove box with an exhaust system. The exhaust lines are manifolded into a larger single duct for exhausting to the atmosphere. The system is provided to exhaust tritium gas in the event of a leak or rupture of a tritium reservoir. Operations involving toxic fumes, vapors or dust, or flammable solvents are performed inside the glovebox with the exhaust system on.

The work areas in Building 12-26 have both alpha and tritium continuous air monitors to detect abnormal levels of alpha and tritium airborne contamination. If radiation in excess of established limits is detected, audible and visual alarms are actuated to warn personnel. A small

3.1.3.3 *Building 12-50, Separation Testing Facility*

A 37.2 m (400 ft²) equipment room and a 95.1 m² (1,024 ft²) test bay/control booth comprise Building 12-50. Building 12-50 is a single-story 132.3 m² (1,424 ft²) earth-covered facility constructed in 1970, and located in the center of the MAA (Figure 3-2.). Operations in the building include functional separation tests on selected reentry body assemblies, a continuing requirement of the weapons surveillance program[20].

The building is composed of 15.2-cm thick (6-in. thick) reinforced concrete slab over 10.2-cm thick (4-in. thick) course aggregate fill. The test bay/control booth walls are constructed of 30.5-cm thick (12-in. thick) reinforced concrete. The equipment room walls are also concrete and are 19.4-cm thick (7 5/8-in. thick). The roof is constructed of 35.6-cm thick (14-in. thick) concrete. The test bay/control booth and access ramp is overlain with a compact layer of earth. Prefabricated asphalt covers the structure. A portion of the roof that is used to hold the spring and cable assembly suspension apparatus protrudes through the earth-covering to an additional 8.5 m (28 ft) height.

The test bay/control booth has a set of blast doors, which are located at the bay entrance area nearest the main ramp. The test bay/control booth is also equipped with bare concrete flooring, copper ground wire, jib crane and air hoist, acoustic tiles, a vacuum line, an air handling unit, a fire protection and suppression system, a radiation alarm monitor system, a tritium monitor, emergency lighting, and a lightning protection system. No fire doors, fire walls, fire dampers, fire vents, or HEPA filters are associated with the facility design.

Operations in Building 12-50 provide data for evaluating specific weapons release assembly hardware and installation procedures and for detecting and monitoring time- and service-related deterioration of the separation system. Selected reentry body assemblies are subjected to functional separation tests as a continuing requirement of weapons-specific surveillance programs.

During surveillance programs, the operational performance of selected weapons release assembly systems are assessed by performing a functioning test on each assembly while it is attached to a reentry body assembly. In this functioning test, the reentry body assembly is held rigidly in a chuck and the release assembly is attached through its missile interface to a suspended inertial capsule. Each inertial capsule is designed so that it, together with its attached release assembly, it duplicates the mass properties of the corresponding tactical reentry body. Because of safety considerations, the reentry body is not ejected in the separation test.
Instead, it is held fixed in the chuck; and the release assembly, with the inertial capsule secured to it, is ejected from the reentry body.

The movement of the capsule is recorded by high speed cameras. Velocities, spin, and tipoff rates are obtained from these recordings. Prior to any electrical interface, a computer software program is used to assure that the weapons assembly electrical circuit is compatible with the test criteria. The test console is equipped with a voltage and current limiting device that will shut the equipment down when an unacceptable limitation is reached.

Prior to the start of each functional separation test, the operators ensure that all unauthorized personnel have evacuated the test bay. They then place all required laser warning signs in their appropriate positions. After all test preparations are completed, the operators turn the cameras, and then the laser switches, to their "ON" position. The authorized personnel then go inside the control booth and remain there during the entire test.

hardwired into the building electrical circuit to provide continuous charging.

Building 12-41 is protected by an automatic wet-pipe sprinkler system with a 15.2-cm (6-in.) alarm check valve and riser. Water for the sprinkler system in Building 12-41 is supplied from the high pressure fire loop. Upon detection of water flow or activation of a manual fire alarm station, local evacuation alarms (inside fire alarm bells) sound, and a coded fire alarm signal is transmitted to the Plant Fire Station. The fire alarm system is electrically supervised and has a 24-hour emergency battery power supply. Building 12-41 also has a lightning protection system.

A supplied breathing air/carbon monoxide (CO) monitoring system is provided for the paint rooms and the sandblasting booth. This system supplies breathing air for air-line respirators worn by the operators. The system is interlocked with the Plant compressed air supply. It consists of supplied breathing air stations, an oil-lubricated breathing air compressor, a CO monitor, and a CO alarm buzzers. The CO monitor is located in the breathing air line, and CO alarm buzzers are located in both the west paint room and sandblasting booth. The CO alarm buzzers are supplied to warn occupants of elevated CO levels in the breathing air lines. In the event of elevated CO levels, the CO alarm buzzers sound, warning occupants to remove their breathing air respirators and evacuate the booth. Upon the evacuation of paint rooms or the sandblasting booth, operations in these areas cease.

The sandblast booth is supplied with a local exhaust system connected to the Plant air system. Each paint room is equipped with a waterfall filtration system which is connected to a local exhaust. It provides a collection source for flammable vapors and paint residue. Air flow from each paint room is directed through a water curtain, which causes the flammable vapors and paint residue to be deposited in a separation trough where the paint residue precipitates out. The air leaving the waterfall filtration system is exhausted directly to the outside. Compressed air equipment supplied by Plant air is used for spray painting. Painting operations are not conducted without the use of the waterfall filtration system.

The RAMS for Building 12-41 consists of a tritium continuous air monitor (located in the center of the facility) connected to a micro-processor, which is further connected to a mini-computer at a remote location. The mini-computer processes the information from the air monitors. It indicates the status of each location at remote terminals and is capable of actuating bay alarm conditions. If the signal from the monitor indicates an alarm condition count rate, the mini-computer actuates the local alarms and indicates alarm conditions at the remote terminals located in Buildings 12-42, 12-122, and 12-75. The tritium continuous air monitor is also capable of actuating a local alarm independently if it senses an alarm condition. The system can also actuate warning alarms to indicate equipment malfunctions, or an increased, but not alarm condition count rate.

Flammable storage cabinets are distributed throughout Building 12-41. They provide safe storage of flammable materials within the areas where they are used.

A combination emergency station with drench shower and eyewash fountain is located on the west wall outside of the east paint room. A portable eyewash fountain is located on the east wall outside of the west paint room.

Building 12-41 is used to sandblast and spray paint weapons and weapon components. The exhaust booth is used for mixing paints and solvents and removing HE from weapons components using solvents. Building 12-41 is currently reaccepting metal frames on casters (called "roadables" or "H-gear") for paint touchup and weld.

weapon, NELA, or subassembly). Operations using the CG/MOI machines are considered NEC Hazard Class II. Therefore, the testing process is [illegible] monitored and controlled from within the bay.

3.1.3.5 *Building 12-94, Weapons Aging Facility*

The purpose of the Weapons Aging Facility, Building 12-94, is to expose weapons to variable temperatures for prolonged time periods to simulate the environmental conditions that the weapons would normally be subjected to during their lifetimes[22].

The facility is connected to the west end of Building 12-50E by enclosed Ramp 12-R-50 in the center of the MAA (Figure 3-2.). The facility is 19.2-m (63-ft) wide on the east and west sides x 24.4-m (80-ft) long on the north and south sides. The total floor area is 468 m² (5,040 ft²). Functional areas within the facility are a control room (15.9 m² or 171 ft²), an aging bay (132.4 m² or 1,425 ft²), and two mechanical/electric equipment rooms(207.5 m² or 2,234 ft²). Additionally, there are corridor spaces (42.9 m² or 457 ft²) and an enclosed ramp (131.9 m² or 1,420 ft²). The facility is constructed of reinforced concrete.

All construction is noncombustible, consisting of reinforced concrete exterior blast walls and gypsum board on metal studs. Interior walls have a 2-hr fire rating. All floors are finished concrete. The roof consists of concrete slabs on reinforced concrete beams supported by concrete columns. Tornado doors are located at the east and south exits. Fire doors are in all of the interior walls.

Building 12-94 blast walls are 4.6-m (15-ft) high, 76.2-cm thick (30-in. thick) laced reinforced concrete. The only blast-resistant walls are exterior ones. All interior partitions are of standard design.

The floor slab is 1.2-m thick (4-ft thick) reinforced concrete, smooth troweled and sealed with a clear penetrating hardener and sealer. In addition, the floor of the aging bay is covered by a seamless polyurethane floor cover.

The roof slabs are 91.4-cm (36-in.) laced reinforced concrete. The roof beams are one-way reinforced concrete members which are 1.5 m × 1.5 m (5 ft × 5 ft), with stirrups designed to carry shear loads. Interior columns of 232.3 cm² (36-in.²) provide support for the beam members.

The ramp wall, roof, and missile barrier on the south face were designed to withstand the worst-case fragment loads from an explosion in Building 12-94. The ramp walls are made of concrete blocks, reinforced on both faces, and fully grouted for containment. Because the roof and walls must contain the impact of a primary missile, they are 30.5-cm (12-in.) reinforced concrete structures.

Exterior doors in the ramp are 2.1 m × 2.4 m (7 ft × 8 ft) hollow metal doors. Tornado doors are at the east and south exits of the facility proper. An 2.4 m × 2.4 m (8 ft × 8 ft) rolling, manually operated tornado door and a pair of swinging hollow metal doors equipped with panic hardware are at the east entrance of the ramp. On the south face are a pair of swinging tornado doors. The height of the doors is 2.9 m (9½ ft) and the total width is 2.1 m × 2.1 m (7 ft 7 in.). These doors are not locked. They do not have exterior hardware and cannot be opened from the exterior.

The aging bay contains up to five environmental chambers, three glass vacuum systems (glass racks), a vent hood/laboratory bench, and a jib crane. The mechanical rooms house equipment skids, a battery pack for the uninterruptible power supply, and other equipment, such as the main switchboard, the motor control center, and the vacuum pumps. Control consoles for the five environmental chambers and a computer monitoring system are located in the control room.

3.1.3.4 *Building 12-60, Mass Properties Facility*

Building 12-60, the Mass Properties Facility, was constructed in 1969. It is a single-story 779 m^2 (8,600 ft^2) earth-covered facility located in the center of the MAA (Figure 3-2.). The building is used for performing mass properties operations. Its floor is a 15.2-cm thick (6-in. thick) reinforced concrete slab over a 15.2-cm thick (6-in. thick) course aggregate fill. The bay walls are 38.1-cm thick (15-in. thick) reinforced concrete. The roof is corrugated steel. The bays and main ramp in the building are overlain with a compact layer of earth. Prefabricated asphalt covers the structure.

The facility consists of six individual bays, four control booths, an office/computer room, an equipment room, and two restrooms. The bays are approximately 6.4 m × 7.6 m (21 ft × 25 ft)[21]. There are no fire doors, fire walls, fire dampers, fire vents, or HEPA filters associated with the facility. Each of the six bays has a set of blast doors, which are located at the bay entrance area nearest the main ramp. The bays are also equipped with resilient flooring, copper ground wire, a jib crane and air hoist, vacuum line, air handling units, fire protection and suppression systems, RAMS, tritium monitor, emergency lighting, and a lightning protection system. Four of the bays are not operational because of subsidence in the roof of the entrance hallway.

Operations in Building 12-60 ensure that tolerance specifications for various nuclear weapons, nuclear explosive like assemblies (NELAs), and subassemblies are met. The tolerance specifications are gauged using test equipment such as the dynamic balancer machine and the Center of Gravity/Moment of Inertia (CG/MOI) machines.

A dynamic balancer is located and anchored in one of two operational bays. The machine is used to determine the amount and location of imbalance for assemblies and other components. It is operated remotely using a key lock switch system in the control booth. An assembly is attached to the turntable of the machine using specific programmatic tooling and then rotated to a predetermined speed. Before the start of each test, the speed of the machine is adjusted for the specific assembly or component being tested, in accordance with the programmatic Operations and Inspection (O&I) Standard.

Operations performed using the dynamic balancer machine are considered National Electric Code (NEC) Hazard Class I. Testing from within a remotely located control booth is supervised for industrial safety reasons. Visual surveillance is maintained on the test subject via a camera positioned inside the bay and wired to the monitor in the Control Booth.

The dynamic balancer has two internal, calibrated sensors that shut the machine off if a preset overturning moment is detected or if a preset maximum force is reached. The dynamic balancer test results indicate the amount and location of imbalance in a nuclear explosive, NELA, or subassembly.

The building fail-safe system is composed of several interlocking and warning systems that ensure personnel safety. The bay containing the dynamic balancer machine is also equipped with a warning system that must be activated prior to beginning operation. The interlocking systems that are interfaced with the machine consist of the bay blast doors, an on/off switch located on the wall inside of the bay near the exit doors, and a key lock switch located in the control booth. Bay doors are interlocked to prevent the dynamic balancer from operating while doors are open. Warning lights and a horn installed on top of the building must be activated prior to beginning operations.

One bay within Building 12-60 contains the CG/MOI machines. Remote operations are conducted in this facility for industrial safety purposes. All machine motors are isolated from the main shaft through the aid of a polyvinyl chloride isolator which prevents electrical energy from reaching the test subject (i.e., nuclear for the interior working areas and the outside corridors.

Building 12-104A is constructed of noncombustible materials, except for the limited use of wood trims and forklift bumpers. The floors of the bays are covered with seamless urethane. The urethane is resistant to tearing by movement of equipment and by cart traffic. The seamless flooring material was selected for explosives safety reasons. It also facilitates cleanup of hazardous materials.

Most of the building is earth covered. The thickness of the earth cover over the bays varies depending on the desired venting characteristics of the bay ceiling. The earth cover is mounded for water drainage and covered with waterproofing material.

Building 12-104A was designed to provide protection against blast overpressures and fragments resulting from high explosive detonations occurring within Building 12-104A and from explosions occurring in Building 12-104 and neighboring buildings. The design precludes explosives propagation from bay to bay and prevents injury to personnel in occupied areas outside the bay of occurrence. Personnel in bays adjacent to an internal explosion are protected from structural collapse and from exposure to external blast pressures in excess of 10,547 kg/m^2 (15 psi), and from missiles with impact energies below 8 kg-m (58 ft-lb) originating outside the bay.

The three radiography bays are located along the north side of the building in bays 17, 19, and 23. The vacuum chamber, aging, and painting bays are aligned along the south side of the building in bays 18, 20, and 24.

Bay 19 has a ceiling height of 7.7 m (25 ft 4 in.) and floor dimensions of 9.8 m × 12.5 m (32 ft × 41 ft). Personnel passageways and blast doors provide access to the corridor outside the Linac Control Room. The doors are interlocked to prevent Linac operation when the interior doors are opened. The Bay 19 support areas provide space for remote control of the Linac and film processing, viewing, and storage.

The Linac generates a spectrum of penetrating X-rays during operation and requires radiation shielding. The unshielded radiation exposure rate in the central beam of the Linac is ~3000 rem/min. The concrete and sand-filled walls and roof of the bay provide sufficient shielding to reduce exposures from direct and scattered radiation in the Linac support areas and in the corridor. Shielding is sufficient to reduce exposures in these areas to less than 0.25 mr/hr when the Linac is in operation. The entrances to the bay are also designed to reduce radiation scatter. A supplemental 15.2-cm thick (6-in. thick) lead shield is incorporated in the wall between the Viewing Room and personnel passageway for Bay 19.

Like those for the Bay 19, the floor dimensions of Bay 17 are 9.8 × 12.5 meters. The designs of the passageways, Linac control areas, blast protection features, and radiation shielding for the Bay 17 are also similar to those for Bay 19. The thick concrete walls provide adequate shielding in all areas, so that supplemental lead shielding is not required. The radiation shielding provided for Bay 17 is as robust as that for Bay 19. Thus, the shielding in Bay 17 is also adequate for tomography operations.

The X-ray facilities have a ceiling height of 6.1 m (20 ft) and floor dimension of 8.5 m × 9.1 m (28 ft × 30 ft). X-ray bay support areas are provided to include space for X-ray film storage, an X-ray control console, and facilities for X-ray viewing. The Control Room door and the inner equipment passageway door are interlocked to prevent X-ray operation when the doors are opened.

The X-ray unit is equipped with interchangeable heads with energies of 160 kV and 420 kV. Radiation shielding is provided to limit radiation dose rates to less than 0.25 mrem/hr in all occupied areas in accordance with the ALARA

Building 12-94 is equipped with a fire protection/suppression system. Floor drains with connections to the sanitary sewer system are located in the mechanical rooms. The liquid effluents from the mechanical rooms are not monitored for hazardous materials.

The Weapon Aging Facility operations consist of exposing weapons and weapons components to variable temperatures for prolonged time periods established by the responsible weapons program design agency. The aging test process involves complete nuclear weapons, encapsulated high explosive core samples, and NELAs. The time periods for exposure vary from a few months to two years or more depending on the design agency specifications.

The weapons and weapons components tested in Building 12-94 may contain plutonium, tritium, uranium, and high explosives. The types of high explosives are determined by the weapons program. The maximum amount of high explosives in the facility is limited to 113.4 kg (250 lb), 147.6 kg equivalent (325 lb TNT equivalent). The maximum amount of plutonium in the facility is limited to 25 kg (55 lb). The testing procedure consists of placing the test specimen in a designated chamber, connecting a sampling device to the remote sampling system, and conditioning the chamber to the prescribed test temperature. The facility extracts gas samples from the test specimen internal atmosphere at the temperature specified for that sampling period and terminates the test after the prescribed test period.

The accelerated aging of a test specimen is achieved by subjecting it to temperatures above and below those it would normally endure during its normal lifetime. Periodic samples of the internal atmosphere are extracted and analyzed in the Gas Analysis Laboratory (Building 12-21) to monitor for chemical changes taking place within the specimen during the aging process. The internal atmosphere is monitored continuously for pressure variations, and atmosphere samples are extracted periodically to determine the moisture variation. Thermocouples are attached to the external surface of the specimen to continuously monitor the temperature for variations. Gas samples are extracted by the glass rack that uses mercury vacuum pumps. The entire gas sampling apparatus is isolated electrically from the weapon by a section of glass or ceramic line. All sampling components are mounted on a plastic base and electrically tested periodically to ensure their nonconductivity.

3.1.3.6 *Building 12-104A, Weapons Special Purpose Bay Replacement Complex*

Building 12-104A, the Weapons Special Purpose Bay Replacement Complex, is a new facility that is not scheduled to begin operations until sometime in late 1996 or early 1997. Operation of this facility will not close any other facilities at Pantex Plant. The building is part of the production area of Zone 12 and is located inside the MAA (Figure 3-2.). Building 12-104A contains eight bays including three radiography bays, a painting bay, an aging bay, a vacuum chamber bay, and two staging bays. This building also contains a break area and a number of supporting electrical and mechanical equipment rooms[23].

Building 12-104A is an addition to the west end of Building 12-104. A north-south corridor separates 12-104 from 12-104A. An enclosed ramp (Ramp 12-R-104) extends from the southeastern corner of 12-104A to provide access to the west end of the Building 12-84 add-on and to a loading dock between the buildings. The corridors around the periphery of Building 12-104A are connected to the Building 12-104 corridors.

Sand fill is used between the bays to provide blast isolation in the event of accidental detonation of high explosives. Blast doors and mazes allow entrance and exit from the bays, while providing containment of blast fragments and venting of blast pressures. The walls surrounding the three radiography bays also provide radiation shielding maximum of 170 kg (390 lb) of IHE may be present, either cased or uncased. Based on explosive safety considerations, restrictions are placed on the weapons or weapon assemblies that are in the bays. If these weapons or weapon assemblies contain HE or IHE, they may not be placed closer than 0.9 m (3 ft) to any reinforced concrete wall.

No main charge HE or IHE (not assembled) may be placed closer than 0.9 m (3 ft) to a outside concrete bay wall in the facility.

Criticality concerns apply to the fissile materials transported into the bays. Typically, weapon parts or assemblies that contain fissile materials are kept in a one-high array located on or attached to assembly fixtures. This configuration prevents fissile components from being pushed or rolled closer than 0.9 m (3 ft) center-to-center to another fissile component. Specific tests are reviewed individually, and approval of modified controls (e.g., configuration in other than one-high arrays) for certain programs is possible. In general, fissile material in shipping containers may be spaced closer than 0.9 m (3 ft) center-to-center. The operations conducted in the bays are under the purview of DOE Order 5610.11 "Nuclear Explosive Safety." Under this order, nuclear explosive safety studies are performed on each nuclear explosive system before operations on that system can begin.

The radiography bays support remote radiographic inspection and certification of explosive components, weapon components, and weapon assemblies. The bays contain radiography equipment, manipulator systems, turntables, real-time imaging systems, alignment lasers, and CCTV systems.

Process flow is similar in the three radiography bays. Components or assemblies to be tested are brought to a radiography bay in fixtures that can be used for radiography, or they are removed from their fixtures and placed in ones suitable for radiography work. The operator then positions the film with respect to the accelerator and component or assemblies to be tested and moves to the control room to make the radiographic exposure. The control room is isolated and shielded from the radiography bay so that exposure rates to personnel follow ALARA principles and do not exceed 0.25 mrem/hr. The operator, after making the radiographic exposure, develops the film in the process/service room, if necessary. After the film is developed, the operator views the film, makes the appropriate verifications of internal structure for the component of test assembly, and completes the forms to release it for further work by other departments.

12-104A is equipped with a computed tomography system used for generating computed tomography and digital radiography images of test assemblies. The system is capable of acquiring, analyzing, displaying, storing, and printing computed tomography and digital radiography data and images. The computed tomography mode of operation provides digital images of a cross-sectional slice of an object, while the digital radiography mode provides digital images of a radiograph of an object.

The weapons aging bay operations consist of exposing weapons or weapon components to variable temperature cycles for prolonged time periods to simulate long-term weapons stockpile-to-target environmental effects. The aging studies are performed using environmental chambers. Complete nuclear weapons, explosive core samples, weapons components, and NELAs may be tested. The time periods for testing may vary from a few months to 2 years or more, depending upon design agency specifications.

The weapons tested in the weapons aging bay may contain plutonium, uranium, beryllium, tritium, and explosives. Only explosives completely enclosed in metal containers are allowed inside the environmental chambers. The types of explosives are determined by the weapon program.

The test procedure consists of placing the unit into a designated chamber, connecting a sampling principles[4]. Supplemental lead shielding is used as required to reduce radiation streaming through shield wall penetrations.

The paint and abrasive blast operations are located on the southwest corner of Building 12-104A. All of the working areas have ceiling heights of 6.1 m (20 ft). Working space is provided for body work, abrasive blasting, painting, and drying.

Sand fill separates the adjoining bays from the paint/abrasive blast bay areas.

Each passageway contains inner and outer blast-resistant doors. The doors are interlocked so that only one passageway door can be open at a time. The equipment blast doors are double doors. A single blast-resistant "exit only" door provides egress into the building corridor.

The paint/abrasive blast bay supports weapons refinishing operations. Operations that occur in this facility are as follows:

- Hand sanding, cleaning, and minor body work (e.g., removing and installing screws, masking for painting)
- Sandblasting
- Painting
- Curing/drying of painted materials
- Tooling and supply storage.

The vacuum chamber bay and supporting areas provide space for the high vacuum system, gas analysis room, and a control room. The overall vacuum chamber bay floor dimensions are 19.2m × 9.8 m (63 ft × 32 ft) with the gas analysis room occupying 13.9 m² (~150 ft²) of that space. The high vacuum system occupies 9.4 m × 7.3 m (31 ft × 24 ft). The room's ceilings are 6.1 m (20 ft) high. Passageways contain inner and outer blast-resistant doors and are interlocked to prevent opening more than one door in a given passageway at a time.

The vacuum chamber bay has three vacuum chambers. Two chambers are 243.8 cm (96 in). in length with an inner diameter of 121.9 cm (48 in.). One chamber is 213.4 cm (84 in.) in length with an inner diameter of 91.4 cm (36 in.).

The two staging bays are identical and have ceiling heights of 6.1 m (20 ft) and floor dimensions of 8.5 m × 9.1 m (28 ft × 30 ft). The equipment passageways have floor dimensions of 25 ft × 33 ft. Personnel and equipment passageways provide access to staging bays. Passageways contain inner and outer blast-resistant doors that interlock to prevent opening more than one door in a given passageway at a time.

Support areas for Building 12-104A include a break area, electric and mechanical rooms, the fan rooms, corridors, ramps, and a loading dock. None of these support areas are designed to contain the effects of internal explosions.

The HVAC system supplies heated or cooled air to the building. All return and exhaust air is filtered by HEPA filters and 2-in.-thick UL Class II prefilters. Process air is also filtered for the staging bays. Positive pressures relative to ambient are maintained in the bays. Positive pressures with respect to adjacent areas are maintained in passageways for staging bays, chambers and pumps room, control room, vacuum pumps and cylinders room of the vacuum chamber bay, equipment rooms, and control room of the weapons aging bay.

The air handling units for the two staging bays contain dehumidifiers. A point exhaust system is also provided in each staging bay to remove nonradioactive hazardous fumes.

Solid wastes potentially consist of low level radioactive waste, mixed waste, hazardous chemicals, explosives from operations, and nonhazardous materials from offices. The wastes are collected and disposed of separately.

A maximum of 136.2 kg (300 lb) of HE (177.0 kg or 390 lb TNT-equivalent) may be in any bay in cased weapon form. Uncased HE is permitted only in the Bay 23 X-ray facility. No uncased HE is allowed in any bay if plutonium is present. A

These facilities are classified as "Regular" Nuclear Facilities. The facilities serve as an interim storage site for radioactive components resulting from the assembly and disassembly of nuclear weapons.

3.2.1.1 *Building 12-26, Pit Vault*

Building 12-26, the Pit Vault (PV), built in 1952, is used as a staging facility for pits. The pit vault, located in the southeastern portion of Zone 12 (Figure 3-2.) occupies about 41.8 m^2 (450 ft^2). The internal dimensions of the vault are 6.1 m × 5.8 m (20 ft × 19 ft), and it is 4.1 m (13½ ft) high[25].

The vault walls are 30.5 cm (12 in.) thick and are constructed of concrete reinforced with 1.2 cm (½-in.) steel bars. The vault roof and floor are constructed of 30.5-cm thick (12-in. thick), steel-reinforced concrete. The single entrance into the facility is approximately 2.1 m (7 ft) high and 1.3 m (4 ft 4 in.) wide. It is protected by three types of doors. A stainless steel security cage is attached to the exterior door frame. The security cage, along with a manually operated, combination lock vault door are open only when personnel are present in the vault. The steel vault door is rated for 4 hours against fire. Finally, an automatically closing rolling steel fire door is set immediately inside the doorway. This door, which is normally open, has a 3-hr fire rating. It closes automatically by fusible links set at 71°C (160°F).

The only utilities that serve the pit vault are electricity and compressed air. An alpha radiation monitor is the only safety-related detection and alarm system. Safety communications to and from the vault are provided by a public address speaker and telephone adjacent to the facility.

The maximum capacity of the vault is 152 pits. Pits staged in the vault may be shipped to other DOE sites upon request for reclamation, modification, or evaluation or transported to and from the staging magazines in Zone 4. While they are in the vault, pits are encapsulated in specially designed containers for staging and intraplant transport. These containers are not opened during the operations conducted within the vault.

As containers arrive at the vault, those that are being processed for shipment from the Plant site are monitored for radiological contamination and to assess dose rates for shipping. The resulting information, along with the type and serial number of each weapon component, is forwarded to the shipping department at the Plant. Radiation hazard labels are applied to the containers. Tamper Indicating Devices (TIDs) are replaced if they have been damaged during container transport. Containers are then arranged on the floor of the vault and on a single steel shelf that lines the side and back walls of the vault. Containers located on the floor are moved using a manual hand truck. Containers located on the shelf are placed into and retrieved from the vault one at a time, using a portable, pneumatic-powered lifting truck.

Other process-related activities that are performed in the vault include: documenting the arrival and departure of each pit with the Plant Control Center, replacing container TIDs that may have been damaged during transportation, and placing an address label on each container. Many of the operations in this facility will be transferred to Building 12-116 when it becomes available for operations.

3.2.1.2 *Building 12-42, North Vault*

The North Vault, is in Building 12-42. This building, in the southern portion of Zone 12 (Figure 3-2.) was built in 1959. The North Vault occupies about 61.3 m^2 (660 ft^2) of floor space and is used to stage RTGs. The interior dimensions of the vault are approximately 64 m × 8.8 m (21 ft × 29 ft), with an interior height of 2.7 m (9 ft). In the past, the vault has been used as a staging area for other types of nuclear device to the remote sampling system, performing a leak check of the system, configuring the chamber to the prescribed temperature program, obtaining prescribed gas samples of the unit internal atmosphere during the test, and terminating the test after the prescribed period.

The accelerated aging of a weapon is achieved by subjecting it to a unique temperature cycle specified by the responsible design agency. Periodic samples of the internal atmosphere are extracted and analyzed in the Gas Analysis Laboratory (Building 12-21) to monitor for moisture and any changes in the constituent gas concentrations. In addition, the weapon internal atmosphere is also monitored for changes in pressure. Thermocouples are attached to the external surface of the weapon to continuously monitor the temperature. The pressure monitoring equipment and sampling manifold are mounted on a plastic base and electrically tested at the beginning of the test to ensure isolation. Each conductor of a thermocouple is fused through a 1/100 amp fuse to isolate the weapon from a possible short in the monitoring system multiplexer. Gas samples are extracted using the sampling manifold and the glass vacuum system (glass rack) that uses a mercury transfer pump, standard burette, and a mercury manometer. The entire gas sampling system is electrically isolated from the weapon by either a glass line or a section of ceramicil in the sampling line.

Termination of the component or assembly test consists of extracting the bulk of its internal atmosphere into pre-evacuated containers and possible controlled fractionation of the remainder of the internal atmosphere. The unit is then backfilled with a prescribed fresh gas or gas mixture. After the test termination, all extraneous hardware is removed from the unit and the unit is transported to a designated disassembly area.

The vacuum chamber bay provides facilities for leak checking, volume determination, backfilling, and sampling assembled weapons and containers for weapons components. The vacuum chamber bay is equipped with a high vacuum system, which includes a three-chamber vacuum system, a three-station pumpdown manifold system, a four-station purge and backfill manifold system, and a computerized automatic control system.

The two staging bays serve primarily as places where weapons and weapon components can be temporarily staged to support other weapons testing operations.

3.2 NUCLEAR STAGING FACILITIES

The following sections describe the structural design and operations of nuclear staging facilities at Pantex Plant. These moderate hazard facilities are holding areas for nuclear explosives and components. Section 3.2.1 provides information on Zone 12 staging facilities which are limited to nuclear explosive components without the associated HE components. HE component staging is discussed in Section 3.3.3. Section 3.2.2 provides staging facility information for those facilities in Zone 4 that stage nuclear explosives and major nuclear explosive components.

3.2.1 Zone 12 Staging

The Zone 12 staging facilities discussed in this section include only those facilities that stage nuclear explosive components without the associated HE. These facilities include:

- Building 12-26, Pit Vault (Section 3.2.1.1)
- Building 12-42, North Vault (Section 3.2.1.2)
- Building 12-42, South Vault (Section 3.2.1.3)
- Building 12-44, Cell 8 (Section 3.2.1.4)
- Building 12-58, Bays 4 and 5 (Section 3.2.1.5)
- Building 12-116, SNM Component Staging Facility (Section 3.2.1.6).

These containers are made of heavy-gauge metal and are suitable for off-site shipment of RTGs. Many of the operations in this facility will be transferred to Building 12-116 when it becomes available for operations.

3.2.1.3 *Building 12-42, South Vault*

The South Vault, built in 1959, is used as a staging facility for tritium reservoirs. The South Vault is located in the southeast corner of Building 12-42, in the southern portion of Zone 12 (Figure 3-2.)[27]. The vault occupies about 61.3 m^2 (660 ft^2), has external dimensions of approximately 6.7 m × 9.1 m (22 ft × 30 ft), and is 3.1-m (10-ft) high.

The vault walls are 20.3-cm (8-in.) thick, and are constructed of concrete reinforced with steel bars. The vault roof is constructed of 20.3-cm (8-in.) thick, steel-reinforced concrete. The floor is 15.2-cm (6 in.) thick, steel-reinforced concrete. There is a single entrance into the vault about 2.0 m × 4.9 m (6 ft 8 in. × 4 ft) in size that is protected by three doors. First, a stainless steel security cage door is attached to a steel plate door frame. Second, the main vault door, is attached to the steel door frame. The steel vault door is rated for 4 hours against fire. Finally, a temperature-actuated, rolling steel fire door is mounted immediately inside the doorway. The rolling steel fire door is normally open and has a 3-hr fire rating. It closes automatically in response to internal or external fires by fusible links set at 71°C (160°F). While this door is not a thermal barrier, it does slow the spread of fire.

The South Vault is heated by a tube-fin steam radi-ator. The utilities serving the vault are electricity, compressed air, and normal ventilation. There is no emergency lighting inside the South Vault. The vault is equipped with an air conditioning system (evaporator unit only) and a filtered task exhaust system. The task exhaust system is used when shipping containers, filled with a potentially hazardous insulating material made of alumina silica ceramic fiber, are opened within the vault.

In addition to the electrical distribution system and normal ventilation system, the other safety-related service systems associated with the vault are a beta radiation (tritium) monitoring system and an internal fire protection system. The beta radiation mon-itoring system consists of an air sampling monitor, warning lights and alarms. The system is part of the Plant-wide RAMS. A red warning light and an alarm bell at the vault are actuated if the monitor detects at least 600 $\mu Ci/m^3$ of beta radiation.

The vault is protected by an automatic, wet-pipe sprinkler system. Water for the system is supplied by the Pantex Plant fire protection hydraulic system. The sprinkler system inside the vault consists of six sprinkler heads spaced evenly throughout the vault. Two public address speakers, one located outside the vault above the door and the other located inside the vault above the doorway, are used for paging personnel and for broadcasting plant announcements. The public address system provides plant-wide communication during impending or existing hazardous conditions including tornado warnings, and evacuation messages. A telephone located inside the vault can also be used to transmit safety communications. A hand held fire extinguisher is located 4.6 m (15 ft) from the vault.

Normal operations include receiving tritium reservoirs in shipping containers and intraplant transport containers, unpacking the containers, staging the reservoirs in drawers or in steel cabinets, and repackaging the reservoirs for shipment to other locations.

All movements of reservoirs at Pantex Plant are reported to, and coordinated with, the Plant Control Center. Shipping containers and reservoir transport cases delivered to the South Vault are immediately hand carried or moved into the facility using a hand truck. Containers are then inspected and are inventoried. Essentially, all explosive components (e.g., pits, ORO items, etc.)[26].

The walls of the vault are 20.3-cm thick (8-in. thick), steel-reinforced concrete. The steel reinforcing bars are set vertically and horizontally within the inner and outer faces of the walls to form two layers of reinforcement set 30.5 cm (12 in.) on-center each way. The vault floor is a 15.2 cm (6-in.-thick), steel-reinforced concrete slab. The roof of the vault is an 20.3-cm thick (8-in. thick) concrete slab reinforced on the top and bottom by steel bars. The roof is attached to the walls by 1.5 m (5 ft) anchors. The walls are attached to the floor with anchors in the northeast corner to the building foundation, and with anchors along the east wall.

A single 2.1 m × 1.2 m (7 ft × 4 ft) entrance into the vault is located in the south wall. The manually operated vault door is approximately 12.7 cm (5 in.) thick, and is rated for 4 hours against fire. An automatically closing, rolling steel fire door is set immediately inside the doorway. This door has a 3-hr fire rating. It automatically closes by three fusible links rated at 71°C (160°F). While this door is not a thermal barrier, it does slow the spread of fire. A stainless steel security cage is attached to the exterior vault door frame. Metal shelving within the vault supports DT-6M containers (heavy-gauge metal shipping containers) containing the RTGs.

Lighting and power for the air conditioning and security systems is electrical. Conditioned air is produced within the vault by a commercial heat exchanger and blower assembly that draws air from within the vault and expels air back into the vault. The condenser assembly for the air conditioning system is located outside the vault on the roof of the vault structure. Compressed air is available just outside the vault entrance, and is used to provide pneumatic power to the manually controlled lift.

The process steps involved in staging RTGs are (1) receiving, (2) inspecting, (3) documenting movement, (4) staging, (5) retrieving, (6) issuing, and (7) shipment. All of these activities are supported by on-the-job training, with the exception of inspecting and replacing TIDs.

Inspecting and replacing TIDs is taught through a formal training course.

RTGs are received from intraplant weapon assembly/disassembly operations and from shipments from off-site locations. RTGs are either issued to the assembly operations from the vault or transported to and from the long-term staging facilities in Zone 4. All RTGs are issued or received in DT-6M containers and only DT-6M containers are used for off-site shipment. The RTGs remain in the containers throughout all phases of the staging operations at the North Vault.

The arrival or departure of each RTG is documented with the Plant Control Center. The DT-6M containers in which the RTGs are staged are in-spected, along with their attached TIDs and asso-ciated material identification and movement docu-ments. If damaged, the container and/or TID is re-placed by production technical personnel. For those RTGs being shipped off-site, gamma radia-tion readings are taken and recorded to meet the monitoring requirements of the U.S. Department of Transportation. The containers are handled manually within the vault. The DT-6M containers may be handled using a portable, manually controlled, pneumatically powered lifting truck.

The location of the RTG within the staging area is determined on a space-available basis and workers are required to identify the proper RTG for issue by inspecting the affixed manifest that uniquely identifies each one. A periodic inventory of all RTGs in the North Vault is performed, consistent with the overall plant inventory requirements.

The DT-6M containers are set in position inside the vault on shelving. Each 37.9-L (10-gallon) capacity DT-6M container is about 38.1 cm (15 in.) in diameter and weighs about 22.7 kg (50 lb).

The personnel tunnel is 0.9 m × 2.6 m (3 ft × 8½ ft) high and is sealed at the inside corridor by a built-up steel revolving door. Approximately 4.6 m (15 ft) in front of the revolving door is a steel door which can restrict personnel access to Cell 8, if necessary.

Wire mesh gates with locks are installed across the passageway near the entrance to the round room. This arrangement prevents unauthorized or inadvertent entry to the round room.

A unique feature of Cell 8 is the staging and retrieval overhead polar gantry robot system in the round room. This system automates pit container placement, retrieval, and inventory.

Alpha monitors are located in Cell 8, and the associated warnings and alarms are displayed both locally and in the entry passageway. Fire protection for Cell 8 is provided by an automatic wet-pipe sprinkler system. The wet-pipe sprinkler system is provided with ordinary temperature-rated, closed-head, 1.3-cm (½-in.) nominal, standard sprinkler heads.

The HVAC system includes blowers, ducts, HEPA filters, and heating and cooling coils. The main components are located in the cell equipment room. An exhaust hood in one of the cubicles is integrated with the Cell 8 HVAC system and includes its own exhaust fan and HEPA filter. The HVAC system for Cell 8 pit staging has been modified to provide negative pressure in the round room.

Compressed air is supplied to the cell via an overhead line that passes above the steel blast doors. Cell 8 has a contaminated vacuum line that is used in conjunction with the alpha radiation monitors. One cubicle of the cell has an oxygen monitoring system. This system consists of an oxygen sensor wired to a control box and a monitor located on the corridor wall across from the cubicle.

Cell 8 is used as a staging facility for pits. Normal operations in this facility include receipt of the pits in sealed shipping containers, gamma spectroscopy of the containers, and the automatic placement and retrieval of the shipping containers into and out of the round room via a conveyor belt and a computer-operated overhead gantry robot. Some pit containers are opened to allow the pits to undergo various inspection, testing, and verification operations in the Cell 8 cubicles.

Pits in sealed shipping containers are delivered to Cell 8 by an electric forklift truck that carries four containers at a time on a metal pallet. Once inside the cell, containers are brought into a cubicle, and undergo gamma spectroscopy to determine the elemental composition and amount of nuclear material present in each pit. TIDs on the containers are inspected following gamma spectroscopy.

When gamma spectroscopy and the TID inspection are complete, most containers are moved to the round room for staging. Some containers are taken to a handling table along the south wall for weight and leak testing. For these tests, the shipping containers are opened and pits are handled manually. Weight tests, are tests performed on selected pits to verify that the weight of the pit is within a certain range. Leak tests are intended to detect any outgassing from the pit are performed in other cubicles.

Three levels of shelving in the round room are available to stage the pit containers. Physical and administrative controls exist for the proper handling and arrangement of pits and pit containers. Plant procedures and physical limitations restrict the number of pit containers that may be placed in various locations in Cell 8 at any time. They also limit the number of pits that can be outside their containers at any time.

The plutonium, uranium, and beryllium contained in pits are the principal hazardous materials found in Cell 8. These materials are in the form of finished, shaped metals that are enclosed in encapsulated, welded assemblies with outer surfaces that are composed of nonradioactive materials. Based on the administrative limits for plutonium in Cell 8, the maximum allowable activities in the South Vault are performed manually.

Most shipping containers are not opened; they are reissued to assembly or inspection facilities. Vault personnel wear latex gloves when handling the tritium reservoirs. However, when vault workers do open tritium containers, they wear Tyvek suits or other anti-contamination suits, respirators, and vinyl gloves to protect themselves from a potentially hazardous packing material inside the containers. Tritium reservoirs are placed in steel drawers in steel cabinets.

Additional tritium reservoirs may be staged in shipping containers on the floor near the south and east wall of the vault. There are administrative controls and plant procedures limiting the number of reservoirs that may be staged in the South Vault. Because tritium is not fissile or fissionable, criticality concerns do not govern staging quantities or geometry. The maximum allowed inventory that could be contained in the vault is 4,437 grams (8.9 lb). The vault also contains a very limited supply of explosive material including explosive-actuated squib valves which are attached to some reservoirs.

Tritium, deuterium, squib valves, and refractory ceramic fiber packing material are the hazardous (or potentially hazardous) materials present in the South Vault. Of these four, tritium, which is flammable as well as radioactive, is by far the most abundant hazardous material. Vault personnel wear dosimeters to monitor for radiation.

Some tritium reservoirs contain a small quantity of deuterium gas, a stable, flammable isotope of hydrogen. Finally, the refractory ceramic fiber used as packing material for the reservoir shipping containers is potentially carcinogenic. Vault personnel wear protective clothing and use a portable, filtered exhaust system to minimize their exposure to this material during packing/unpacking operations. Many of the operations in this facility will be transferred to Building 12-116 when it becomes available for operations.

3.2.1.4 *Building 12-44, Cell 8*

Building 12-44 Cell 8, built in 1971, is used as a staging area for nuclear weapon components. The facility is located in the Building 12-44 complex in the southern portion of Zone 12 (Figure 3-2.)[28]. The major areas of Cell 8 include five process cubicles, an equipment room, hallways and corridors, and a 10.4-m (34-ft) diameter circular room called the "round room." Up to 336 pits can be staged in the facility inside closed steel containers. Cell 8 could be renovated for use as an assembly/disassembly cell in the future. However, several critical safety systems including tritium continuous air monitors, smoke detectors, ventilation RAMS interlock, etc. would need to be installed to meet current standards.

Cell 8 is a "gravel gertie" structure and was originally built to house nuclear weapons assembly and disassembly operations. The walls of the structure are 30.5-cm to 45.7-cm (12-in. to 18-in.) thick and are reinforced with 1.3-cm (½-in.) steel bars. The Cell 8 roof consists of cable and wire-rope mesh, which supports a 5.8-m (19-ft) mound of gravel covered by a 7.6-cm (3-in.) thick layer of concrete. The floor of the facility is an 45.7-cm (18-in.) thick reinforced concrete slab. The round room is 10.4 m (34 ft) in diameter, with a maximum ceiling height of 4.6 m (15 ft). Two cubicles are approximately 3.4 m × 3.4 m (11 ft × 11 ft), three cubicles are approximately 2.1 m × 34 m (7 ft × 11 ft), and the equipment room is approximately 3.4 m × 4.6 m (11 ft × 15 ft). The ceiling height in the cubicles and equipment room is 2.6 m (8½ ft). The equipment passageway is 2.7-m (9-ft) wide and 2.6-m (8½-ft) high. There is a built-up steel door on either end of the passageway. The doors are designed to withstand the blast of the maximum high explosive detonation (550 lb TNT equivalent) in the cell. The doors are opened and closed manually.

Uranium and lithium deuteride in sealed ORO items within containers are the hazardous or potentially hazardous materials handled in the bays. That is, Bays 4 and 5, contain no main charge explosive material. Operations in Bays 4 and 5 will be transferred to Building 12-116 when this facility becomes operational. Building 12-58 Bays 4 and 5 will then be used for general equipment storage. Many of the operations in this facility will be transferred to Building 12-116 when it becomes available for operations.

3.2.1.6 *Building 12-116, SNM Component Staging Facility*

Building 12-116 is a two-story, reinforced-concrete building located in the southwest area of Zone 12 (Figure 3-2.). Building 12-116 is currently undergoing construction, and a final SAR is being written[30]. Operations in this facility will not begin until 1997. Operations in Building 12-116 may replace some or all of the operations in Building 12-26 Pit Vault, Building 12-26 bottle bay, Building 12-42 North and South Vaults, Building 12-44 Cell 8, Building 12-58 Bays 4 and 5, and Building 12-99 Bays 1 through 3. ORO component staging will be conducted in Building 12-116 until the AT-400A pit repackaging operation is moved into this building.

The design of Building 12-116 incorporates a main corridor running in the east-west direction. This corridor will serve as the primary path for both material and personnel flow through the building. Adjacent to, and on each side of the corridor are the component staging vaults, component processing areas, and support areas (i.e., the nondestructive testing bay, combustible materials staging bay). The first floor support areas include an administrative area, decontamination area, and mechanical and electrical rooms. The component staging vaults, radiography bay, weight/leak check bay, and crane bays extend upward to the full height of the building. The second floor has a main corridor running in the east-west direction above the remaining portions of the first floor. It houses various mechanical and electrical systems including the HVAC that support the facility.

The RF staging area is composed of four rooms on the first floor of Building 12-116. The ORO staging area has three rooms used for staging containerized ORO components. These components will be stored in Building 12-116 until the AT-400A pit repackaging operation is moved into these vaults. The SRO staging area consists of two rooms. SRO component staging activities will be performed in the SRO inspection bay.

Shipping containers are inserted into or withdrawn from the RF staging vaults using a container handling system. The container handling system is composed of a conveyor feed system, four staging/retrieval machines, and a computer inventory and control system. It is anticipated that use of this system will reduce radiological release/exposure potential.

Containers are transferred from the RF vaults to other plant areas on an "as needed" basis. Each shipment of pits that is received into or issued from the RF vaults is coordinated with the Plant Control Center using a secure telephone. Most containers are not removed from the RF vaults until they are discharged to other on-site or off-site locations. However, some types of pits are periodically removed and tested in other parts of the building.

Three vaults will be used for staging ORO components. No chemical or mechanical processing is conducted in these vaults. ORO components are weapons components, composed primarily of metallic uranium of various enrichments, and lithium deuteride. The containers they are in are manually inserted into or withdrawn from the ORO staging vaults. One of the three ORO staging vaults is equipped with shelves designed to hold up to 300 containerized ORO components. Small containers of components are manually placed on a scissors-lift platform. The platform elevates containers to the proper height for shelves in the vaults. The plutonium is 2,184 kg (4,816 lb) based on 336 "generic pits." Substantially smaller amounts of other hazardous materials are also present. In addition, gaseous nitrogen and a very limited supply of inspection related substances (e.g., cleaning solvents, alcohol) are present.

3.2.1.5 *Building 12-58, Bays 4 and 5*

Bays 4 and 5 of Building 12-58 were built in the early 1970s. They are located in the north end of Building 12-58, which is in the southern portion of Zone 12 (Figure 3-2.)[29]. Bays 4 and 5 are used exclusively for staging ORO weapon secondaries composed principally of uranium and lithium deuteride. No main charge explosive material is stored in these bays.

Bays 4 and 5 occupy approximately 148.6 m^2 (1,600 ft^2) within Building 12-58. Each bay is 12.2 m x 6.1 m (40 ft × 20 ft), and 3.0-m (9-ft 10½-in.) tall (interior dimensions). The bays are separated by 16 ft of earth fill and are earth-covered. Exterior to the bay entrance is a 12-ft ramp that is covered by a metal truss roof. Across the ramp from the entrances to Bays 4 and 5 is an equipment room that contains the utility and service systems for Bays 4 and 5.

The bay walls are 30.5-cm (12-in.) thick and constructed of steel-reinforced concrete. Near the entrance to each bay are penetrations for water, steam, electricity, ventilation, and the alarm system. The bay roofs are constructed of 4.3-m (14-ft) thick, steel-reinforced concrete. The roofs are covered with approximately 0.8-m (2½-ft) of earth overburden that is further covered with weatherproofing material. The bay floors are steel-reinforced concrete with a 7.6-cm (3-in.) diameter penetration for condensate to drain from the HVAC system.

The single entry into each bay has a double, steel, tornado-resistant doors, 2.4 m × 1.5 m (8 ft × 5 ft) and 7.6-cm (3-in.) thick. The doors are not designed as fire doors, and do not close automatically in the event of fires. The doors are open only when the bay is occupied.

The floor of the ramp in front of each bay is a 15.2-cm (6-in.) thick, steel-reinforced concrete slab. The ramp walls are constructed of 20.3-cm (8-in.) thick "Haydite" panels on steel-reinforced concrete footers. The ramp roof is mineral fiber form board covered with a poured gypsum deck and "built-up" roofing, which is composed of layers of fiberglass felt, asphalt, and gravel. A metal truss supports for the roof and also supports the utilities supplied to the area.

The utilities that serve the bays are electricity, steam, and water for the HVAC system. A wet-pipe fire protection system is the only safety-related detection and alarm system. Safety communications can be transmitted to and from the bays through a public address system or a telephone located in the ramp outside of the bays.

Operations in the bays include receiving, staging, and shipping ORO components and all associated record keeping activities. ORO items are not removed from their containers when they are staged in the bays. Essentially all activities in the bays are performed manually. ORO items and their shipping containers are placed on the bay floor. Personnel working in Building 12-58 are not required to wear protective clothing, but they do wear dosimeters.

Each shipment of ORO items received into or issued from Bays 4 and 5 is coordinated with the Plant Control Center. ORO items in their containers are delivered to the bays by an electric forklift truck. The TIDs on the containers are then inspected and replaced with Pantex TIDs. If a container arrives at Bays 4 and 5 with a broken or missing TID, the container is moved to an area such as an assembly bay, where opening the container is authorized. Following confirmation, a new Pantex TID is installed.

The staging capacity in the bays is limited. Administrative controls or plant procedures limit the number of ORO items that may be staged.

Small-scale batch chemical processing will take place in the film processing room and the dark room. Bulk quantities of chemicals will not be stored in the facility, except for solutions contained within the film processing equipment. A small, built-in storage vault is provided to store classified film generated by the radiography operation.

A room is provided to contain the Linac modulator. This room contains a power transformer, disconnects, tempered water cooling system, a floor drain, a communications system, electrical outlets, and spare parts cabinet. It is also equipped with a fire protection system.

The main structural penetrations to Building 12-116 are the vestibule doors. The vestibule doors are designed to meet tornado design loads, including tornado driven missiles, and overpressurization from a HE detonation in adjacent facilities. The vestibule itself extends west from Building 12-116 and connects to existing Ramp 12-R-84. This vestibule has two pairs of oversized, interlocking security vault doors and with dimensions of 3.0 m × 3.0 m (10 ft x 10 ft). The door and frame construction is steel, with an equivalent of UL 0.75-hr Class C fire rating. Another vestibule extends from Building 12-116 south, connecting to existing Ramp 12-R-79. This vestibule has two single vault doors and spans a doorway with dimensions of 1.2 m × 2.1 m (4 ft x 7 ft). The door and frame construction is steel, with an equivalent of UL 0.75-hr Class C fire rating.

A third vestibule exit is located at the east end of the main corridor of the Building 12-116. This vestibule has two single vault doors and a 1.2-m × 2.1-m (4-ft x 7-ft) doorway. The door and frame construction is steel. The inner door is designed with an equivalent of UL 1½-hr Class B fire rating. The outer door is designed with an equivalent of UL 0.75-hr Class C fire rating.

The structural shell surrounding the critical areas was designed to prevent structural collapse and will continue to act as a confinement structure during the design basis fire. Fire resistance of this shell is provided by the structural elements and not by a composite assembly. The fire resistance rating is not less than 2 hours. Penetrations in this shell incorporate, as a minimum, protection against design basis accident exposures.

Noncombustible and heat-resistant materials are used throughout the facility, particularly in locations vital to the functioning of confinement systems, to control of hazardous materials within the facility, and to maintain safety control functions. All interior finishes have a flame spread rating not exceeding 25 and a smoke development rating not exceeding 50.

All concrete partitions extend from the floor slab to the underside of roof. Floor and walls are finished with washable or strippable coverings. All cracks, crevices, and joints are filled and finished smooth. Corners are rounded and flooring extends a minimum of 15.2 cm (6 in.) up the wall, forming an integral base. Floors are built-up seamless urethane. Concrete walls and ceiling are sealed and painted.

The electrical system for Building 12-116 is composed of primary and secondary distribution systems, lighting systems (interior, exterior, and emergency), a lightning protection system, a grounding system (equipment and antistatic), and an uninterruptible power supply.

Water from the 10-in. high pressure fire loop north of the facility is used in the sprinkler system. A potable water service supplies both process and domestic water in the building. Plant air is provided for pneumatic-operated tools and dampers, and for pneumatic door seals. Plant steam supplies the heating requirements of the facility.

A RAMS continuously monitors operating areas for uranium or plutonium (alpha) and tritium (beta) radiation contamination. The systems are equipped with continuous air monitor sensors, and audible and visual alarms in the work areas, air locks, and adjacent corridors. Sensors located in remaining two ORO vaults are equipped with underhung bridge cranes designed to handle up to 100 larger, floor-staged component containers. Building 12-116 is designed to handle up to 400 ORO components. ORO component staging will be conducted in Building 12-116 until the AT-400A pit repackaging operation is moved into these vaults.

The SRO staging area is designed to receive and stage tritium reservoirs. Tritium reservoirs are small, metal bottles filled with tritium and/or deuterium gas under high pressure. The reservoirs are shipped to and from Pantex Plant in specially designed metal shipping containers. Intraplant shipment of tritium reservoirs uses special metal and wooden carrying cases called "Kennedy Kits". Both types of containers may be received at Building 12-116.

Newly filled reservoirs that have been shipped to Pantex Plant from the Savannah River Plant, as well as reservoirs that have been removed from disassembled weapons, are brought to Building 12-116 for staging. Off-site shipping containers and intraplant transport containers are delivered to Building 12-116 via electric fork truck. Once at the building, the containers are transferred to a hand truck for delivery to the SRO Packaging/Unpacking Room. The SRO Packaging/Unpacking Room is designed for packaging and unpackaging tritium reservoirs. However, some off-site shipping containers may never be opened, merely temporarily staged in the room and reissued to the final assembly cells. Approximately 50 containers may be present at any one time. After unpacking, the tritium reservoirs will be moved by hand to the SRO staging vault and placed into predesignated positions in cabinets or drawers or into wire baskets on open shelves. The empty shipping containers will be transferred to the In-Process Container Staging Room.

Newly filled tritium reservoirs are staged until needed for weapons assembly. Reservoirs in the vault that have been removed from disassembled weapons are shipped back to the Savannah River Plant, to other DOE sites, or are reused in weapons assembly operations. Some types of reservoirs removed from disassembled weapons will be processed through the SRO inspection bay. This bay will be used for the inspection, build-up, and tear-down of some reservoirs transferred between the SRO staging vault and the assembly/disassembly bays. If the SRO staging vault is full or unavailable, tritium reservoirs can be staged in the Building 12-42 South Vault.

When reservoirs are to be issued to the final assembly cells, they are retrieved manually from their staging locations and repackaged within intraplant transport containers.

Within Building 12-116, the radiography bay is designed for a combination 1 and 2 MeV Linac. The bay is equipped with a 2-ton capacity bridge crane and hoist, compressed air service, a process vacuum, radiation monitoring, electrical outlets, internal security system, fire protection, a communication system, CCTV, an HVAC system, and a Rad-Safe system.

The vestibule of the radiography bay will be used to temporary stage pit canisters delivered to the bay for processing or ready to be returned to the RF staging area. Doors to the vestibule will be interlocked with the Rad-Safe system to control personnel access during radiography operations.

A control room supports the radiography operation in the radiography bay. It contains a control console, cabinets, turntable controls, real-time system controls, counter space, CCTV monitors, the Rad-Safe controller, and warning devices/sensors associated with the Rad-Safe and the RAMS. The control room is equipped with electrical outlets, fire protection, and communication systems.

The film processing area in the radiography bay consists of a film processing room and a dark room. It is designed for day-lighting processing with provisions incorporated into the design for darkroom processing.

An exhaust hood is provided for possible acoustic testing. It and the accompanying acoustic test system are designed to provide a controlled test environment. Pits are removed from their containers and placed into the exhaust hood for "acoustic emissions" testing. Dye penetrant testing will be conducted on pits and occasionally ORO components at a separate workstation to determine if any surface defects are present. Components will be prepared for this test with a wipedown of alcohol to remove any material from their surfaces. After the test, they will be cleaned with acetone.

In the NDT bay, tritium reservoirs will be subjected to infrared testing. The test involves subjecting the reservoir to an infrared source to determine its percentage of fill. Following testing, the reservoirs will be repackaged and returned to their appropriate staging vault.

All solvents in the NDT bay will be kept in approved safety cans at all times. In addition, quantities are limited to the those necessary for daily operations. When not in use, these materials will be stored in an approved flammable liquid storage cabinet located in the Combustible Materials Staging Bay. Administrative controls, Plant standards, and Plant chemical control and tracking programs provide guidance and limitations for the materials stored in the combustible materials staging bay.

Tritium reservoirs will be inspected, tested, and assembled in the SRO inspection bay. This bay is partitioned into three rooms to segregate storage and testing activities. Explosive-actuated squib valves are attached and detached in the squib cut room within the SRO inspection bay. Other rooms associated with the SRO inspection bay include a vacuum pump room, a storage room, and an air lock.

With the SRO inspection bay, tritium reservoirs are moved by hand to the testing/inspection areas. Squib valves are removed from some reservoirs in the squib cut room, and the reservoirs are returned to the inspection bay. The empty shipping containers are transferred to the in-process container staging room. The following activities will occur in the SRO inspection bay:

- Mechanical disassembly and reassembly of tritium reservoirs. Squib cutting is the mechanical disassembly of squib valves from certain types of reservoirs.
- Reconfiguration of reservoirs into new design-agency approved configurations
- Electrical testing of components (such as continuity checks
- Reacceptance of valves and other components. "Reacceptance" means taking components off weapons removed from the stockpile, checking them for acceptability for service, and recycling them back into service.
- Reacceptance of other explosive components (e.g., Mound components)
- Helium leak-checking of O-ring seals after reservoir reassembly (This activity may be phased out).
- Cleaning and stenciling of items using acetone and alcohol.

After the inspection, tritium reservoirs and component assemblies are packaged and returned to the SRO staging area until they are issued to the final assembly cells.

Building 12-116 has a radiography bay with control room, vestibule, and associated film processing room, dark room, and storage vault. Pits will be radiographed in the radiography bay utilizing a combination 1 to 2 MeV Linac X-ray system. The purpose of this activity is to detect anomalies in pit structure (e.g., cracks). Radiographic film is developed in the film processing and dark rooms. The Non-Destructive Evaluation Group operates this area.

each bay detect abnormal levels of airborne alpha and beta radiation. The separate detection systems are integrated into the existing Plant RAMS.

The RAMS is interlocked with the building air handling units, including exhaust systems, to provide coverage for all HVAC zones where radio-active contamination could reasonably occur. In the event of an alpha alarm within a HVAC zone, the air handling units and associated equipment will shut down. In the event of a beta alarm, the air handling unit will provide additional building venting capability. The RAMS has an override (bypass) condition for the door interlock systems. The override allows both interlocked doors of an entrance path to be opened simultaneously for unencumbered escape by personnel.

Selected pits will be inspected prior to staging or issuance within the Plant. Inspections are conducted to verify pit weight and conduct leak tests of pits to ensure their integrity. Inspection

may be performed when components are first received at the building, after the safeguards verification activities are complete. They may also be performed periodically after the components have been staged. Weight/Leak Check activities are conducted under the management of the Gas Lab.

Weight/leak check activities will be performed at an Automated Material Handling System workstation. The workstation comprises an industrial robot with interchangeable end-of-arm tooling; two vacuum chambers, each equipped with a residual gas analyzer; a control computer with isolated control console; a conveyor system; and a shuttle table.

Prior to transferring pits to the workstation, the surface of the pit will be wiped by an operator who monitors for radioactive contamination. If surface contamination on a pit is detected, all operations are suspended and the Radiation Safety Department is immediately notified. If no surface contamination is detected, the operator wipes the pit with acetone or isopropanol to remove any paint, tape, or surface dirt. The operator may also perform other mechanical disassemblies such as pit tube clamp removal, as necessary, before the operator instructs the robot to pick up the pit and transport it to the workstation.

At the workstation, the pit is weighed. Following weighing, the pit is removed by the robot and transferred to one of two evacuation (leak test) stations. Each leak test station is equipped with a vacuum chamber (bell jar), with accompanying monitoring and computer control equipment. The leak test is performed by a computer-controlled leak test machine. Monitoring equipment detects any outgassing from the pit, and the results are recorded by the computer.

When weighing and leak testing are complete, the pit is returned to the shuttle table, its metal protective device is re-attached, and the entire assembly is returned to the proper canister at the assemble/disassemble position.

Selected pits and reservoirs may periodically be sent to the nondestructive testing (NDT) bay to be tested. There, the pits and tritium reservoirs may be subjected to acoustic emissions testing and dye penetrant testing. Quad-pallets are moved to the NDT Bay using a pallet truck. SRO containers are moved to the NDT bay by hand or by using a manual lifting truck. ORO components may occasionally be sent to the NDT bay for dye penetrant testing, but these tests are expected to be uncommon. NDT activities are conducted under the management of the Non-Destructive Evaluation Department.

No more than two pits or two tritium reservoirs may be out of their containers at any given time in the NDT bay. Components awaiting testing during a shift will temporarily be staged in their containers. As many as four pits or four tritium reservoirs may be present in the bay at any time.

expected at the facility. New bar code labels are made for containers newly received from other DOE sites.

When the bar code activities are complete, most containers will be moved directly to the appropriate vault for staging. However, some RF or ORO component containers will be randomly selected to be sent to the safeguards verification bay.

3.2.2 Zone 4 Staging

The Modified-Richmond (MR) and Steel Arch Construction (SAC) magazines are used as staging or interim storage facilities for nuclear explosives and major nuclear explosive components. Because the magazines contain more than the DOE-STD-1027 Category 3 thresholds for radioactive material, they are classified as nuclear facilities. Five types of items may be housed in these magazines: (1) nuclear explosive assemblies, (2) pits, (3) ORO components, (4) RTGs, and (5) NELAs[31,32].

The magazines are located in the western portion of Zone 4, which is at approximately the center of the Plant site (Figure 3-4.). Eighteen MR magazines (4-19, 4-21, 4-25, 4-30 through 4-44) and 42 SAC magazines (4-101 through 4-142) are in the MAA of Zone 4. These facilities are considered nonreactor nuclear facilities.

The magazines are not equipped with radiation monitoring systems, fire protection systems, comm-unication systems, heating, or forced-ventilation systems. However, portable fire extinguishers are stationed outside each Modified Richmond and SAC magazine on poles in Zone 4 and two of the Modified Richmond magazines are equipped with cooling systems. More magazines may be provided with cooling systems in the future[33].

Each MR magazine consists of a concrete, box-like structure covered with at least 0.9 m (3 ft) of earth overburden. The gross, exterior dimensions of a magazine (including overburden and protecting walls) are approximately 15.2 m × 22.9 m (50 ft × 75 ft), and are 4.7-m (15½-ft) high. Each magazine is divided into two identical staging or interim storage areas that are separated by a 0.3-m (1-ft) thick, steel reinforced concrete wall. The approximate internal dimensions of each side are 3.8 m × 12.2 m (12½ ft × 40 ft), and 2.9-m (9½-ft) high. All of the magazines are oriented so that their doors face east. Table 3.2.2-1. provides a comparison between the Modified Richmond Magazines in the MAA of Zone 4 and the Richmond Magazines located in Zone 4 East.

The side and back walls of each magazine are constructed of nonreinforced concrete, 1.2-m (4-ft) thick at the base, tapering to 20.3-cm (8-in.) thick at the roof line. The magazine roof is a 0.3-m (1-ft) thick, steel-reinforced concrete slab, covered by a minimum of 0.9 m (3 ft) of earth overburden. The magazine floor is a 12.7-cm (5-in.) thick, nonreinforced concrete slab. The front wall of the magazine is 20.3-cm (8-in.) thick and is constructed of steel-reinforced concrete. Inside the magazine, a 0.3-m (1-ft) thick, steel-reinforced concrete wall divides the structure into two distinct staging areas. This dividing wall extends the entire length and height of the magazine.

The entrance to either side of the magazine consists of 2.5-cm (1-in.) thick, steel plate double doors, approximately 2.5 m × 3.2 m (8 ft 4 in. × 10 ft 4 in.) In front of each door are two-piece, steel-reinforced concrete barriers measuring 3.0 m × 3.8 m (10 ft × 12½ ft). Each barrier is 1.2-m (4-ft) thick at its base and tapers to 0.6-m (2-ft) thick at the top. To gain access to the magazine doors, a forklift/tractor is required to remove each barrier. These barriers are in place at all times except during access operations.

The only utility system that serves the magazines is electricity, which is used for security-related purposes and cooling. Other than these loads, no electrical loads are associated with the magazines. Natural circulation through the structure is provided by a 35.6 cm (14-in.) diameter steel pipe

ORO components may occasionally require radiography. This is a fairly routine occurrence in the sense that the procedures for conducting this activity are well-established. However, radiography of ORO components will not be a "common" (i.e., daily or weekly) activity in the radiography bay. ORO components will not normally be present in this area.

Selected pits will be sent to the radiography bay to be radiographed. This occurs periodically after the components have been staged in the RF staging area. Quad-pallets are moved to the radiography vestibule using a pallet truck. The number of canisters normally staged in this area for testing depends upon the type of radiography to be done. Two quad-pallets may be present in the radiography bay at a time. Six canisters, containing one (1) pit each, can be radiographed simultaneously in the panoramic mode, while direct mode radiography is conducted one pit at a time. Pits will be manually removed from their canisters by workers using pneumatic impact wrenches. Wearing lead aprons, the workers manually move each pit to a position to be radiographed. Radiography is conducted through the pit canister in certain circumstances where the integrity of the pit is in question.

When radiographic activities are complete, the operators will enter the bay and return the pits to their canisters on the proper slave pallet on the quad-pallet. Quad-pallets will be removed from the bay by manual lift truck and temporarily staged in the vestibule for return to the RF staging area.

The radiography system is interlocked with the fire detection and alarm system. The ventilation system for the entire radiography area is provided with duct-mounted smoke detectors. The radiography system also interfaces with the RAMS and will perform an orderly shut-down of the system and area ventilation on receipt of an alpha radiation alarm. On receipt of a beta radiation alarm, the radiography system is shut down and emergency tritium exhaust interlock is engaged. Failure of an interlock check prevents operation of the radiography and Linac machines. CCTV cameras are also provided for visual observation of the radiography bay.

Pits and ORO components are subjected to inspections in the safeguards verification (radiometry) bay. The safeguards verification bay is designed to conduct examinations of TIDs and gamma-ray spectrographic analysis of container contents to verify the presence, quantity, and type of fissile material. Selected pits and ORO components are periodically sent to the safeguards verification bay to be tested after the components have been staged. A radiometric inspection system is used for the spectrographic analysis of container contents. The containers will normally remain sealed during this activity. The area surrounding the table and spectrometer is provided with shielding to block out background radiation.

The TIDs on the containers are then inspected, and the TIDs newly received from other DOE sites are replaced with Pantex TIDs. If a container arrives at the bay with a broken TID, the container is opened to verify the serial number of the component with the Plant Control Center.

When gamma spectroscopy and TID inspection and replacement are complete, most containers are moved directly to the appropriate vault for staging. However, some RF component containers are brought to the weight/leak check bay so that the pits can be removed from their containers for weighing and leak testing.

The bar code room is designed to support bar coding activities for all SNM components staged in the facility. The room contains one large page printer, two label-maker printers, one office CRT, and an off-load station.

All SNM component containers will be sent to the bar code room upon arrival at Building 12-116. The containers with existing bar code labels are scanned with portable bar code readers so that they can be compared against manifests of components in the ceiling of each magazine side and small vents in the east (front) wall located at ground level on either side of each magazine door. The only service system (aside from security-related and cooling service systems) is a lightning protection system installed throughout each magazine.

SAC magazines consists of a 4.0 m (13 ft) steel arch structure covered by at least 0.9 m (3 ft) of earth overburden. The approximate internal dimensions of the magazine are 7.6 m × 12.5 m (25 ft × 41 ft) (at the base), and a maximum of 4.4-m (14-ft 4-in.) high (at the top of the steel arch). The 4.0-m (13-ft) radius steel arch rests on concrete stem walls that extend from below grade to slightly above ground level. The magazine floor is a 15.2-cm (6-in.) thick, steel-reinforced concrete slab that rests upon 15.2 cm (6 in.) of coarse aggregate fill. The SAC magazines are arranged in groups of three or five throughout Zone 4. The gross, exterior dimensions (including overburden and front barriers) of both magazine configurations are 24.4-m (80-ft) deep and 5.3-m (17-ft 4-in.) high. However, the three-magazine complexes are 65.5-m (215-ft) wide and the 5-magazine complexes are 103.6-m (340-ft) wide. All of the magazines are oriented so that their doors face east. The side walls of the SAC magazine are curb-like and are part of the stem wall of the structure. These steel-reinforced concrete walls measure 0.4-m (1-ft 4-in.) thick and extend 0.8 m (2½ ft) below grade to the magazine foundation. Within the magazine, these curb side walls measure 0.4-m (1-ft 4-in.) high and provide a base onto which the steel arch is fastened.

The front wall is 0.3-m (1-ft) thick and is constructed of steel-reinforced concrete. This wall extends to the top of the structure and spans the width of the magazine. This wall rests on top of a steel-reinforced concrete stem wall, 0.35-m (1½-ft) thick, that extends 1.0 m (3½ ft) below grade.

Extending along the front wall of the SAC magazine are "connecting walls" that join the individual magazines in three and five magazine complexes. These walls, along with the front wall of each individual magazine, form a continuous concrete face for each complex. At either end of a complex, the connecting walls are tapered in height away from the magazine front wall. Depending on the distance from the front wall, the thickness of these steel-reinforced walls varies from 0.5 m (1 ft 8 in.) to 0.3 m (1 ft).

The back wall is 0.3-m (1-ft) thick and is constructed of concrete reinforced with steel bars. This wall extends to the top of the structure and spans the width of the magazine. The wall also rests on top of a steel-reinforced concrete stem wall, 0.35-m (1½-ft) thick, that extends 1.0 m (3½ ft) below grade.

The entrance to the SAC magazine consists of insulated, steel-plate double doors, approximately 2.4 m × 3.0 m (8 ft × 10 ft). In front of the doors is a two-piece, steel-reinforced concrete barrier measuring 3.1-m (10-ft) high and 3.8-m (12½-ft) wide. Each barrier is 1.2-m (4-ft) thick at its base and tapers to 0.6-m (2-ft) thick at the top. To gain access to the magazine doors, a forklift/tractor is required to remove each barrier. There are also headwall barriers placed on either side of the door barriers to protect the front wall of some magazines. The one-piece, steel-reinforced concrete headwall barriers are 3.4 m × 2.1 m (11 ft × 7 ft), and are 0.9-m (3-ft) thick at the base, tapering to 20.3-cm (8-in.) thick at the top. These headwall barriers remain in place under all normal operating conditions.

The only utility system serving the SAC magazines is electricity, which is used for security-related purposes. No other electrical loads are associated with the magazines. Natural circulation through the structure is provided by a 45.7-cm (18-in.) diameter steel pipe in each magazine ceiling and small vents in the east (front) wall located at ground level on either side of the door. The only service system (aside from security-related service systems) is a lightning protection system installed throughout each magazine.

TABLE 3.2.2-1.—*Comparison of Richmond Magazines and Modified Richmond Magazines*

Richmond Magazine	Modified Richmond Magazine
No earth overburden	0.9 m (3 ft) earth overburden
No concrete divider, one large room	Concrete divider
Roll-up door	Steel door
No security alarms	Security door alarms
No shielding blast rock	Shielding blast rock
Wood roof	Concrete roof

quantity-distance controls, electrical and lightning protection, ventilation and collection systems, vacuum and electrical equipment guidelines, and contamination controls are utilized to the maximum extent practicable.

Many of the facilities described in this Section discuss the National Electrical Code classification for hazardous locations[35]. Class I facilities are those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures. Class II locations are those that are hazardous because of the presence of combustible dust. Class III locations are those that are hazardous because of the presence of easily ignitible fibers or particulate, but in which such fibers or particulate are not likely to be in suspension in the air in quantities sufficient to produce ignitible mixtures. Table 3.3-1. provides definitions of the Divisions within each classification.The level of personnel protection required for any specific explosives activity is based on the explosives hazard class (accident potential) for the explosives activity involved. The four hazard classes are defined in Table 3.3-2.

The following sections describe the structural design and operations for explosive facilities at Pantex Plant. These facilities are primarily for development, manufacturing, staging, and testing facilities that handle explosives and explosive components. They include:

- Development (Section 3.3.1)
- Manufacturing (Section 3.3.2)
- Staging (Section 3.3.3)
- Testing and Evaluation (Section 3.3.4)
- Disposal (Section 3.3.5).

The facilities discussed in these sections are all non-nuclear facilities.

3.3.1 Development

This section discusses the structural design and operations that involve the development of HE compounds. These facilities include:

- Building 11-17, High Explosives and Test Facility (Section 3.3.1.1)
- Building 11-38, High Explosives Development Bays (Section 3.3.1.2)
- Building 11-51, Weapons Material Analytical Laboratory (Section 3.3.1.3)
- Building 11-55, High Explosives Synthesis Facility (Section 3.3.1.4)
- Building 12-8, Analytical Chemistry Laboratory Annex (Section 3.3.1.5)
- Building 12-19 East, High Explosives Formulation Facility (Section 3.3.1.6)
- Building 12-19 West, Materials Compatibility Laboratory (Section 3.3.1.7)
- Building 12-59, Analytical Chemistry Laboratory (Section 3.3.1.8)
- Building 12-62, PETN Processing Facility (Section 3.3.1.9)
- Building 11-36, High Explosives Synthesis Facility (Section 3.3.1.10).

3.3.1.1 *Building 11-17, High Explosives and Test Facility*

Building 11-17 is the High Explosives and Test Facility. It is a one-story, moderate hazard facility originally built during World War II and upgraded in the 1960s for laboratory use[36]. Building 11-17 is located in the central portion of Zone 11 (Figure 3-1.) and is scheduled for demolition in 2001.

The exterior walls are brick and hollow clay tile. Room partitions are gypsum board on wood studs and cemesto board on steel framing. The walls of the bays are concrete.

Building 11-17 is equipped with an explosives storage bay. The bay walls are concrete, and the floor is seamless urethane. Functional areas

Normal operations include receiving, staging or interim storage, retrieving, and issuing of nuclear explosive assemblies and containerized nuclear explosive components into and out of either type of magazine. DOE Courier activities are conducted at these facilities. The Courier activities are discussed in Chapter 5.0 of the Programmatic Information Document. Additionally, inspection, inventory, and recordkeeping activities are performed periodically. No process-related operations are conducted. As such, no waste streams are generated as a result of the operations performed there.

Nuclear explosive component containers are never opened, and only some nuclear explosive assembly containers may be opened (simply to perform minor shipping/receiving inspections). All items placed into and retrieved from the magazines are transferred either manually or with the aid of electric forklifts. Within the magazines, items may also be moved using small, manually operated lifting trucks. Most nuclear explosive assemblies and weapon components are staged or stored for an interim period in compartmentalized and noncompartmentalized magazines.

Pit containers are currently brought into magazines on "pit pallets." Containerized pits are horizontally stacked no more than six high, in steel pallets, with four or six containers to a pallet. In the past, an electric forklift with radiation shielding has been used for the storage, retrieval, and inventory operations for palletized stacking configurations or individual container handling. The forklift was equipped with a lateral motion, turret for assembly that allows the palletized pit containers to be stacked and retrieved without turning the forklift. A passive guidance system (e.g., rail guides, wire guides, etc.) prevented the forklift from veering from the aisle. An automated guided vehicle (AGV) has recently been developed for use in 1996 to replace the shielded forklift. This vehicle may be used to place and inventory the pits in each magazine. The use of the AGV is an improvement modification to the Stage Right operations in Zone 4. While the AGV will replace the shielded vehicle as the primary vehicle in Stage Right operations, the shielded forklift capabilities will be retained for backup.

Plutonium (several isotopes), uranium (several isotopes and levels of enrichment), tritium, beryllium, lithium deuteride, and high explosives are the principal types of hazardous materials that could be located in the magazines. No uncased high explosives are located in these magazines. All materials are contained within finished, sealed assemblies, steel drums, or wooden and steel boxes. Significantly smaller quantities of other hazardous materials associated with nuclear explosive assemblies and components (e.g., epoxies, heavy metals, encapsulant materials) are also present. The quantity of hazardous material present throughout the magazines can vary significantly depending on the level of activity at the plant and the current mix of nuclear explosive assemblies and components.

3.3 EXPLOSIVE PROCESSING FACILITIES

The explosive processing facilities are predominately located in Zone 11. Each facility may conduct operations with HE, IHE, or both. The safety significance of the materials handled in each facility is based upon which material is handled. HE is a chemical compound and mechanical mixture that, when subjected to heat, impact, friction, shock or other suitable initiation stimulus, undergoes a very rapid chemical change, releasing energy in the form of large volumes of heated gases. IHE are high explosives that, although mass detonating, are so insensitive that there is negligible probability of accidental initiation or transition from burning to detonation.

The explosive processing facilities and operations at Pantex Plant are designed to conform to the requirements of the DOE Explosives Safety Manual[34], DOD guidelines, and other Federal and industrial standards. Operational guidelines, remote operations, explosives area controls,

TABLE 3.3-2.—*Explosives Hazards Classes as Defined in the DOE Explosives Safety Manual*

Explosive Hazards Class	Description
Explosives Hazards Class I	Class I consists of those explosives activities involving a high accident potential; any personnel exposure is unacceptable for Class I activities, and they thus require remote operations. In general, Class I would include activities where energies that may interface with the explosives are approaching the upper safety limits, or the loss of control of the interfacing energy is likely to exceed the safety limits for the explosives involved. This category includes those research and development activities where the safety implications have not been fully characterized. Examples of Class I activities are screening, blending, pressing, extrusion, drilling of holes, dry machining, machining explosives and metal in combination, new explosives development and processes, and explosives disposal.
Explosives Hazards Class II	Class II consists of those explosives activities that involve a moderate accident potential because of the explosives type, the condition of the explosives, or the nature of the operations involved. This category consists of activities where the accident potential is greater than for Class III, but the exposure of personnel performing contact operations is acceptable. Class II includes activities where the energies that do or may interface with the explosives are normally well within the safety boundaries for the explosives involved, but where the loss of control of these energies might approach the safety limits of the explosives. Examples of Class II activities are weighing, some wet machining, assembly and disassembly, and environmental testing.
Explosives Hazards Class III	Class III consists of those explosives activities that represent a low accident potential. Class III includes explosives activities during storage and operations incidental to storage or removal from storage.
Explosives Hazards Class IV	Class IV consists of those explosives activities with IHE or IHE subassemblies. Although mass detonating, this explosive type is so insensitive that a negligible probability exists for accidental initiation or transition from burning to detonation. IHE explosions will be limited to pressure ruptures of containers heated in a fire. Although the fire hazards of IHE or IHE subassemblies are not as great as those of other explosives, they are classified as Hazard Class/Division 1.3 (mass fire) to be consistent with DOD 6055.9 STD[5]. Most processing and storage activities with IHE and IHE subassemblies are Class IV except Class I activities such as pressing, some machining, dry blending, dry milling, and dry screening.

TABLE 3.3-1.—*Hazardous Locations Classifications*

Class	Division	Definition
Class I	Division I	• Ignitible concentrations of flammable gases or vapors can exist under normal operating conditions. • Ignitible concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage. • Breakdown or faulty operation of equipment or processes might release ignitible concentrations of flammable gases or vapors, and might also cause simultaneous failure of electric equipment.
	Division II	• Volatile flammable liquids or flammable gases are handled, processed, or used, but in which the liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment. • Ignitible concentrations of gases or vapors are normally prevented by positive mechanical ventilation, and which might become hazardous through failure or abnormal operation of the ventilating equipment. • Adjacent to a Class I, Division I location, and to which ignitible concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided.
Class II	Division I	• Combustible dust is in the air under normal operating conditions in quantities sufficient to produce explosive or ignitible mixtures. • Mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitible mixtures to be produced, and might also provide a source of ignition through simultaneous failure of electric equipment, operation of protection devices, or from other causes. • Combustible dusts of an electrically conductive nature may be present in hazardous quantities.
	Division II	Combustible dust is not normally in the air in quantities sufficient to produce explosive or ignitible mixtures, and dust accumulations are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus, but combustible dust may be in suspension in the air as a result of infrequent malfunctioning of handling or processing equipment and where combustible dust accumulations on, in, or in the vicinity- of the electrical equipment may be sufficient to interfere with the safe dissipation of heat from electrical equipment or may be ignitible by abnormal operation failure of electrical equipment.
Class III	Division I	Easily ignitible fibers or materials producing combustible particulate (flyings) are handled, manufactured, or used.
	Division II	Easily ignitible fibers are stored or handled.

inside dimensions of the rooms are 4.5 m × 7.6 m (14 ft 10 in. × 25 ft), 4.5 m × 7.2 m (14 ft 10 in. × 23 ft 8 in.), and 4.5 m × 7.7 m (14 ft 10 in × 25 ft 4 in.) An equipment shed on the south side of the bay has been added to house an air compressor related to the gas gun, for noise reduction in the bay.

The gas impact gun in Bay 1 is designed to provide a velocity of 1,600 m/s (5,250 ft/sec) with a 454 g (1 lb) projectile, using gas as a propellant in a double diaphragm breech and a 13.5-m (44-ft) long, 10.2-cm (4-in.) bore barrel. The gun system is completely enclosed, providing acceleration, target impact, and deceleration of components within the enclosed system. The maximum weight of the HE specimen to be propelled from the gun or affixed to the target holder is 15 grams (0.5 oz).

A high pressure gas system provides gas (helium or nitrogen) from 0 to 4.2 x 10^6 kg/m² (0 to 6,000 psi) to the breech. The gas is stored in one to six standard bottles, connected to the system through individual remote valves.

Three separate and independent vacuum systems are provided on the gun; one each for the target chamber, catch tank, and breech. The target chamber and catch tank vacuum systems each have two in-line 10 micron filters to provide safety in an explosive environment. The breech vacuum system has no filter.

An interlock system was designed to assist the operating personnel to prepare the gun properly. The interlock system consists of three separate sections which are called "pressure," "operation," and "safety." The conditions of the pressure interlock must be satisfied before the breech chambers can be pressurized. The operation interlock prevents the operation of the fire switch when there is low pressure in the breech chambers and instrumentation switches are not closed. The safety interlock opens the breech high pressure vent when there is a loss of breech, target chamber, or catch tank vacuums or when any door to the gun room has been opened.

One bay has been modified to allow installation of two 454 g (1 lb) HE firing tanks with laser holes (steel tubes with steel doors) for the use of the laser into the two tanks in the other bay.

Bay 2 is utilized to test fire small components in order to evaluate the detonations and velocities of the components. The test fires are conducted in test fire chambers. Personnel control the tests from the control room, which houses the control panel and the electronic diagnostic equipment.

Bay 3 houses the high explosive sample dissolution process for liquid scintillation detection of tritium contamination.

The maximum HE limit for Bay 1 is 60 g (2 oz), Bay 2 is 454 g (1.0 lb) and 5.4 kg (12 lb) for Bay 3 when the projectile impact system is in operation. The HE is subdivided into smaller quantities so that in the event of an HE explosion, only one of the smaller quantities would be involved.

3.3.1.3 *Building 11-51, Weapons Material Analytical Laboratory*

Building 11-51 is a moderate hazard facility located in the southern portion of Zone 11 (Figure 3-1.). Building 11-51 is a single-story structure, and consists of 14 lab rooms, HE staging bays, restrooms, storage areas, an equipment room, and office space. A concrete slab was constructed to connect the facility to an existing ramp. All facilities are located at ground level. The building square footage (including the ramp) is 1,228 m² (13,215 ft²)[40].

Exterior walls are fabricated from 15.2 cm (6 in.) precast concrete panels with 3-in. rigid insulation on the inside face. The interior of the insulation is faced with 1.6 cm (5/8 in.) gypsum board full height. The roof is a Factory Mutual Class I insulated metal roof-deck assembly. The floor is concrete with a seamless urethane flooring (except rooms 106 & 125) and base in all laboratories, within the facility consist of a storage bay, laboratory bays, two mechanical rooms, and corridor spaces. The laboratory bays contain steam-heated vacuum ovens, vent hoods, safety hoods, evaluation instruments, and equipment used to support general laboratory operations.

The facility is equipped with an automatic wet-pipe sprinkler system. The available water supply at the existing main has a static pressure of 38,671 kg/m² (55 psi) and a residual pressure of 25,312 kg/m² (36 psi) with a 140.7 liters/sec (2,230 gpm) flow rate.

Building 11-17 is used for the synthesis of small quantities of explosives for testing purposes, phase approvals, and analytical standards. Analysis of explosives, explosive formulations, and environmental samples in support of process development, design agencies, and the military purchasing organization is conducted. The building is also used for plant production and management support.

A variety of instruments are used to evaluate the thermal properties and compatibility of explosives. These include differential thermal analysis, differential scanning calorimetry, and chemical reactivity by gas chromatography. Chromatographic capabilities include gas, high pressure liquid, and thin layer. General analytical capabilities include a wide range of wet chemistry processes applicable to the analysis of explosives.

3.3.1.2 *Building 11-38, High Explosives Development Bays*

Building 11-38 is a one-story masonry, World War II vintage, moderate hazard facility in the southwest portion of Zone 11 (Figure 3-1.)[39]. The building consists of three bays (one bay is 9.8 m × 23.2 m [32 ft × 76 ft], the other bays are 9.8 m × 15.2 m [32 ft × 50 ft]), and a corridor (with dimensions of 3.7 m × 29.3 m [12 ft × 96 ft]). Building 11-38 is dedicated to the Projectile Impact System and development operations.

There are no ceilings or blast doors in any of the bays. Two substantial dividing walls separate the bays; these walls are 0.3-m (1-ft) thick, 2.1 x 10^6 kg/m² (3,000-psi), reinforced concrete with horizontal and vertical rebar on each face of 30.5 cm (12 in.) centers. The exterior walls are constructed of 20.3-cm (8-in.) thick hollow clay tile having a weight per exposed surface area of about 641 kg/m² (40 lb/ft²). These wall arrangements will allow overpressures to be vented to the outside of the building in the event of an explosion. The bays and corridor have reinforced concrete floors covered with seamless floor covering. The roof covering the entire building consists of steel frame covered with corrugated transite.

Exits in the west and east exterior walls provide two exits for each bay, and on each end of the corridor. All exit doors have panic hardware.

The entire building is provided with an approved lightning protection and grounding system and is protected by an automatic wet-pipe sprinkler system designed for extra hazard occupancy.

One bay has been modified to accommodate the Projectile Impact System which consists of a 7.9 m × 9.8 m (26 ft × 32 ft) addition constructed of 20.3 cm (8 in.) reinforced concrete masonry walls and a roof deck supported by open web steel joists. The height of the addition is 0.4 m (12 ft) where it joins Building 11-38 and is sloped to 3.4 m (11 ft) at the east wall. The foundation consists of a concrete slab with perimeter footings. The addition is divided into two rooms by a 20.3 cm (8 in.) reinforced concrete masonry wall 2.4 m (8 ft) high. The south room is an extension to the gas gun room. The north room contains a VISAR laser. The northern section of the bay is divided into three rooms, which are separated from each other by 20.3 cm (8 in.) reinforced-concrete masonry walls, 2.4 m (8 ft) in height, and hollow metal doors. All 20.3 cm (8 in.) reinforced-concrete walls are secured to the floor slab with vertical rebar inside the block walls. The rebar is fastened into the floor holes with epoxy, and all voids are filled with concrete. The explosives formulations, recovery of dimethylsulfoxide and cyclotetramethylenetetranitramine (HMX) from demilitarization operations, the synthesis of crude hexanitrostilbene (HNS-I) to HNS-II, precipitation of fine particle HNS, and amination of TCTNB (1,3,5-trichloro 2,4,6-trinitrobenzene) to TATB (1,3,5-triamino 2,4,6-trinitrobenzene).

Each processing bay will be protected by an automatic deluge system. The system may be controlled manually, remotely, or automatically. The primary automatic fire detection will be cross-zoned UV detectors with backup fire detection by rate-compressed, fixed-temperature heat detectors. Fire water for each processing bay will be supplied from a separate riser connected to the exterior fire water system.

3.3.1.5 *Building 12-8, Analytical Chemistry Laboratory Annex*

Building 12-8 is a moderate hazard facility initially constructed in 1944, located in Zone 12 North (Figure 3-3.), and scheduled for demolition in 2000[43]. Asbestos may be encountered in some of the building structures and furniture, such as lab benches. Building 12-8 is a one-story, 58.2 m^2 (626-ft^2) facility built in 1944 consisting of a general purpose room and one containing three HE and IHE ashing tanks. The roof is gypsum board on steel framing. Ceiling height varies from 4.3 m to 5.0 m (14 to 16½ ft). Exterior walls are con-structed of hollow clay tile over a structural steel frame faced on the interior with noncombustible insulation. The interior wall between the two rooms is non-load-bearing. All doors are hollow metal. A compressed gas cylinder storage area is located adjacent to the general purpose room.

Emergency lighting in the general purpose room is supplied by a battery operated emergency light. The battery charger for the emergency light is hardwired into the main building circuit to provide continuous charging. The ashing tank room contains a single-bulb emergency light connected to the battery located in the general purpose room. A lightning protection system is also provided.

The facility is protected by an automatic wet-pipe sprinkler system with a 15.2 cm (6 in.) alarm check valve and riser located in the equipment room of Building 12-59. Upon detection of water flow in the system or activation of a manual fire alarm station, local evacuation alarms sound (inside fire alarm bells), Building 12-59 HVAC shutdown occurs, and a coded fire alarm signal is transmitted to the Plant Fire Station.

The fire protection system is electrically supervised and has a 24-hour emergency battery power supply. The system will transmit a coded fire alarm to the Plant Fire Station. An emergency notification system has been installed in the laboratory for announcement of evacuation instructions by the Fire Department. A flow actuated switch is located in the Mechanical Room of Building 12-59.

Exhaust is provided for the explosion-proof tanks through an exhaust system on the outside of the east wall of ashing tank room. The exhaust vent pipes contain explosion-proof vents and vent directly into the blowout chamber in the outside exhaust system. The ashing tank room is equipped with an explosives-contaminated vacuum system. The vacuum station is located in the Building 12-59 Mechanical Room. The station is equipped with an in-line filter, regulator, vacuum gauge, and couplings. The in-line filter provides a controlled collection source for preventing explosives contamination of the vacuum pump and preventing discharge of explosive material to the environment.

A combination emergency station with drench shower and eyewash fountain is located in each room. The emergency eyewash and shower facilities are connected to a duress alarm. When activated, the local duress alarm bell and alarm bells in the Building 12-59 office area sound. The duress alarm panel is located in the hall outside the Building 12-59 office area.

restrooms, corridors, and office areas. The remainder of the floor is concrete with a steel trowel finish and sealer.

The entire laboratory facility, including the ramp section fronting the building, is protected by an automatic, wet-pipe sprinkler system designed for ordinary hazard occupancy (as defined by NFPA 13, "Standard for the Installation of Sprinkler Systems"), except the HE staging bay, coupon bay, and solvent storage room, which are equipped for extra hazard occupancy[41]. All construction is noncombustible.

Building 11-51 is used for chemical, thermal, and instrumental analyses of explosives, adhesives, polymers, and other weapon-related materials. The analytical capabilities include a wide range of general wet and dry chemical processes.

A Fourier-transform nuclear magnetic resonance spectrometer with two dimensional capability is available for analysis and determination of molecular structure of organic chemicals. Molecular weight characterization capabilities include gel permeation chromatography and by supercritical fluid chromatograph.

Solids particle characterization methods include sieve analysis, photomicrography, and image analyzers. Powder surface areas are determined by static and dynamic gas flow adsorption, and powder densities can be measured using a helium/air pycnometer. Surface analysis methods include scanning electron microscopy, Auger electron spectroscopy, x-ray photoelectron spectroscopy, and ion-scattering spectroscopy.

Thermal analysis and small-scale materials compatibility testing are conducted using differential scanning calorimetry, thermogravimetric analysis, thermo-mechanical analysis, accelerating rate calorimetry, vacuum stability, and chemical reactivity testing. Metallographic operations include x-ray fluorescence for elemental analysis, optical microscopy, and image analysis, as well as hardness determination.

3.3.1.4 *Building 11-55, High Explosives Synthesis Facility*

The High Explosives Synthesis Facility will be a two-level, moderate hazard building, housing process equipment and necessary support systems. The High Explosives Synthesis Facility may replace some or all of the operations conducted in Buildings 11-23, 11-24, and 11-36. The structure will measure about 29.6 m (97 ft) in the north-south direction, and 31 m (102 ft) in the east-west direction (Figure 3-1.)[42].

The ground level will contain two process bays which will house the process equipment required for the synthesis of explosives. Each process bay will have one blast door and two pressure resistant doors for emergency egress.

The oven bay will house the equipment required for drying, weighing, and packaging explosives. The oven bay will have one blast door and two pressure-resistant doors for emergency egress.

The inert staging room will be utilized for storage of all the movable equipment necessary to support processes and also contain work benches, storage cabinets, and transfer hose storage racks.

The control room will have a console for monitoring, controlling, and recording process and utility functions.

The missions of the High Explosive Synthesis Facility will be to develop new processes for the demilitarization of components and the recovery of materials from demilitarization operations such as explosives and solvents, and to develop new explosives and new explosives processes for DOE with the direction of the various design laboratories. Additional work will include the production of small quantities of specialty high explosives for DOE that are not available from commercial sources.

Some processes that may be carried out in Building 11-55 are the base hydrolysis of

Building 12-8 is equipped with a local public address (PA) system originating from Building 12-59. Each room contains a PA speaker that is used for emergency notification of personnel. The PA can be accessed from the office area in Building 12-59. The local PA system is the primary emergency notification system for Building 12-8.

Operations in the Analytical Chemistry Laboratory Annex consist of glassblowing and explosives grinding, chopping, and ashing. The general purpose room houses the glassblowing operation which uses a methane and oxygen flame torch and a glassblowing lathe.

The ashing tank room houses the HE and IHE grinding, chopping, and ashing operations. The grinding mill and ashing furnaces are contained in explosion-proof tanks, which are capable of totally containing the effects of a 50 gram (1.6 oz) (TNT equivalent) explosion. These explosives operations are associated with sample preparation for further analysis. IHE only is ashed in the furnaces. The micro-toming machine chops explosives to facilitate further analysis. The front of the machine is covered by a 2.54-cm (1-in.) thick plexi-glass shield with a safety interlock that prevents machine function without safety shield closure. The machine has a 5 grams (0.16 oz) (TNT equivalent) explosives limit which, when combined with the safety shield, provides Class I level of protection during micro-toming operations.

3.3.1.6 *Building 12-19 East, High Explosives Formulation Facility*

Building 12-19 East, located in Zone 12 South (Figure 3-2.), is a moderate hazard facility, originally constructed in 1944 as a TNT melt/cast facility. It was modified 1963-1964 to be a formulation facility[44].

Building 12-19 East consists of the east half of a 1½ story building. The east half has an area of 1,085 m^2 (11,680 ft^2) on the ground floor and 556 m^2 (5,986 ft^2) on the second floor. The second floor only covers half of the east side of the building. The structure is built on spread fittings with grade beams, slab on grade for the first floor, and a slab floor supported by 30.5 cm (12 in.) reinforced concrete dividing walls and concrete structural beams and columns for the second floor. The outside shell of the building is non-load-bearing, 20.3 cm (8 in.) hollow clay tile block. The original roofing system was made of 4.0-cm (1 9/16-in.) thick cemesto panels with built-up roofing. Portions of the facility still using these materials exists over the second story bays only, the first floor has been replaced with built-up roofing materials over corrugated metal decking. A roof netting material is also over the second floor roof to contain roof fragments in the event of an accidental explosion in the second floor bays.

The east and west sides of Building 12-19 are considered separate facilities and are separated by a 30.5-cm (12-in.) thick reinforced concrete wall and blast resistant doors that have been sealed shut. The east side consists of 16 bays divided by 30.5-cm (12-in.) thick reinforced concrete walls. These bays are numbered 8 through 17 on the first floor and 212 through 217 on the second floor. A remote control shelter with three walls and roof made of 2.54-cm (1-in.) thick steel plate. Work stations with cemesto walls are on the east end of the facility on the second floor. Bays 8 through 11 are essentially two-wall work areas with a corridor on each end. Bays 12 through 17 are three-wall cubicles with a 30.5-cm (12-in.) thick reinforced-concrete roof. Bays 212 through 217 are three-wall cubicles on reinforced concrete slab and are covered with cemesto.

A generator located in the south area of Building 12-19 East provides emergency power for this facility. The generator circuit provides power to lights in the building hallways and exit lights over the doors.

temperature controllers. Heating of explosives must be monitored at all times. Auto-dialers provide constant monitoring for the steam ovens. The pressures in the steam systems used to heat the ovens and vessels are limited by a pressure-reducing valve, a pressure relief valve, and a thermostatic valve, satisfying the requirements for automatic heat controls.

3.3.1.7 *Building 12-19 West, Materials Compatibility Laboratory*

Building 12-19 West is a, low hazard, one-story, 1,451 m² (15,624 ft²) facility built in 1944[45]. The facility is located in the north-east quadrant of Zone 12 South (Figure 3-2.) and is rectangular in shape. It runs in a general east-west direction. Building 12-19 West is attached to Building 12-19 East on its eastern-most end. Blast doors are located between Buildings 12-19 West and East, but on the west side of the building a cemesto board partition has been constructed over the blast doors creating a substantial wall. There is no access route between the two buildings.

Building 12-19 West consists of seven bays that are separated by 30.5 cm (12 in.) reinforced concrete partitions. The roof construction is Class A, built up with a cemesto board-on-steel frame base. All floors are concrete and covered with flooring approved through the use of established procedures. The exterior walls are pressure relieving and are constructed of 2.4 m (8 in.) hollow clay tile block.

Bay 1 contains equipment used for vacuum testing and a 2.4-m (8-ft) deep assembly pit covered by a steel lid. The assembly pit is not expected to be used. Bay 2 has been partitioned into two offices, an office cubicle, and a monitoring area. Both Bays 1 and 2 are enclosed on either end by cemesto partitions with hollow steel doors.

Bays 3 and 4 are separated into two sections. The north section contains water cooling units and equipment skids and the south section contains monitoring equipment and walk-in environmental chambers. The north section is enclosed by comes-to partitions. Bays 5, 6, and 7 are not partitioned. All bays except Bay 7 are enclosed on each end with rolling, grid-type, steel telescoping gates.

An uninterruptible power supply provides power through the use of a constantly running inverter and large rectifier/charger. This power is supplied without interruption of load functions for the circu-lar chart recorder on each environmental chamber.

Battery-operated exit lighting is provided by explo-sion-proof lighting systems. Each system battery is continuously charged by the battery charger, which is hardwired into the building circuits. The lights are located above the center of each exit door. A diesel generator powers standby lights in the north and south hallways. A lightning protection system is also provided in Building 12-19 West.

Building 12-19 West is protected by an automatic wet-pipe sprinkler system with a 15.2 cm (6 in.) alarm check valve and riser located in Building 12-19 East. Upon detection of water flow in the system, activation of a manual fire alarm station, actuation of duct smoke detector, or local evacuation alarms sound (inside bells and outside water motor gong), and a coded fire alarm signal is transmitted to the Plant Fire Station.

The fire alarm signaling system is electrically supervised and has a 24-hr emergency battery power supply. Duct type smoke detectors are provided in fan rooms 3 and 4. In addition, the vent hood in Bay 4 is equipped with a dry chemical extinguishing system activated by a 182°C (360°F) fusible link and a remote manual fire alarm station. These systems are interlocked with the HVAC system to interrupt the fan motor operation and transmit an alarm to the Plant Fire Department.

allowing the gas to be recycled back to the drum dryer. The condensed solvent can then be reused for dissolving binder on mock pressed pieces or to make new IHE. The airlock valve allows removal of the product without losing the nitrogen-rich atmosphere on the drum dryer. A portable hexane TLV sniffer is provided for use when operations involve flammable or toxic liquids whose vapors could be released into the facility interior due to loss of ventilation or containment.

Combination emergency stations with safety shower and eyewash fountain are located in the hallway outside Bays 10, 13, and 16. Also, an emergency safety shower station is located in the hallway outside Bay 213. The drain lines lead to trenches running along the hallway of the lower floor of the facility.

Building 12-19 East serves as a pilot plant for developing techniques to manufacture plastic-bonded explosives (PBX) and other material on an intermediate scale between the laboratory and the production plant for evaluation by design laboratories. These processes include development of slurry processing techniques for most of the PBXs in use throughout the DOE complex. Also included are development of methods for making booster grade triaminotrinitrobenzene (TATB) in a form that is easy to handle and producing War Reserve lots for use in current and upcoming weapons programs. Other materials produced for War Reserve applications include HNS, treated with a small amount of an inert plastic binder, and cyclotrimethylenetrinitramine (RDX), recrystallized for incorporation into an extrudable explosive. Also, methods are being developed to make paste extrudable explosives (PEX) and extrusion cast explosives (ECX), and to load these explosives into parts for testing and evaluation. Other processes performed include mixing, blending, and steaming, oven, and freeze drying, formulation of explosives with different bonders by a variety of processes, particle size reduction by milling, micronizing, or grinding. Explosives reclamation (alternatives to open burning/detonation), solvent recovery to support dismantlement activities, mock explosives formulation for set-up, and JTA support are also conducted.

Bays 9, 10, and 12 are used on occasion for Explosives Class I remote operations in addition to Class II operations. Remote operations in Bay 12 are controlled through viewing ports in the wall between the bays. Remote operations in Bays 9 and 10 are controlled from the remote control room on the east end of the facility using CCTV to monitor the equipment.

Exclusion areas are established around the facility for all remote operations to control personnel access to areas subject to over pressures capable of causing serious injury to humans due to accidental detonation of explosives. Appropriate warning lights, horns, signs, and barricades are used to designate the exclusion areas. Steel plate blast shields 2.54-cm (1-in.) thick are positioned around equipment used to process quantities of explosives capable of producing missiles with a significant range. The blast shields limit the distance that missiles can travel, allowing a reduction of the exclusion area. Earthen berms on the north and south side of the facility are also provided to reduce the effects of an explosion and reduce the exclusion area.

An interlock to the remote controls assures that the lights and horns are operating for a minimum of 4 min prior to beginning remote operations. Personnel performing the remote operations are required to inspect the exclusion area while the warning system is activated to assure that the warning system is functioning properly and that all personnel are outside the exclusion area.

Some of this process equipment is capable of adjusting the temperature of the HE material during processing through the use of jacketed vessels. Steam, or cold water flowing through the jacket of the process vessel, is used to heat or cool the HE as required for the formulation process. Temperatures are adjusted manually by the personnel performing the operations, except for the steam ovens, which have automatic

Manual fire alarm stations are provided adjacent to the emergency exits. All fire alarms received at the Fire Alarm Control Panel automatically shut down the HVAC system.

A dry chemical extinguishing system is provided in the vent hood (local exhaust) located in Bay 4. A 9.0 kg (20 lb) dry chemical canister is mounted outside of the hood enclosure can be actuated by either a 182°C (360°F) fusible link inside the hood enclosure or manually. Upon actuation, electrical power is shut off to the vent hood, causing the exhaust system in the hood to shut down.

The steam-heated ovens in Building 12-19 West are used for isothermal cycling of weapons parts and material compatibility containers. The steam ovens are equipped with a pressure reducing valve, pressure relief valve, and an over-temperature device. The over-temperature device is equipped with two set points, an automatic remote warning system, and an audio-visual monitor/alarm panel. The controller/recorder limits steam flow to the oven, using an air-actuated valve and regulator combination. Separate temperature sensors within the oven are connected to the over-temperature device and the controller/recorder. Two solenoid-operated steam valves, powered by the over-temperature device, control the steam flow to the oven in an over-temperature condition.

Building 12-19 West contains seven environmental chambers. Each chamber is provided with a separate control console and equipment skid. Safety controls and features are a major part of the design of the chambers. These controls include; a Panic Button system, Independent Manual Reset Over-Temperature (109°C or 228°F) System, Auto Reset Heater Element (165°C or 329°F) Interrupters, Airflow Differential Circuit, and Power Surge Protection.

Emergency eyewash and shower facilities are conspicuously located in the northeast corners of the south section of Bays 3 and 4 and on the southwest end of Bay 1.

The operations performed in Building 12-19 West include vacuum testing and compatibility testing on weapon related parts (material compatibility con-tainers). The testing includes leak checking, vol-ume determination, sampling, and thermal cycling of the containers. Only material compatibility con-tainers containing no SNM will be tested in this building; however, some do contain source mater-ial. The containers will be either heated at a con-stant temperature or thermally cycled from sub-ambient up to approximately 70°C (158°F). Glass racks will be used to perform cryogenic fractionation to separate the gas in compatibility containers and sample bottles from the production area. The glass rack will be attached to a vacuum system to evacuate the glass fittings. The method of transfer of the sample for measurement is mercury. Traps will be used to capture the various gases for measurement and analysis.

Bay 1 supports the design, implementation, and testing of new vacuum systems, leak detectors, residual gas analyzers, vacuum fittings, manometers, hygrometers, and transducers. In addition to testing new products, new systems are brought on-line in the production areas and technical support is provided for line operations.

3.3.1.8 *Building 12-59, Analytical Chemistry Laboratory*

Building 12-59, the Analytical Chemistry Laboratory, is a moderate hazard facility initially constructed in 1969, located in Zone 12 North (Figure 3-3.).

Building 12-59 is a one-story, 771 m² (8,300 ft²) facility housing eight lab rooms, a cluster of offices, a storage room, janitor closet, mechanical room, and restrooms. The exterior walls are concrete block with noncombustible insulation on the interior face. Room 103 North was added to the structure and utilizes the pre-existing exterior wall to separate it from the original facility. The interior partitions are 1.3 cm (½ in.) gypsum board on metal studs, except in Rooms 116 and

117. Rooms 116 and 117 have 76.2 cm (30 in.) concrete walls on the north, south, and west sides and a frangible east wall. These rooms are separated by a 30.5 cm (12 in.) concrete wall. The roof is a 5.1 cm (2 in.) poured gypsum deck. The ceiling height varies from 2.4 m to 3.1 m (8 to 10 ft) and consists of noncombustible suspended ceiling tile. All doors are hollow metal. Floor covering, approved through the use of established procedures, is provided. The ramp is unsprinklered and is noncombustible. The compressed gas cylinder storage area is accessed through the south door of Room 106. Emergency lighting is supplied by two battery-operated emergency lights. The battery chargers for the self-contained emergency lighting units are hardwired into the main building circuit to provide continuous charging. Outside of Rooms 116 and 117 are two single-bulb emergency lights whose battery charge (located in Room 105) is hardwired into the building's electrical circuit. A lightning protection system is provided in Building 12-59. The facility is protected by an automatic wet-pipe sprinkler system with a 15.2 cm (6 in.) alarm check valve and riser located in the equipment room. The sprinkler system is connected to a 15.2 cm (6 in.) lead-in main with an outside post indicator valve. Upon detection of water flow in the system, activation of a manual fire alarm station or actuation of a sprinkler head, local evacuation alarms sound (inside bells), HVAC shutdown occurs, and a coded fire alarm signal is transmitted to the Plant Fire Station.

The fire alarm signaling system is electrically supervised and has a 24-hour emergency battery power supply. An emergency notification system has been installed in the laboratory for announcement of evacuation instructions by the Fire Department.

The air handling unit of the HVAC system provides make-up air and provides positive pressure in the lab rooms.

Laboratory exhaust hoods are located throughout Building 12-59. Air is exhausted from the hoods to outside the building without recirculation. The exhaust hood sash, when closed, serves as an operational shield.

A dry chemical extinguishing system is provided in each of the fume and vent hoods in the laboratories (except for Rooms 116 and 117), and in each of the chemical safety storage units. The hoods in Rooms 116 and 117 are used for explosives operations and are provided with sprinklers.

Room 117 contains a steam oven equipped with a pressure reducing valve, pressure relief valve, and an over-temperature device. Room 117 also contains an electrically heated oil transfer oven equipped with an over-temperature device.

Building 12-59 is equipped with an explosives-contaminated vacuum system. The vacuum station is located in the mechanical room and supplies all laboratories. The station is equipped with an in-line filter, regulator, vacuum gauge, and couplings. The in-line filters provide a controlled collection source for explosives contamination, preventing explosives buildup in the vacuum lines, preventing explosives contamination of the vacuum pump, and preventing discharge of explosive material to the environment.

There is a storage shed for compressed gas cylinder storage and distribution. These facilities provide for the safety and convenience of building personnel by removing compressed gas cylinders from the operating areas to exterior locations. Room 106 is supplied oxygen by a line fed from the gas cylinder storage area.

Flammable storage cabinets have been distributed throughout the facility to safely store these materials within the areas where they are used. Spill kits (i.e., acid, caustic, solvents, and mercury) are also strategically distributed throughout the facility. All rooms where laboratory operations are conducted are equipped with a Safety Eyewash and Emergency Shower which is connected to a central alarm panel to alert other lab personnel.

Building 12-59 is equipped with a hazardous vapor monitoring system. Sensors are strategically located in areas where vapors might exist.

Building 12-59 is also equipped with two outdoor chemical safety storage units located on the south side of the building. The large unit contains three separate rooms which are supplied with a dry chemical extinguishing system, ventilation system, specific vapor concentration detector, spill and leak detection system, pressure relief panel, and secondary containment. The second unit is supplied with a dry chemical extinguishing system, spill and leak detection system, ventilation system, pressure relief panel, and secondary containment. The large unit will be used for the storage of laboratory reagents, while the second unit will be used for non-regulated waste accumulation and to store unused waste containers.

Building 12-59 is equipped with a local PA system that can be accessed from the office area. This system is used for emergency announcements in Building 12-59 and Building 12-8 labs only. Building 12-59 operations include the chemical analyses of high explosives, adhesives, paints, environmental samples, and other samples which are valuable to the Pantex Plant mission. Production, dismantlement, surveillance, and R&D activities are supported for the weapon programs as well as for the Plant as a whole. Common analytical instruments and wet chemical analyses are used to analyze the samples described above. Documented procedures, which include hazard information, are used for all laboratory work (e.g., O&I Standards, Mil-Specs, Federal Test Methods, etc). The job requirements for laboratory personnel necessarily exceed those normally found in a manufacturing environment because of the complex tasks that use a variety of small amounts of hazardous chemicals.

The explosive and personnel limits for the building and for Room 117 are posted on placards at the entrance to the building and to Room 117. All of the operations in Building 12-59 are found in laboratories associated with the private sector.

3.3.1.9 *Building 12-62, PETN Processing Facility*

Building 12-62, an extrudable explosives formulation facility, is a moderate hazard facility originally built in 1971 and located in the northern midsection of Zone 12 (Figure 3-3.) just inside the protected area barrier[47]. Building 12-62 is an HE processing facility consisting of six bays, one mechanical room, one emergency diesel generator room, one cleaning solvent storage room, and rest rooms. The building structure is primarily steel-reinforced concrete, with cemesto board over steel framing used for ancillary areas. Processing Bays 1, 2, 3, 4 and 5 consist of steel-reinforced concrete walls 0.3-to 0.9-m (1-to 3-ft) thick, steel-reinforced concrete roofs approximately 30.5-cm (1-ft) thick, and steel-reinforced concrete floors approximately 30.5-cm (1-ft) thick over grade and sand fill. Bay 6 consists of walls that are constructed of 20.3 cm (8 in.) concrete blocks, a ceiling of metal deck covered with 5.1 cm (2 in.) of insulation and a built-up roof, and a floor of 15.2 cm (6 in.) reinforced concrete. The mechanical room consists of the southwest wall and part of the southeast wall constructed of cemesto sandwich panels, with the remainder of the southeast wall and back wall conjoining Bay 3 and its access corridor. The emergency diesel generator room consists of the front and side walls constructed of cemesto sandwich panels and the remaining wall conjoining Bay 3. The roof of the equipment and emergency generator rooms is a built-up roof over 5.1 cm (2 in.) of insulation and a metal deck.

Deaeration of extrudable explosives (XTX) is conducted in Bay 1. Bay 2 contains a roller mill to homogenize the XTX mixture. Bay 3 is currently used for mixing the HE base with the resin and curing agent to create XTX. Bay 4 contains oven and weighing operations where the crystallized HE base material is heated. Bays 1 through 4 are clean rooms, where the air is constantly circulated through filters to remove any airborne particles of HE or contaminants. Bay 5 provides refrigerated storage for the finished, but uncured, XTX patties. Bay 6 is the control room from which remote operations for Bays 1, 2, and 3 are controlled. The mechanical equipment room contains various operational support and mechanical equipment.

The utilities that serve Building 12-62 include electricity, water, HVAC, compressed air, steam, and vacuum. The safety-related service systems associated with operations in Building 12-62 include a fire protection system; an interlock-warning system; a lightning protection system; a steam pressure reduction, relief, and monitoring system; and an emergency backup power system. Safety communications are available throughout the facility by means of a public address system and a telephone located in the control room.

3.3.1.10 *Building 11-36, High Explosives Synthesis Facility*

Building 11-36, a moderate hazard facility, is located in the west-central portion of Zone 11 (Figure 3-1.)[48] and is a noncombustible two-story World War II vintage structure of approximately 537 m^2 (5,781 ft^2). The building was rehabilitated in 1967 for use as an HE Formulation and Synthesis Facility and refitted in 1975. This facility is scheduled for demolition in FY96.

The building contains two process rooms (first and second floors) of about 102 m^2 (1,100 ft^2) each, a remote control/laboratory room of about 52 m^2 (560 ft^2) (second floor), an oven room of about 33 m^2 (360 ft^2) (first floor), a two-level equipment room (adjoining the two process rooms), restrooms, and a stairway. The stairway is cut off from the process rooms and the remote control/laboratory room by self-closing doors. A 908 kg (2,000 lb) capacity conveyor runs from the ground level slab east of the building to a door opening and landing on the second floor.

All walls of the building are non-load-bearing clay tile, except the north wall of the process rooms, which is reinforced concrete, and the outside walls of the oven bay, which are concrete block. The structural frame, except in the oven bay, and floor slabs are reinforced concrete. The structural frame of the oven bay is steel beam construction. The roof is built-up asphalt and gravel roof on insulated steel deck supported by steel beams.

To prevent buildup of vapor-air concentrations in Building 11-36, the upstairs and downstairs process bays are provided with floor-level air sweeps and point source ventilation. The exhaust system has a water-scrubber type system for removal of hazar-dous material (explosives, toxic, and flammable materials) prior to discharge to the atmosphere.

The High Explosive Synthesis Facility develops new processes for the demilitarization of components and the recovery of materials from demilitarization operations such as explosives and solvents, and develops new explosives and new explosives processes for DOE with the direction of the various design laboratories. Additional work includes the production of small quantities of specialty high explosives for DOE that are not available from commercial sources.

Some processes that may be carried out in Building 11-36 are the base hydrolysis of explosives formulations, recovery of dimethyl-sulfoxide and HMX from demilitarization operations, the synthesis of crude hexanitrostilbene (HNS-I) to HNS-II, precipitation of fine particle HNS, and amination of TCTNB to TATB.

The combined explosives limit for Bays 1, 2, and 3 is 60 kg (150 lb) and is 500 g (1.1 lb) for the Control Room (Bay 22). A detonation of the maximum quantity of the 60 kg (150 lb) of explosives permitted in the oven bay is considered to be the worst case situation in the building. The building, except for the reinforced concrete roof of the first floor and the 30.5 cm (12 in.) reinforced concrete wall at the north end of the building, would be demolished or severely damaged.

3.3.2 Manufacturing

This section discusses structural design and operations involving HE manufacturing. They include:

- Building 11-20, High Explosives Processing Facility (Section 3.3.2.1)
- Building 11-50, High Explosives Machining Facility (Section 3.3.2.2)
- Building 12-17, High Explosives Pressing Compounds (Section 3.3.2.3)
- Building 12-63, High Explosives Pressing Facility (Section 3.3.2.4)
- Building 12-121, High Explosives Machining Facility (Section 3.3.2.5)
- Building 12-24S, High Explosives Machining Facility (Section 3.3.2.6)
- Building 12-43, High Explosives Filtration Facility (Section 3.3.2.7).

3.3.2.1 *Building 11-20, HE Processing Facility*

Building 11-20 was constructed during World War II and contains 11 bays. It is a moderate hazard facility[49] and located in the south section of Zone 11 (Figure 3-1.).

The construction of the bays is designed to mitigate the external effects of an explosion inside a bay and to provide a Class II level of protection for personnel in bays other than the bay where the explosion occurred. The bay structures are designed to resist the effects of an explosive accident in an adjoining bay, to capture primary missiles originating in the bay of explosive occurrence, and to provide controlled release of the blast pressures associated with internal explosions. The bay structures prohibit the propagation of an explosion from bay to bay in the event of accidental explosives detonation.

Bays 1 through 6 are of similar construction. These bays all have three reinforced concrete walls and one frangible wall toward outside. Bays 1, 4, 5, and 6 also have a frangible roof, while Bays 2 and 3 have built up roofs with reinforced concrete for debris attenuation. The reinforced concrete walls are 30.5-cm (12-in.) thick around Bays 1 and 6; 91.4-cm (36-in.) thick around Bays 2, 3, and 5; and 45.7-cm (18-in.) thick around Bay 4. The dimensions of Bays 1 and 6 are approximately 6.1 m ×7.0 m (20 ft × 23 ft) and the dimensions of Bays 2, 3, 4, and 5 are slightly less because of the thicker walls. Bays 1 through 5 have a drainage trench that leads outside the building to an HE drainage flume along the east side of the building. The flume flows to the filter building for treatment of liquids contaminated with high explosives. Bays 2, 3, 4, and 5 have blast doors at the entrance from inside the building, and all five bays have a door to the outside of the facility.

Bay 7 was constructed with two 30.5-cm (12-in.) thick reinforced concrete walls, two frangible walls, and a frangible roof. Bay 7 has dimensions of 8.4 m × 15.2 m (27 ft 8 in. × 50 ft). Bay 8 was constructed with three 30.5-cm (12-in.) thick reinforced concrete walls, one drywall wall, and a frangible roof. Bay 8 opens into the corridor of the building and has dimensions of 5.8 m × 7.6 m (19 ft × 25 ft). Bay 8 also has three drywall cubicles with dimensions of 2.9 m × 2.5 m (9 ft 6 in. × 8 ft 4 in.) for the staging of high explosives and prevention of cross contamination of explosives.

Bay 9 dimensions are 5.9 m × 7.6 m (19 ft × 25 ft); the bay was constructed with three 30.5-cm (12-in.) thick reinforced concrete walls, a frangible roof, and one frangible wall with an opening into a corridor.

Bays 10 and 11 were constructed with frangible walls and roofs. Bay 10 dimensions are 9.6 m × 18.8 m (31 ft 6 in. × 61 ft 6 in.) Half of Bay 10 is a raised concrete platform with steps to an office area located on the east side of the platform. Bay 11 dimensions are 18.8 m × 19.2 m (61 ft 6 in. × 63 ft) with a pit area of 8.2 m × 17.4 m (27 ft × 57 ft). A polish room is located in the northeast corner of Bay 11. A firing chamber room is located in the southwest corner. A room housing three electric ovens for heating non-high explosives is located in the southeast corner of the bay, and an electrostatic testing room is located in the southwest corner of the pit area in Bay 11.

The remote-control protective shelter for pressing operations in Bays 4 and 5 is a 3.7 m × 3.7 m (12 ft × 12 ft) room constructed on the west side of Bay 6. The walls of the control shelter are of reinforced masonry securely connected to the west wall of Bay 6. The roof consists of an 20.3-cm (8-in.) thick reinforced concrete slab providing protection for personnel in the shelter from falling debris in the event of an accident during remote operations. An air conditioner, including a heat pump, installed on the southern side of Bay 6, was designed to maintain the temperature in Bay 6 between 19.4°C (67°F) and 28.3°C (83°F).

The three attached equipment rooms house the building HVAC system, a high explosives contaminated vacuum system, and a dehumidifier. The equipment room housing the HVAC system is located at the north end of the building next to Bay 1. This equipment room was constructed with masonry and the roof on metal decking on steel supports. The equipment room housing the high explosives contaminated vacuum pump is located on the east side of the building (sharing the Bay 5 frangible wall) and is constructed with cement walls. The equipment room housing the dehumidifier is located on the south side of the building, next to Bay 6, and is constructed of masonry. All three equipment rooms are steam heated to a minimum of 7°C (45°F) during the winter months.

Two additional equipment rooms, i.e., 11-20 E1 and 11-20 E2, located at the north end of the building and east of Bay 3, contain the hydraulic systems for the Hydramet press in Bay 2 and the 50.8 cm (20 in.) gun barrel press in Bay 3.

All floors inside Building 11-20, except Bay 10, Bay 11, and parts of the corridors, are covered with a seamless flooring to aid in housekeeping and minimize high explosives contamination. Resilient floor coverings are used in areas where additional protection is required per DOE/EV/06194, "DOE Explosives Safety Manual" and DOE 6340.1A, "General Design Criteria."

An earth revetment was constructed along the east side of the building. It is about 30.5-m (100-ft) long and 10-m (33-ft) tall. The revetment serves as an attenuation wall for potential missiles originating from Bays 2 through 4.

The three most important safety features associated with operations in Building 11-20 are the blast- resistant structure of the facility, remote control of the explosive pressing operation, and the adminis-trative explosives limits. These features contribute to the health and safety of workers and the environment either by limiting the potential effects, or by mitigating the consequences of a blast.

The major explosives that are processed in Building 11-20 include: PETN, HMX, RDX, HNS, TNT, TATB, and formulations of these explosives.

Explosive preparation before pressing, including inspection, weighing, and heating, is performed in Bay 1. The materials prepared are high explosives and mock high explosives.

Three steam-heated ovens are installed in Bay 1 for heating the explosives. Other supporting equipment includes transport carts, tote boxes, aluminum trays, an inspection table with a magnetic separator, an oven exhaust air scrubber, scales, work benches with shock absorbent covering, and storage cabinets.

High explosive powders and mock HE (inert material) are not allowed to be heated together in an oven; therefore, separate sets of trays are provided for mock powders. Normally, steam cleaning is all that is necessary to clean the trays which have been used for explosives. However, if it is necessary to use acetone or alcohol to clean the trays, only the minimum amount necessary is used.

Explosives dust collected by the vacuum system is removed periodically from the collection chamber to eliminate hazardous explosives concentrations. Waste water is generated by Rotoclone exhaust system. Discharge from this unit is cycled through the water filtration facility at Building 11-20 to remove any solid or dissolved contaminants.

Acetone or alcohol is used to clean trays that have been used for carrying explosives. Used acetone and alcohol are taken to Bay 11 where there is an exhaust hood available. Small quantities of acetone and alcohol are kept in and dispensed from approved safety cans having flash screens and self- closing lids. Waste materials from cleaning opera-tions, i.e., Kimwipes and rags, are disposed of in designated trash receptacles. The waste is collected regularly and taken to the High Explosive Burning Ground for disposal as contaminated waste.

Explosive pressing is performed in Bays 2, 3, 4, 5, 6, and 7, using a variety of presses with different capacities. The variety of press capacities provide stable pressure ranges for the different pressure requirements. The best stability usually occurs at 75 percent to 95 percent of press capacity. High capacity explosive pressing operations are Class I Remote-Control Operations.

Presses are used for forming high explosive powders into desired geometries. The large-capacity presses are hydraulically operated and are remotely controlled. The small-capacity mechanical presses are operated manually. The presses used in Building 11-20 and their operations are discussed in the following sections.

During the pressing process, small scrap explosive pieces shall be collected and transported in Army Navy (AN) containers lined with plastic. Explosives contaminated waste that is or has been wet with flammable liquids such as acetone or alcohol shall be collected in a yellow flame tamer type container with a plastic liner.

Bays 1 to 5 have a trench that leads outside the building to a high explosive drainage flume along the east side of the building. The flume flows to the filter room for treatment of liquids contaminated with high explosives. The decontaminated water is discharged into the sanitary sewer system.

The safety of pressing/shaping operations is maintained by remote controls, door interlocks, evacuation of personnel, and installation of closed-circuit television cameras. Shields are installed on the small-capacity, locally controlled presses for the protection of the operators.

Extrudable explosives are prepared in Building 12-19, the High Explosive Formulation Facility, where an explosive is mixed under low temperatures with a binder and an activator. This fluid mixture is shipped to Building 11-20 and is stored in a refrigeration unit in Bay 3 to retard the curing effect. Shortly before the extrusion process, the mixture is taken out of the refrigerator. At room temperature, the mixture starts to polymerize to a plastic solid for extrusion or other shaping processes.

The low-temperature environmental chamber in Bay 7 provides low-temperature conditions ranging from -51°C (-60°F) to 73°C (-100°F) for removing explosive pellets from punch and die sets, releasing of adhesive bonds, and achieving cold temperatures for conditioning when dry ice is impractical.

Explosive devices and simulators are assembled in Bays 4, 5, 7, 8, and 9 of Building 11-20 for firing tests at the firing range. The assembly is performed on work benches with shock-absorbing tops. Electrical grounding is provided.

During assembly operations, the operator is alert for mismating parts and misalignment of components. Hard surfaces of work benches should be lined with cushion material.

The equipment for assembly activities in Bays 4, 5, 7, 8, and 9 includes transport carts, tote boxes, work tables, gauges, hand tools, and related equipment. Three cubicles were built in this bay for staging the dried PETN, RDX, and HMX awaiting pelleting operations. Special tools used in assembly work are, for example, non-sparking tools, wooden tongue depressors, etc.

Storage compartments are provided in Bays 6, 7, 8, 9, and 11 for short-term explosives staging. There are nine compartments available in Bay 6. In Bay 7, there are four high explosives storage cabinets. Each cabinet provides nine compartments. A total of 36 compartments are, therefore, available for storage in Bay 7. Further, two storage cabinets, each with nine compartments, are installed for high explosives storage in Bay 9.

A number of other activities are conducted in Bays 10 and 11. These activities include:

- The impact sensitivity of the explosives is evaluated.
- Gap testing is completed to indicate the shock sensitivity of an explosive.
- Electrostatic sensitivity test are conducted.
- Small-size shape charges of different explosives and geometries are manufactured for test firing.
- The test adapters that are not damaged in the firing tests are reclaimed and reconditioned for repeated use.
- Resin is used as adhesive to fill the gaps or cracks of the manufactured components.
- The vacuum coating system in the Polishing Room in Bay 11 uses a hot evaporation process to vapor deposit thin films on surfaces, such as coating a metal layer on the surface of an explosive sample.

3.3.2.2 *Building 11-50, High Explosives Machining Facility*

Building 11-50 is a moderate hazard facility located in the western portion of Zone 11 (Figure 3-1.) and built in 1983[50]. It is an HE development machining facility consisting of multiple bays. Ancillary areas include the main corridor, rest rooms, storage rooms, an office/vault area, and an upper-level utilities corridor. A Machine Control Unit room is associated with each machining bay, and there are several storage rooms. The machining bays contain lathes, a 3-axis mill and a band saw, a 5-axis mill, and a fluid (water) jet cutter.

All bays have blast doors and vestibules. The pair of interlocking steel blast doors enclosing each vestibule prevents explosion blast products from entering the central corridor. The equipment, cranes, piping, and lighting within the bays are designed with mechanical shock isolating devices. Building 11-50 is protected by a fire suppression system. The sprinkler systems are supplied by an 20.3-cm (8-in.) underground main installed around the facility and by a loop connected to the existing plant water distribution system to provide two-way flow. The available water supply to the loop is 100.9 L/sec (1,600 gpm) flow at static pressures of about 10,547 kg/m^2 (150 psi).

Normal operations in Building 11-50 include receiving, staging, and machining explosives or mock explosives, and subsequent waste processing. Additionally, inspection, inventory, and quality assurance activities are performed to support normal operations. The primary process-related operations include HE processing and machining.

The In-Process Staging Bay is located on the north side of Building 11-50. The bay has no special equipment, but does have space to temporarily house work in progress. This includes rough and finished explosive pieces and space for assembly.

The Metrology Bay has four operational areas: vestibule, density testing, gauging, and file and computational space. The density area and dimensional area are physically separated. Gauging and other testing operations are governed by Development Division Standard Operating Procedures, which provide Building 11-50 with both operating procedures for the Metrology Bay laboratory and specific metrology safety requirements.

The Waste Water Treatment Bay, located on the southwest corner of the facility, contains the equipment necessary to process effluent for discharge to the environment. This equipment includes four separation tanks, three filters (and associated pumps), piping, gauges, and valves.

The Metrology Bay performs density determination and physical dimensions of the explosives machined. The Waste Water Treatment Bay receives explosives-contaminated waste cooling water, filters out solids, and releases the liquid effluent. The control rooms associated with the machining bays provide for remote controlled machining and cutting operations. Materials, including development explosives, are temporarily stored in the In-Process Staging Bay while awaiting operations or disposition after machining.

3.3.2.3 *Building 12-17, High Explosives Pressing Compounds*

Building 12-17, an HE processing facility, is a moderate hazard facility originally built in 1944 and located in the northern midsection of Zone 12 (Figure 3-2.) just inside the protected area barrier. The building is 22.9 m × 94.5 m (75 ft × 310 ft) with a portion of the building one story high, and the remainder two stories high. The facility consists of 28 bays, including two bays (12-17A and 12-17B) set apart from the main building[51,52].

The floor in each of the first-level bays in Building 12-17 proper is a 20.3-cm (8-in.) thick, steel reinforced concrete slab poured on a gravel base. Second level bay floors are composed of 30.5-cm (12-in.) thick, steel-reinforced concrete slab and reinforced concrete beam construction. The floors are covered with a seamless adiprene coating. The exterior walls are constructed of 20.3 cm (8 in.) clay tile blocks, and the walls between the bays are constructed of 30.5-cm (12-in) thick, steel-reinforced concrete. Two other common types of walls used in the construction of Building 12-17 are metal studs covered with gypsum board, and steel angle braces faced with cemesto board. The roof for all first level bays, with the exception of those having a second level, in Building 12-17 proper is a purlin type, with beams set either 0.6 m or 1.2 m (2 ft or 4 ft) on-center, and two- or three-ply built-up membranes.

Bay 12-17A is a two-story structure with a basement used as a mechanical equipment room that is separate from the rest of Building 12-17. The building dimensions are approximately 11.0 × 10.7 m × 8.1 m (36 ft x 35 ft x 26 ft 6 in.) and primarily composed of steel-reinforced concrete. The building walls range in thickness from 0.3 m to 0.9 m (1 to 3 ft). The main press area walls closest to the main building are 0.9 m (3 ft) thick. The south wall is 30.5-cm (12-in) thick and designed as a "blow-out" panel. A portion of the south wall is from the original building and is constructed of cement-asbestos (cemesto) board on a structural steel frame. The floor slab for main press area is 0.9-m (3-ft) thick. Floor slabs for the remainder of the building varies in thickness from 15.2 cm (6 in.) to 30.5 cm (12 in.) The roof is constructed on a post-stressed concrete system consisting of 1.2 m (4 ft) thick joists, 0.6 m (2 ft) on-center, with 3.2 cm (1¼ in.) diameter carbon cable for tensioning. The roof is covered with a standard two-ply asphalt-and-rock-chip, built-up roof.

Off the northeast corner of Bay 17A, there is a small bay approximately 3.0 m × 3.0 m (10 ft x 10 ft). The area is three-sided, with one of the sides being the wall conjoining the main press bay and the remaining walls being 30.5-cm (12-in) thick, steel-reinforced concrete. The roof is of open web, steel truss construction topped with a three-ply, built-up roof.

Bay 12-17B is 7.9-m wide × 9.1-m long (26-ft wide x 30-ft long) and two stories in height. The bay is a typical footing-and-grade-beam type of construction, with a floor slab resting on the grade. The main press bay wall is 0.9-m (3-ft) thick reinforced concrete. Exterior walls are constructed of steel-reinforced concrete. A portion of the north wall is a cemesto board panel on a structural steel frame. The roof is a prestressed concrete system topped with a built-up roof.

The safety-related systems in Building 12-17 include a fire detection, alarm, and suppression system; a lightning protection system; safety communications; several design features to ensure strict control of high explosives handling; and several design features to mitigate the potential effects of accidental explosions.

The building fire detection, alarm, and suppression subsystems provide automatic firefighting capabilities against fires originating inside the facility. The various bays are equipped with wet-pipe sprinkler systems, heat-activated device deluge systems, and ultra-high speed deluge systems that automatically discharge water in case of fire. Normal operations in Building 12-17 include receiving, staging, and processing high explosives; extrudable high explosives loading into small components; and pressing insensitive high explosives (IHE) and mock explosives. Additionally, assembly and disassembly of small explosive components, dismantlement of weapon components, inspection, inventory, and quality assurance and control activities are performed. The primary process-related operations include HE processing, pressing, and dismantlement.

Bays 1 and 2 are used for oven heating, charge makeup, and dismantlement operations. Bay 3 is used primarily as a staging and dismantlement bay. Both are open at both ends to the building's roof.

Bay 4 is divided into three separate areas. The main portion of the bay is used as an office area. Two smaller areas at either end of the bay were designed as remote control areas for press equipment in Bays 12-17A and 12-17B. Recently, the press and remote control panel has been removed from Bay 12-17A.

Bays 5 and 8 are designated clean areas for small component assembly. Bay 13, containing laser welding operations, is also a clean room. Bay 11, used in the assembly of small components and dismantlement of weapon components, is open at both ends to the roof of the building. Bay 6N and 7N are used for staging and dismantlement operations.

Bays 6S and 7S are used for extrudable explosive loading operations. Bay 9N is used for radiography inspection of small explosive components. Bay 9S contains a walk-in vent hood and is used for solvent soaking operations. Bay 10 is the desig-nated office area for Building 12-17. Bay 12 is used to press explosive pellets. Bays 14 and 15 are used for staging and small component processing.

Bay 16, used for the PETN recrystallization process, has a two-level mezzanine, which holds the processing kettles. Bay 17 is an inspection bay for completed HE product.

Bay 12-17A was originally designed and used to press high explosives into component parts using a Gun Barrel-type press, but the press has been removed. The bay is currently being used as a staging area.

Bay 12-17B is designed for high explosive pressing operations using a pot belly press. The bay is currently being used for IHE and mock explosives pressing operations.

Bays 212, 213, 214, 215, 216, and 217, are located on the second floor of Building 12-17. A break area is located in the hallway east of Bay 216. Bays 212, 213, and 217 are used for storage. Bays 214, 215, and 216 are used for miscellaneous inert storage. Bays 214 and 216 also contain water distilling operations.

3.3.2.4 *Building 12-63, High Explosives Pressing Facility*

Building 12-63 is a moderate hazard facility used for pressing and processing high explosive components in Zone 12 South (Figure 3-2.). The facility consists of three bays, a control room, and three equipment rooms[53].

The concrete floor of Bay 1 measures 7.6 m × 9.5 m (25 ft × 31 ft) and is 15.2-cm (6-in.) thick. The roof and side walls are constructed of a 1-gauge steel arch that has a longitudinal center height of 4.0 m (13 ft). A compacted earth mound 1.4-m (4½-ft) thick covers the steel arch and extends approximately 8.5 m (28 ft) beyond the sidewall foundation. The top of the earth mound is covered by a blast-resistant concrete cap, which extends the full length of the bay and the adjoining ramp.

Bay 2 is 6.7 m ×8.2 m (22 ft × 27 ft), is 4.3-m (14-ft) high, and is currently used for HE processing operations. The concrete walls are 30.5-cm (12-in.) thick. The roof over the main area of the bay is 0.8-m (2 ft 6-in.) thick concrete.

Bay 3 was originally designed to be used for pressing operations, but is currently used as a staging and processing bay. Bay 3 is 6.7 m × 8.2 m (22 ft X 27 ft), is 6.1-m (20-ft) high, and the floor is 15.2-cm (6-in.) thick concrete. The walls are heavily reinforced concrete and are 0.4-m (1-ft 3-in.) thick. The roof is 0.8-m (2-ft, 6-in.) thick concrete with a built-up roofing outer layer over a 1.3 cm (½ in.) layer of insulation.

Two of the bays are equipped with wet-pipe sprinkler systems, consisting of fusible link-actuated heads. Two of the bays contain conventional, heat-activated, deluge fire protection systems. One bay is also equipped with an ultra-high speed deluge system in the area of an HE processing table. A fire alarm is sounded locally, and an emergency signal is automatically transmitted to the plant fire department when the deluge or sprinkler systems actuate or upon manual activation of a fire alarm pull.

Normal operations include receiving, staging, processing, and pressing high explosives. Additionally, inspection, inventory, and quality control activities are performed periodically.Also, demilitarization/sanitization of weapon components from dismantlement operations using the 725,760 kg (800 ton) mechanical press.

Bay 1 is used for pressing HE and mock explosives into component parts. Pressing operations are conducted with the use of a 21.1×10^6 kg/m² (30,000 psi) isostatic yoke press. Bay 2 is used for heating HE in steam ovens, filling mandrel assemblies, vacuum-evacuation of mandrel assemblies, and various quality control activities.

Bay 3 is used for staging and processing operations. The operations include inspecting HE on a magnetic-separator inspection table, weighing HE, processing mock explosives (a non-explosive substance used to simulate HE in certain nonoperational weapon assemblies).

3.3.2.5 *Building 12-121, High Explosives Machining Facility*

Building 12-121 will be a moderate hazard, single-story, production and development machining facility for explosives. It is located in the northwest part of Zone 12 South (Figure 3-2.)[54]. Building 12-121 may replace some or all of the operations conducted in Buildings 12-24, 12-24A, 12-43, and 12-43A. It is divided into two areas: the HE area and the IHE/Support area. The

HE area includes areas for HE machining, staging, quality inspec-tion, and wastewater treatment. The IHE/Support area is used for IHE machining, inert machining, staging, quality inspection, a tool crib, mechanical and electrical rooms, an office area, a control room, a personnel break room, and restrooms.

A ramp on the south side of the facility provides personnel and product access to and from existing facilities. Floors in the HE bays have a seamless, flexible covering that meets the Pantex Plant "skid- test" requirements because uncased explosives are handled in the bays. All walls in the HE and IHE areas are painted with enamel for ease of cleanup.

Building 12-121 is protected by automatic fire detection, alarms, and suppression systems. Fire detection is provided by heat-activated devices and smoke detectors. The fire suppression includes automatic sprinkler and deluge systems. The building is divided into 16 separate fire protection zones, each having independent fire suppression systems.

The main process that takes place in Building 12-121 is explosives machining. Packaged, roughly shaped, compressed explosive pieces are carried by forklift to the Building 12-121 corridor via the ramp, and are transferred by cart to the appropriate bay. Compressed explosives are machined using special-purpose machines. The packaging and transportation of these pieces is performed in accordance with written safety requirements. All transportation of HE and IHE is in approved containers. Explosives are positioned manually on machines on approved fixtures.

After machining, parts are transported by cart to a staging bay, a gaging bay, or another machining bay for further machining. Completed parts are transported out of the building to a storage or assembly area.

3.3.2.6 *Building 12-24S, High Explosives Machining Facility*

Building 12-24S is a rectangular building located in the east central portion of Zone 12 (Figure 3-2.)[56]. The approximately 2,109 m² (22,700-ft²) building was constructed in 1948. Demolition of this facility is pending DOE review and decision.

Building 12-24S operations consist of staging nonnuclear nuclear explosives like assemblies and components, disassembly of Arming Fusing and Firing Assemblies for surveillance and demilitarization activities, and mixing and casting epoxy foam.

HE is not permitted in Bays 1 through 9 and 11 through 21 but these bays have an IHE limit of 113.4 kg (250 lb). The explosive limit for Bay 24 is 0.9 kg (2 lb) and Bays 23, 25 through 33, 36, and 37 have HE limits of 5.4 kg (12 lb).

Equipment and systems used in operations include an overhead hoist, ladders, vacuum system, fire protection system, machine tools, hand and fork lifts, and electric carts.

3.3.2.7 *Building 12-43, High Explosives Filtration Facility*

Building 12-43 is an approximately 251 m² (2,700 ft)² building located near the eastern border in the east central portion of Zone 12 South (Figure 3-2.)[57]. Demolition of this facility is pending DOE review and decision.

The primary operations of the facility consist of filtering the process water from the explosive machining operations in Building 12-24. The influent from Building 12-24 averages approximately 5 ppm explosive and the effluent leaving Building 12-43 averages approximately 2 ppm. The filtering system processes approximately 11,355 liters (3,000 gallons) of contaminated process water per year. The filtering process produces approximately 113.4 kg (250 lb) of HE-contaminated carbon, 37,850 liters (10,000 gallons) of steam condensate, and 181.4 kg (400 lb) of HE contaminated waste per year.

The equipment used in the filtration process includes a sieve (sock-type) filter and a carbon filter. The sieve filter has six vessels of approximately 56.8 liters (15 gallons) each and the carbon filter has one vessel of approximately 1,136 liters (300 gallons) each. Other equipment and systems in Building 12-43 include an overhead hoist, fire protection system, and ladders. The IHE limit for Building 12-43 is 59 kg (130 lb) and the HE limit is 45.4 kg (100 lb).

3.3.3 Staging

This section discusses the structural design and operations that involve the HE staging before assembly and after disassembly operations. Radiological materials are not staged in the same facilities as the HE, with the exception of Building 12-55 which is currently being used for the storage of equipment and a radiation source for nondestructive evaluation. These facilities include:

- Building 11-42, High Explosives Service Magazine (Section 3.3.3.1)
- Buildings 4-45 through 4-75, Richmond Magazines (Section 3.3.3.2)
- Building 11-23, High Explosives Staging Facility (Section 3.3.3.3)
- Building 11-25, Service Magazine (Section 3.3.3.4)
- Building 11-37, Explosive Storage (Section 3.3.3.5)
- Building 11-45, High Explosives Storage Facility (Section 3.3.3.6)
- Building 11-46, Explosives Service Magazine (Section 3.3.3.7)
- Building 12-55, Production Staging Facility (Section 3.3.3.8)
- Building 12-58, Weapons and Weapons Components Staging Facility (Section 3.3.3.9)
- Building 12-65, High Explosives Service Magazine (Section 3.3.3.10)
- Building 12-71, Explosives Staging Magazine (Section 3.3.3.11)
- Building 12-83, High Explosives Service Magazine (Section 3.3.3.12)
- Building 12-92, High Explosives Service Magazine (Section 3.3.3.13)
- Building 12-95, Explosives Staging Magazine (Section 3.3.3.14).

3.3.3.1 *Building 11-42, High Explosives Service Magazine*

Building 11-42 is a moderate hazard facility in Zone 11 initially constructed in 1966 (Figure 3-1.). It is an explosives magazine used for the storage of HE and IHE parts/materials[58]. This facility is comprised of six bays. Three bays measure 21.4 m² (230 ft²) each, two bays measure 64.1 m² (690 ft²) each, and one bay is 84.6 m² (911 ft²). These bays are earth-covered, steel-arched type construction. All concrete floor slabs are reinforced. The floors in all bays are covered with a seamless conductive flooring.

Fire control for this facility is provided by the Fire Department by utilizing the high pressure fire loop

Bays 1 through 4 and Bay 6 are Explosive Hazard Class III, but the activities in Bay 5 are Class II. The Staging/Service Magazine bay operations consist of storage of high explosives in five bays. Abused explosives, determined to be Group L materials, are stored in a separate bay. One bay is utilized for storage of containerized less-than-90-day hazardous waste. HE is allowed in the same bay, however, the HE must be compatible with the waste in accordance with the DOE Explosives Safety Manual. Other high explosives and high explosives parts are also stored in the other three bays within the facility. Receiving of HE and HE parts, sampling, weighing, and packaging of HE, and packaging of HE parts are conducted in Bay 5. HE is stored in the 2.4 m × 2.4 m (8 ft × 8 ft) room.

3.3.3.2 *Buildings 4-45 through 4-75, Richmond Magazines*

These 31 Staging Magazines (Buildings 4-45 through 4-75) were constructed in 1944 and are located in the east half of Zone 4 (Figure 3-4.). All of the buildings, with the exception of 4-50 and 4-72 are moderate hazard facilities. Buildings 4-50 and 4-72 are support facilities and are discussed in Sections 3.5.2.6, and 3.5.2.7[59]. All of the remaining magazines are identical in construction, each one approximately 96.6 m² (1,040 ft²). The magazines consist of a concrete slab floor and three concrete walls with earth cover sloped up to the top of the exterior sides. The fourth wall is clay tile and has a 5.5 m (18 ft) wide roll-up door that opens to a concrete driveway. A 76.2-cm (30-in.) wide personnel access door is also provided through this wall. The roof of each magazine is cemesto board on top of wood deck supported by wood trusses.

No utilities are provided in any of the magazines. Ventilation occurs by natural convection through the use of vents in the front wall and gravity ventilators in the roof. Telephones are provided on poles located outside of Magazines 4-50, 4-69, and 4-72. At least two portable fire extinguishers are readily accessible to personnel during operations at a magazine. These extinguishers are used the purpose of fighting small external fires or magazine fires where explosives are not involved. Each magazine is provided with a lightning protection grounding system in each magazine.

These magazines are primarily used for storage of HE and IHE; but, selected magazines are also used to store other materials. Electrically powered forklifts or low lifts are used inside magazines for loading and storing material. The maximum explosives limit for HE explosives ranges from 22,680 to 36,288 kg (50,000 to 80,000 lb) and the IHE limit is 90,720 kg (200,000 lbs) for each facility. Appendix B provides HE and IHE limits for each facility.

3.3.3.3 *Building 11-23, High Explosives Staging Facility*

Building 11-23 is a moderate hazard facility in Zone 11 (Figure 3-1.), originally constructed during World War II, reactivated in 1968, and currently used for HE storage[60]. It is a one-story, 58.5 m² (630 ft²) facility that is made up of two staging/resting bays. The building walls are constructed of hollow clay tile. The floors in both bays are concrete with a seamless urethane flooring. The roof is constructed of a mineral surface on wood sheeting and trusses. Building 11-23 is contaminated with HE, and is scheduled for demolition after decontamination no sooner than 1996.

Building 11-23 is protected by an automatic dry pipe sprinkler system. The sprinkler system consists of a 10.2 cm (4 in.) dry pipe valve and riser located in Building 11-24. The system is a pipe schedule design for an ordinary hazard occupancy providing adequate coverage to the facility. Building 11-23 is equipped with a water flow pressure switch and an air supervisory switch that transmits fire and supervisory alarms, respectively, to the Plant Fire Station. The only audible alarm device for this system is the sprinkler water motor gong at Building 11-24. There are no building fire alarm control panels, fire evacuation bells, or manual fire alarm stations. The lighting in Building 11-23 has a classification of Class II, Division 2 for hazardous locations; and a lightning protection system is also provided.

Building 11-23 is used for explosive storage/staging to support explosive synthesis operations in Building 11-36. The operations in this facility are Explosives Hazard Class III. The maximum explosive storage time is 180 days.

3.3.3.4 *Building 11-25, Service Magazine*

Building 11-25 is a moderate hazard facility in Zone 11 (Figure 3-1.) and is used as a service magazine for storage of energetic materials such as explosive samples[61]. Building 11-25 is a one-story, 89.2 m² (960 ft²) facility constructed in 1961. The exterior walls are concrete block. The concrete floor is covered with rubber mats approved through the use of established procedures. The roof is constructed of built-up roofing over a cemesto deck on a steel frame.

The lighting in this facility has a classification of Class II, Division 2, for hazardous locations. A lightning protection system is provided in Building 11-25.

Building 11-25 is used to store explosives samples less than 454 grams (1 lb). The maximum storage time of such explosives is 180 days. The explosives activities in this facility are Explosives Hazard Class III.

3.3.3.5 *Building 11-37, Explosive Storage*

Building 11-37 is a moderate hazard facility in Zone 11 (Figure 3-1.) used for explosives staging and drying[62]. Two staging/resting bays were constructed for high explosives staging operations. These bays are earth-covered, steel-arched type construction. They are each 27.9 m² (300 ft²) with a covered access entrance in front. All concrete floor slabs are reinforced concrete with an expansive shrinkage-compensating cement having a maximum design live load of 1,221 kg/m² (250 psf). The floors in both bays are covered with a seamless resilient flooring. Blast doors have been installed at the entrance to each bay.

The two staging bays are protected by a wet-pipe sprinkler system, and the cover access in front of the bays is protected by a dry-pipe sprinkler system, which is an extension of the dry-pipe system in Ramp 11-R-8. The automatic wet-pipe sprinkler system servicing the bays is designed for extra hazard occupancy, and the covered access area dry-pipe sprinkler system is designed for ordinary hazards.

Building 11-37 is used to support operations in Building 11-20. The HE Staging/Drying Facility bay operations consist of storage in the North Staging Bay and disbursement and drying of high explosives in the South Staging Bay. The north bay is also used for storage of complete test fire assemblies.

The North Staging Bay is used for storage of compatible explosives, which may be in powder, pressed, cast, or machined configurations. This bay has storage racks, cabinets, and a workbench. The maximum storage time for such explosives is 180 days, except as indicated in the Facility Management Waiver granting deviation from the DOE Explosives Safety Manual.

High explosives drying operations are conducted in the South Staging Bay. Workbenches and a refrigerator for explosives are located in the east room of this bay. A steam-heated vacuum-drying oven with temperature limit controls is located in the west room of this bay.

3.3.3.6 *Building 11-45, High Explosives Storage Facility*

Building 11-45 is a moderate hazard facility in Zone 11 (Figure 3-1.) used to store Group A high explosive samples[63]. Building 11-45 is a one-story facility initially constructed in 1944. The floor area of the building is 7.6 m² (82 ft²). The walls and roof of the facility are constructed of corrugated transite panels, connected to steel framing. The floor is concrete and is covered with a floor covering approved through the use of established procedures.

A lightning protection system is provided for Building 11-45.

Building 11-45 is a Group A explosive storage facility. The maximum storage time of explosives is 180 days.

3.3.3.7 *Building 11-46, Explosives Service Magazine*

Building 11-46 is a storage facility in Zone 11 constructed in 1944 (Figure 3-1.) and used to store detonators[64]. Building 11-46 is one-story facility initially constructed in 1944. The concrete floor area of Building 11-46 is 5.6 m^2 (60 ft^2). The walls and roof of the facility are constructed of corrugated transite panels, connected to steel framing.

The lighting in the building has a classification of Class II, Division 2, and Class I, Division 2, for hazardous locations. .

A lightning protection system is provided for Building 11-46. Building 11-46 is a storage facility used to store 1.4 detonators. Pursuant to DOE Variance Request No. 7, dated February 1, 1994, a Facility Waiver was granted for the storage of detonators in Building 11-46, in excess of 180 days.

3.3.3.8 *Building 12-55, Production Staging Facility*

Building 12-55 is a moderate hazard facility in Zone 11 (Figure 3-1.) used for HE storage[65]. Building 12-55 consists of three earth-covered bays with a total floor area of 71.9 m^2 (774 ft^2). Each bay is a corrugated steel arch anchored to reinforced-concrete walls. End walls for each bay are 30.5-cm (12-in.) thick reinforced concrete. The reinforced-concrete floor slab is 15.2-cm (6-in.) thick. The adjacent ramp and equipment room are constructed of reinforced concrete masonry block walls, 15.2 cm (6 in.) reinforced-concrete floor slab, and steel bar joist roof structure with built-up roofing over a steel deck.

The electrical equipment and lighting located in the bays and corridors meet the requirements of Class II, Division 2 for hazardous locations.

Emergency lighting for the bays is supplied by a battery-operated emergency light located in the ramp. The battery charger for the emergency light is hardwired into the main building circuit to provide continuous charging.

A lightning protection and grounding system is provided in Building 12-55.

The facility is protected by an automatic wet-pipe sprinkler system. The system contains a 10.2 cm (4 in.) alarm valve connected to a 15.2 cm (6 in.) underground lead-in main supplied by the Zone 12 high pressure fire loop. Upon detection of water flow in the system or activation of a manual fire alarm station, local evacuation alarms (bells and lights) are actuated; and a coded fire alarm signal is transmitted to the Plant Fire Station.
The fire alarm protection system is electrically supervised and has a 24-hour emergency battery power supply. An emergency notification system has been installed in the facility for announcement of evacuation instructions by the Fire Department.

Building 12-55 is currently being used for the storage of equipment and a radiation source for Non-Destructive Evaluation. The facility can be used for explosives storage or radiographic operations. The cobalt source for radiographic equipment is presently stored in Bay 2. No plutonium is allowed to be stored in this facility.

3.3.3.9 *Building 12-58, Weapons and Weapons Components Staging Facility*

Building 12-58 is a moderate hazard facility in Zone 12 South (Figure 3-2.) originally built in 1966[29]. Each bay is used to store small amounts of Class 1.1 and 1.3 explosives. No plutonium is staged in these bays. The utilities serving the bays are electricity, steam, and water (for the HVAC), and electrical lighting. The only safety-related system associated with the bays is a wet-pipe fire protection system. A telephone and a public address speaker in the ramp adjacent to the bays provide safety communications.

Building 12-58 consists of five separate single-story staging bays and has a ground area of approximately 243 m^2 (2,616 ft^2). Bays 1, 2, and 3 are designated as explosives staging bays and are used to receive, ship, and store weapon components and explosives materials. See Section 3.2.1.5 for a description of Bays 4 and 5. All five bays are served by a ramp and by an equipment room. Entrance into each bay is via a pair of hollow metal doors. Bays 1, 2, and 3 were constructed in 1965. This building was designed to provide for Explosives Hazard Class III activities.

The interior dimensions of the Bays 1, 2, and 3 are 3.4 m × 5.2 m (11 ft × 17 ft). The side walls are 0.4-m (1¼-ft) thick reinforced concrete, and the back wall and retaining wall are 0.3-m (1-ft) thick reinforced concrete. The side walls of these bays are 0.9-m (3-ft) high and provide a base to which the steel arch roofing (quonset hut style) is attached. The steel arch has a 1.91-m (6.25-ft) radius, giving a ceiling height of 2.8 m (9.25 ft) at the center. The bays are separated from each other by 4.9 m (16 ft) of earth-fill and have an earthen overburden of at least 0.6 m (2 ft). The 4.22-m (14-ft) high, 0.3-m (1-ft) thick reinforced-concrete front wall serves as a retaining wall for the earthen overburden and earth fill, extending beyond both side walls of the bays. The floor is a 15.2 cm (6 in.) reinforced-concrete slab. The ramp walls are constructed of concrete block on steel-reinforced concrete footers. The ramp roof consists of mineral fiber form board covered with a poured gypsum deck and "built-up" roofing, which is composed of layers of fiberglass felt, asphalt, and gravel. Support for the roof is provided by a metal truss, which also supports the utilities supplied to the area.

Bays 1, 2, and 3 are supplied with two single-bulb light fixtures. Two wall-mounted emergency light units are installed in the ramp area; one between Bays 1 and 2, and the other between Bays 3 and 4. These lights will automatically illuminate for means of egress in the event of any interruption of normal lighting. The self-contained fully automatic emergency light unit is equipped with a rechargeable battery which provides illumination for a period of at least 1½ hours. A lightning protection system is also supplied in Building 12-58.

Bays 1, 2, and 3 are protected by an automatic wet-pipe sprinkler system with a 15.2 cm (6 in.) alarm check valve and riser located in the equipment room. The sprinkler system is connected to a 15.2 cm (6 in.) lead-in main with an outside post indicator valve. Upon detection of water flow in the system or activation of a manual fire alarm station, local evacuation alarms sound (inside bells and outside water motor gong), and a coded fire alarm signal is transmitted to the Plant Fire Station. The fire alarm signaling system is electrically supervised and has a 24-hour emergency battery power supply.

Bays 1 and 3 are limited to the staging of Class 1.1 (mass detonating), 1.3 (mass fire), and 1.4 (moderate fire, no blast or fragments) explosive component parts. Bay 2 allows for the staging of Class 1.3 and/or 1.4 explosive materials only. Explosives in these bays will remain in their original or approved in-plant shipping containers. Materials taken into or from these bays are either hand loaded or assisted with a forklift truck.

3.3.3.10 *Building 12-65, High Explosives Service Magazine*

Building 12-65 (Service Magazines) is a moderate hazard facility in Zone 12 South (Figure 3-2.), which was constructed in 1973. It consists of seven high explosives service magazines connected along a common corridor and an access ramp[66]. The magazines are covered with mounded earth to protect adjacent magazines in case of an HE explosion. Each magazine is approximately 6.7 m × 6.7 m (22 ft × 22 ft) inside. The sidewalls and roof are formed by 1-gauge galvanized, corrugated steel arches, set on a 15.2 cm (6 in.) thick concrete floor with a perimeter foundation curb. The rear wall of each individual magazine is 0.3 m (1 ft) thick concrete, and another 0.3 m (1 ft) thick concrete wall along the corridor forms a common front for the row of magazines. Each magazine has a 2.4 m × 2.4 m (8 ft × 8 ft) front opening through the wall, which is closed by opposing swinging leaves that are 1.2 m × 2.4 m (4 ft × 8 ft). These doors are tornado resistant because of their heavy construction. Each door face is constructed out of a 0.5 cm (3/16 in.) steel plate, welded to a core of structural channel iron.

Each magazine is supplied by Class II, fluorescent lighting and 110-V convenience outlets. The magazines are protected by a water sprinkler system suitable for extra hazardous locations.

The purpose of this facility is to provide safe temporary storage for high explosives processed in Zone 12. Explosives are stored on shelves located along the magazine walls, and are also stored in specially packed metal AN containers either on pallets or setting on the floor within the magazine.

Up to 1,762.2 kg (3,885 lb) of HE or 2,948.4 kg (6,500 lb) of IHE may be stored in one magazine at a time. Other than low level radioactive material, e.g., depleted uranium, no nuclear material is allowed inside Building 12-65. Strict control is maintained over temperature and humidity. Main charge explosives are transported in specially packed metal AN containers that are mounted in specially designed pallets.

3.3.3.11 *Building 12-71, Explosives Staging Magazine*

Building 12-71 is a moderate hazard facility in Zone 12 South (Figure 3-2.), which was constructed in 1975. It consists of two rooms: a 5.8 m ×6.1 m (19 ft × 20 ft) packaging room and a 11.9 m × 12.2 m (39 ft × 40 ft) storage room[67]. The facility is constructed with Zonolite-filled concrete block walls and a 15.2-cm (6-in.) thick concrete slab floor. The roof consists of a Class A built-up roof covering an FM Class I insulated metal deck and steel joists. The false ceiling consists of 1.6 cm (⅝ in.) gypsum board covering the roof joists.

The packaging room contains facilities for receiving, inspecting, packaging, and repackaging Class C explosive devices. Parts and materials for the staging and repackaging operations are brought on transportation carts and forklifts into the bay through the vestibule from the outside ramp. Storage is on metal racks with solid metal shelves, 71.1-cm (28-in.) wide. Racks are arranged in single and double rows with 15.2 cm (6 in.) flue space between double rows, and 1.2 m (4 ft) aisles.

3.3.3.12 *Building 12-83, Explosives Service Magazine*

Building 12-83 is used for temporary staging of HE and IHE parts/materials in Zone 12 South. The building was constructed in 1983 and is classified as a moderate hazard facility (Figure 3-2.). Operations are similar to existing operations located in the Building 12-65 service magazine[68].

Building 12-83 consists of seven standard, earth-covered, steel arch-type magazines for temporary staging of in-process high explosive materials. The seven service magazines are located 48.5 m (159 ft) southeast of Building 12-73, and they connect to ramp 12-R-29.

The magazines are earth-covered, with a 0.6 m (2 ft) minimum cover and a maximum slope of 2:1. Erosion control is installed over the earth cover. All floors are reinforced concrete over a 15.2 cm (6 in.) sand bed and have a steel troweled finish. The magazine floors have a radial rubber tile floor covering with an integral cover base extending a of 15.2 cm (6 in.) up the wall which is approved for high explosive operations. Floors of the magazines have curbs at the side walls for attachment to the semicircular steel arch.

The end walls of each magazine are constructed of 0.3-m (1-ft) thick, reinforced concrete. Semicircular corrugated steel arches form the side walls and roofs of the magazines and portions of the ramps. The equipment rooms are separated from the magazines and corridor by a 2-hr minimum fire separation wall. The storage room is also separated from the corridor by a 2-hr minimum fire separation wall.

Each magazine door is designed such that a detonation of 2,948 kg (6,500 lbs) of TNT in an adjacent donor magazine will not cause the doors or portions of the doors of the acceptor magazine to become missiles within the acceptor magazine. They are constructed of double leaf steel plate and are 2.4-m (96-in.) high.

The facility is protected by an automatic wet-pipe sprinkler system. The connecting ramp to Ramp 12-R-29 is protected with a dry pipe system. The system is complete with an alarm check valve (located in the south equipment room), water flow alarm switch, excess pressure pump, local alarms for building occupants, outside water-motor gong, and fire alarm transmitter devices compatible with the Plant's coded system. The sprinkler system is supplied by an 20.3 cm (8 in.) underground lead-in, connected to an 20.3 cm (8 in.) branch main of the plant's high pressure fire loop water distribution system.

Each of the seven service magazines has a limit of 2,948 kg (6500 lb.) IHE only. HE limits are 2,268 kg (5,000 lb) for Bay 1, 907 kg (2,000 lb) for Bay 2, 204 kg (450 lb) each for Bay 6 and Bay 7. Only IHE is allowed in Bays 3, 4, and 5. The movement of explosives is accomplished with a forklift. Forklifts are not permitted in areas where there are exposed explosives. The predominant sizes handled weigh from 3.6 kg to 11.3 kg (8 lb to 25 lb), and can be safely handled by one person. (Lifting procedures require a limit of 25.0-kg or 55-lb weight for one person, and pieces weighing 25.0 kg to 45.4 kg or 55 to 100 lb require two people). Any piece weighing over 45.4 kg (100 lb) requires mechanical aids and procedures are established and approved as necessary.

3.3.3.13 *Building 12-92, Explosives Service Magazine*

Building 12-92 is a moderate hazard facility in Zone 12 South (Figure 3-2.) and was initially constructed in 1984[15]. The facility is an earth covered corrugated steel arch structure of approximately 55.7 m², or 7.5 m × 7.0 m (600 ft², or 24½ ft × 23 ft). The arch of the magazine is formed of No. 1 gage semicircular steel. The floor slab is placed over a 15.2 cm (6 in.) sand bed and is of reinforced concrete using expansive shrinkage compensating cement. Flooring consists of a 0.13 cm (0.050 in.) resilient floor covering meeting the Shore "A" durometer hardness test of 95.

The exterior of the steel arches was waterproofed with bituminous material and a moisture-proof membrane prior to backfilling with earth. Steel arch joints are sealed with waterproofing tape.

Double leaf, steel plate, blast doors are utilized for this facility. The doors were constructed to prevent propagation from an explosion in an adjacent facility.

Building 12-92 is used as a Special Purpose Facility in support of assembly/disassembly operations.

3.3.3.14 *Building 12-95, Explosives Staging Magazine*

Building 12-95 is a moderate hazard facility in Zone 12 South (Figure 3-2.), constructed in 1984, with a design life of 40 years. It consists of a 11.6 m × 14.0 m (38 ft × 46 ft) staging area, 5.5 m × 6.1 m (18 ft × 20 ft) packaging area, 3.4 m × 5.5 m (11 ft × 18 ft) mechanical room, and a 3.7 m × 49.4 m (12 ft × 162 ft) connecting ramp[69]. The facility is constructed with 20.3 cm (8 in.) concrete block walls. The roof consists of a built-up asphalt and marble chip aggregate roof insulation over metal deck steel bar joists. The false ceiling in the packaging area consists of 1.6 cm (⅝ in.) gypsum board covering roof joists, whereas the staging and ramp areas consist of painted exposed structures.

Building 12-95 is protected by an automatic, wet-pipe, fire suppression system. Automatic fire detection devices and central alarm systems alert personnel and are connected directly to the Fire Department.

The staging area contains rows of metal storage racks. The packaging area contains work space for packaging and repackaging small explosives to be used in various tests. The packaging area contains facilities for receiving, inspecting, and packaging Class C explosive devices. Parts and materials for the staging and packaging operations are brought on transportation carts and forklifts into the staging and/or packaging areas from the outside ramp.

Staging is done on metal racks with solid metal shelves, 71.1-cm (28-in.) wide. Racks are arranged in single and double rows, with 15.2 cm (6 in.) flue space between double rows, and 1.2 m (4 ft) aisles. All explosives are either self-contained or are packaged self-contained. Storage is primarily in metal AN containers. No explosive operations other than storage and packaging are done in the facility.

3.3.4 Testing and Evaluation

This section discusses the structural design and operations that involve the testing and evaluation of HE and HE components. These facilities include:

- Building 11-5, Physical Properties Facility (Section 3.3.4.1)
- Building 11-16, High Explosives Environmental Testing Facility (Section 3.3.4.2)
- Building 11-18, Explosives Testing Facility (Section 3.3.4.3)
- Firing Sites (Section 3.3.4.4)
- Building 12-21, Gas Analysis Laboratory (Section 3.3.4.5)
- Building 12-21A, Nondestructive Evaluation Laboratory (Section 3.3.4.6)
- Building 12-31, High Explosives Subassembly Facility (Section 3.3.4.7)
- Buildings 12-32 and 12-33, Inert Operations Facilities (Section 3.3.4.8)
- Building 12-56, Neutron Radiography Facility (Section 3.3.4.9)
- Building 12-26, Bays 22 and 26 (Section 3.3.4.10).

3.3.4.1 *Building 11-5, Physical Properties Facility*

Building 11-5, initially constructed in 1944, is an 832 m² (8,960 ft²) two-story building in Zone 11 (Figure 3-1.) made from 30.5-cm (12-in.) thick reinforced-concrete walls on the first level and concrete masonry units on the second. Building 11-5 is a moderate hazard facility[70]. The building is approximately 13.1 m × 35.1 m (43 ft × 115 ft.)

The gabled roof is made from wooden trusses. The first level is designed for Class I, II, III, and IV operations. All floors are concrete covered with flooring approved through the use of established procedures. Functional areas on the first level of the facility are eight operational bays and a control room. The second level has a work room, equipment room, and an environmental chamber area with control room.

Several explosive nonpropagation containers and equipment skids for the environmental chambers are located throughout the facility. Various pumps are located in the mechanical rooms. The computer room contains the monitors and controllers for the environmental chambers.

Wall-mounted emergency lighting is provided throughout the facility. These lights will automatically illuminate the means of egress in the event of any interruption of the normal power supply to the lighting. Each emergency light unit is equipped with a battery providing a 1½ hour emergency power supply.

An uninterruptible power supply provides power through the use of a constantly running inverter and large rectifier/charger.

A lightning protection and grounding system is also provided in Building 11-5.

The first and second levels of the building are protected by a wet-pipe sprinkler system and the attic by a dry-pipe system. Upon water flow in the system, local evacuation alarms sound and an alarm is transmitted to the Plant Fire Station. The fire alarm signaling system is electrically supervised with a 24-hr emergency battery power supply, and is connected to the uninterruptible power supply.

Manual fire alarm stations are provided adjacent to the emergency exits.

A vacuum system to remove HE contamination is also provided for this building.

Building 11-5 Bays 3, 4, 6, 9, and 21 contain environmental chambers which are used to provide environmental conditions for testing HE and IHE containing systems. Safety controls and features are a major part of the design of the chambers. These controls include a Panic Button system, an Independent Manual Reset Over-Temperature 109°C (228°F) System, Auto Reset Heater Element 165°C (329°F) Interrupters, Airflow Differential Circuit, Power Surge Protection, and Humidity Controller.

Emergency eyewash facilities and portable fire extinguishers are conspicuously located in the building on each floor.

The testing in Building 11-5 involves determining the physical properties of HE. Typical tests include tension, compression, and torsional testing. Adhesive compounds are also developed in this building. Operations in this building require three to six employees.

Mechanical testing of explosives is done remotely using tensile, compression, and diametric disc specimens of various sizes. Testing is done on two Instron Universal test machines and a Phoenix 20K tester in Building 11-5. Each machine's control is located in the general purpose control room (Bay 9) with their associated load frames located in Bays 3, 4, and 6.

3.3.4.2 *Building 11-16, High Explosives Environmental Testing Facility*

Building 11-16, the High Explosives Environmental Testing Facility, is a small, one-room, moderate hazard facility used for environmental testing of small quantities of HE in Zone 11 (Figure 3-1.)[71]. It is a square one-story building, approximately 5.6 m (8½ ft) on each side, with brick walls, a concrete floor, and a wooden roof.

The dry electrical transformer is west of the facility and the air conditioner unit is on the east side of the building. This facility is scheduled for demolition in 2001.

Five environmental ovens are operated in this building. The facility entrance is on the north side of the building, off Ramp 11-R-11. The temperature interrupters are mounted on the east wall, approximately 1.2 m (4 ft) from the floor. The lightning protection system is mounted on the roof of the building.

There are three safety-class items in Building 11-16: the temperature interrupters for the environmental ovens, the electrical grounding system, and the lightning protection system. These safety systems are designed to prevent accidental detonation of the high explosives. The temperature interrupters continuously monitor the temperatures in the ovens and disconnect power if a preset maximum temperature limit is reached. The grounding system electrically links the systems in Building 11-16 and is designed to prevent static discharges. The lightning protection system is a static system designed to mitigate the effects of lightning strikes on Building 11-16.

The only process in Building 11-16 is the environmental testing of high explosives. Testing consists of elevating the temperature of the high explosive to simulate the aging process. All experiments are contained in approved containers. The environmental ovens used in the process pass warmed air over the test containers. There are no waste streams from the facility. The maximum capacity of the building is 34.9 kg (77 lbs) of HE or 45.4 kg (100 lbs) of IHE. The nominal processing capability depends on the length of the test.

3.3.4.3 *Building 11-18, Explosives Testing Facility*

Building 11-18 is the Test Fire Facility in Zone 11 (Figure 3-1.), which is used for testing of explosives. It is a one-story, moderate hazard facility[72]. It was originally constructed during World War II, although additions and modifications have been made, most recently in 1985. The structural frame is concrete block and hollow clay tile. Room partitions are constructed of cemesto board on steel framing. The floor is concrete with a seamless urethane flooring.

Functional areas within the facility consist of a camera room, testing room, electronic assembly control room, dark room, and corridor space. The testing room consists of a test firing chamber, portable vacuum cleaner, sprinkler riser, and miscellaneous equipment needed to support the test shots. The camera room contains monitors and camera equipment. The electronic assembly control room houses the control panel and electronic diagnostic equipment.

The entire facility is protected by an automatic, wet-pipe sprinkler system. The available water supply at the existing main has a static pressure of 1.1×10^6 kg/m^2 (40 psi) with 142.9 liters/sec (2,265 gpm) flowing.

Operation of the Test Fire Facility consists of the one-dimensional time-to-explosion (ODTX) test of explosives and test-firing small components. The ODTX test determines the detonation time of confined energetic materials at different temperatures. The ODTX is a remote operation. The lab-scale apparatus used to perform this test is located in the firing chamber, and the personnel control the test from the control room and camera room.

Test-firing of small components involves evaluating the detonation and velocity of these components. The test is performed in a manner similar to that of the ODTX test. A component is placed in the test-fire chamber and personnel control the test from the control room. After the test-fire, personnel verify the condition of the shot from the control room before entering the test room or chamber.

3.3.4.4 *Firing Sites*

Several different buildings comprise the firing sites (Figure 3-6.). Each facility is discussed separately in the following sections.

Building FS-2. Building FS-2 is a one-story reinforced concrete building with 30.5-cm (12-in.) thick concrete walls and 18.2 m^2 (196 ft^2) of floor space. The building has a 12.7 cm-thick (5-in.-thick) concrete roof slab covered with layer of insulation and a built-up roofing outer layer. The floor is a 15.2 cm (6 in.) concrete slab with a resilient cover. The facility contains an electrical system, HVAC, and lightning protection system. A fire extinguisher and telephone are also provided. Building FS-2 is a moderate hazard facility. It is used to stage explosive material to be used for test fires at FS-10 and FS-21[73].

Building FS-4. Building FS-4, the Test Fire Facility, is a moderate hazard, one-story bunker (10.0 m × 6.1 m [32²/₃ ft × 20 ft] approximate interior dimensions) with walls, floor, and roof of reinforced concrete. FS-4 was built in 1951[75]. The roof is approximately 0.5-m (1½-ft) thick and is coated with pitch and gravel. The walls are approximately 0.5-m (1½-ft) thick and 2.4-m (8-ft) tall. The top of the building extends approximately 0.6 m (2 ft) above ground level. A 2.5-cm (1-in.) thick steel plate covers approximately 0.9 m (3 ft) of the roof and 0.9 m (3 ft) of the wall on the top corner of the building closest to the firing pad. Earthen barricades are built up to the north, east, and south of the building and firing pad. This support building houses a vacuum pump and methane gas cylinder. Piping for methane and vacuum supply are extended to FS-4.

The interior of the building consists of a control room and a camera room. Portholes with periscopes are provided in the camera room for photographing test firings. A sound reduction door is located between the camera room and control room.

A door at the bottom of a flight of stairs, which opens into the control room, is the only entrance or exit to the building.

Single-bulb emergency lights with battery backup are provided in the control room.

A lightning protection grounding system is provided in FS-4. FS-4 is mostly underground, and lightning protection is provided on a pole next to the building.

This facility is protected by a total flooding Halon 1301 Fire Extinguishing System. The system is actuated by heat detectors or a manual system trip station located on the Halon cylinder control head. An adjustable time delay of 0 to 25 sec between activation of alarms and discharge of the Halon is provided for personnel evacuation.

A fire alarm signaling system is provided for the facility. The system has a 24-hour emergency battery power supply and is electronically supervised to transmit a supervisory alarm in FS-4 and the Plant Fire Station upon loss of power or detection of a fault condition. Upon detection of a fire condition, the HVAC system is shut down, electrical power is disconnected to the test equipment, local evacuation alarms (bells and lights) are initiated, and an alarm is transmitted to the Plant Fire Station. The Halon discharges after a preset time delay (0 to 25 sec) only when a fire condition is detected by the heat detectors.

The firing site area is equipped with a test fire interlock and warning system to ensure that area personnel and transients are notified of impending test firing. The system consists of area pole-mounted sirens and rotating red lights, a barricade on the access road, and interlocks wired to the firing controls. The interlocks include limit switches on the access barricade and facility door and switches at each of the area operational facilities (FS-4, FS-10, FS-22, and FS-23) and at the telephone booth located near the access barricade. The limit switches ensure that the barricade has been placed across the access road and that the facility door is closed. The switches at each facility must be turned to the "ON" position to ensure that personnel at these locations are aware of the impending test firing.

A methane monitor is provided in the control room of Building FS-4.

The FS-4 facility is used for qualification testing of explosive components. The components are placed on blow-away shot stands, which are positioned either on steel firing pads or over a gravel pit. Detonation of the explosive components is controlled from inside the FS-4 building. Cameras are set up in the camera room to photograph the explosion via periscopes through the ceiling of the camera room. The firing controls are interlocked with the building door, area access roadblock, other area firing sites, and area visual and audible alarms to ensure coordination of personnel protection in the area. Also, personnel are required to operate the sirens and lights for 4 minutes before initiating a test firing.

Building FS-5, Test Fire Facility. Building FS-5, the Test Fire Facility, is a moderate hazard, one-story bunker (10.1 m × 6.1 m [32 ft 8 in × 20 ft] approximate interior dimensions) with walls, floor, and roof of reinforced concrete identical to FS-4. The roof is approximately 0.5-m (1½-ft) thick and is coated with pitch and gravel. The walls are approximately 0.5-m (1½-ft) thick and 2.4-m (8-ft) tall. The top of the building extends approximately 0.6 m (2 ft) above ground level. A 2.54-cm (1-in.) thick steel plate covers approximately 0.9 m (3 ft) of the roof and 0.9 m (3 ft) of the wall on the top corner of the building closest to the firing pad. Earthen barricades are built up to the north, east, and south of the building and firing pad. An approximately 1.5 m² (16 ft²) building outside the earthen barricade formerly housed a vacuum pump and methane gas cylinder.

A door at the bottom of a flight of stairs, which opens into the control room, is the only entrance or exit to the building. A lightning protection grounding system is provided in FS-5. FS-5 is mostly underground, and lightning protection is provided on a pole next to the building. FS-5 is no longer operational and work orders have been submitted to remove all the equipment. Only a few equipment racks are left in the facility. The fire protection system is no longer operational.

Building FS-10. Building FS-10 is a firing bunker, approximately 609.6 m (2,000 ft) northeast of Building FS-1[76]. Building FS-10, built in 1962, is a moderate hazard, one-story, 138 m² (1,490 ft²) facility that is surrounded on the north, east, and west sides by an earthen barricade designed for missile containment. The east, west, and south exterior walls, and the roof of Building FS-10 are constructed of 0.6-m (2-ft) thick steel-reinforced concrete, with Class A membrane waterproofing covering the roof. The north exterior wall is a 1.5-m (5-ft) thick steel reinforced concrete wall that is covered on the firing pad face and top with a 1.9 cm (¾ in.) steel plate. The concrete wall and steel plate extend 1.2 m (4 ft) above the roof of Building FS-10. All floors are constructed of concrete with a vinyl tile covering. The inner walls are noncombustible. Both the ceiling and walls are covered with acoustical tile over 1-in. insulation.

Functional areas within Building FS-10 include a control room, camera room, film developing room, and an equipment storage room.

Building FS-10A is located approximately 50 ft east of Building FS-10 and is partially covered by the earthen barricade. Like Building FS-10, its exterior walls and roof are constructed of 0.6 m (2-ft) thick steel-reinforced concrete with membrane waterproofing covering the roof. The floors are constructed of concrete with a vinyl tile covering. Building FS-10A is primarily used as a workshop to construct shot stands and other equipment in support of test fire operations.

Other facilities that support the test fire operations associated with Building FS-10 include Buildings FS-10B and FS-10C. FS-10B is a metal building located approximately 45.7 m (50 yards) west of FS-10 and is used as a solvent storage area. Building FS-10C is located in the southwest corner of FS-10 and is used to store high pressure helium cylinders. Neither Building FS-10B nor FS-10C are considered critical in performing HE test firing operations. Buildings FS-10B and 10C are used as storage sites for non-explosive material, and hence, safety systems have not been designed or implemented for these two facilities.

A 24-hr battery supply provides emergency back-up power to the Halon extinguishing systems. The battery charger for the FS-10 system is located in the Equipment Room of Building FS-10. A separate battery charger for the Halon system serving FS-10A is located in Building FS-10A.

Emergency lighting is supplied for Building FS-10 by a battery-operated emergency lighting system. Upon the loss of normal power, the emergency lights provide illumination for means of egress. There is no emergency lighting system in Building FS-10A. A lightning protection system is supplied for Buildings FS-10 and FS-10A.

Buildings FS-10 and FS-10A are each protected by separate, total flooding Halon fire extinguishing systems. Each system is connected to a separate control panel installed in each building and has a 24-hour battery pack for emergency power supply. Each Halon system is actuated independently by either heat detectors or time-delayed manual system trip stations located near the exit of each building. An adjustable time delay of 0 to 25 sec between activation of alarms and discharge of the Halon is provided for personnel evacuation. Upon detection of a fire condition, local evacuation alarms (bell) are initiated, and the Halon discharges after a preset time (0 to 15 sec). Additionally, the building alarm is actuated and an alarm is transmitted to the Plant Fire Station.

A fire alarm signaling system is provided for Buildings FS-10 and FS-10A. The system is electrically supervised and has a 24-hour emergency battery power supply. Fire and evacuation alarms are transmitted by actuation of heat detectors or manual fire alarm stations on a time delay relay. The HVAC system for Building FS-10 is interfaced with the fire alarm control panel to interrupt operation of the supply fan motor upon receipt of an alarm.

The firing site area is equipped with a test fire interlock and warning system to assure that area personnel and transients are notified of impending test firing. The system consists of a siren and rotating red light, a barricade on the access road, and interlocks wired to the firing controls. The interlocks include limit switches on the access barricade and facility door, and switches at each of the area operational facilities (FS-4, FS-10, FS-22, and FS-23). The limit switches ensure that the barricade has been placed across the access road and that the facility door is closed. The switches at each facility must be turned to the "ON" position to ensure that personnel at these locations are aware of the impending test firing.

An emergency eyewash facility is located on the north side of the Film Developing Room in Building FS-10.

The primary function of Building FS-10 is to test the sensitivity, reactivity, and other characteristics of HE by detonating the HE on the adjacent test firing pad. Several different methods of detonating the HE are used, including detonators, friction, impact, and small arms fire. Additionally, the integrity of shipping containers is tested by dropping the containers from varying heights and observing the results of the impact. Four camera ports are in place on the north side of Building FS-10 to serve as viewing ports and to record the detonation of HE and the integrity of the shipping containers.

Detonation of the explosives components is controlled from inside the FS-10 control room. The firing controls are interlocked with the facility doors, area access roadblock, other area firing sites, and area visual and audible alarms to ensure coordination of personnel protection in the area. Additionally, the sirens and lights are operated for a period of 4 minutes before initiating a test fire.

A designated area extending approximately 1.2 m (4 ft) from the main control panel is marked by strips of colored tape. During HE test firing operations, only one person is allowed within this area.

Building FS-10A was originally constructed in 1965 to store X-ray equipment used in the film developing processes in Building FS-10. Instead, the building is now used as a workshop to construct wooden shot stands and other equipment used in testing HE.

Building FS-11/ 11A. Building FS-11 (Shot Make Up Facility), a moderate hazard facility, consists of three earth covered steel-arch bays (7.6 m × 7.6 m × 4.0 m [25 ft × 25 ft × 13 ft] each), a mechanical equipment room (5.7 m × 5.7 m × 3.0 m [18¾ ft × 18¾ ft × 10 ft] including the rest room area), and an inert storage area (6.1 m × 9.1 m × 2.8 m [20 ft × 30 ft × 9⅓ ft]). All areas are connected by an enclosed ramp which is 2.4 m × 48.6 m × 3.0 m (8 ft × 159½ ft × 10 ft) high[77].

The facility was built in 1977 and is used for explosive test fire assembly and build-up operations for test fire activities. Explosives are prepared for test fire by installing detonators, instrumentation devices, test fixtures, and holding fixtures. Test assemblies are boxed in preparation for test fire. Explosive assemblies can be heated or cooled in an Environmental Chamber. Operations are similar to those in Building 11-20.

The three bays are designed for Class II explosives operations. Bay arch sections are galvanized, corrugated metal, bolted with high-strength steel bolts. Bay stem walls and end walls are reinforced concrete. Each bay arch section and end wall is covered with material to prevent moisture penetration and a 0.6 m (2 ft) minimum earth cover. All floors are concrete. A floor covering approved through the use of established procedures is provided in the bays of the facility. The mechanical room, restroom, and connecting ramp walls are reinforced concrete block and the roof deck is steel. Inert storage area walls are cinder block and the roof consists of 5.1 cm (2 in.) poured gypsum board supported by bar joist and covered with a gravel/asphalt build-up exterior surface.

Lighting for the ramp is enclosed with plexiglass covers. Installations in the assembly bays are Class II, Division 1, rated for hazardous locations. Equipment in the assembly bays is either Class II, Division 1; Intrinsically Safe; and/or Air Purged or Ventilated. The electrical facilities located in the inert storage area are general purpose.

Emergency exit lights with battery backup are provided for the bays, ramp, mechanical room, and inert storage area. A uninterruptible power supply provides power without any interruption of load functions for the security system. The Fire Alarm Control Panel also has a separate battery backup system which powers the Fire Alarm Signaling System during loss of power.

A lightning protection and grounding system is also provided in FS-11.

Water for the automatic fire suppression system in Building FS-11 is supplied from the combined system by means of a 15.2 cm (6 in.) underground pipe. A protectively located outside post indicator valve is provided on the 15.2 cm (6 in.) pipe.

Fire protection for the facility consists of a wet-pipe automatic sprinkler system designed for extra hazard occupancy in each assembly bay and the connecting ramp. The sprinkler system in the mechanical room, restroom, and inert storage area is designed for ordinary hazard occupancy. A sprinkler pressure switch on the alarm check valve of the wet pipe sprinkler riser indicates water flow to the sprinkler system. A flow switch installed on the sprinkler piping to the bays and ramp distinguishes between flow to bays and ramp areas, or flow to the mechanical room, bathroom, and inert storage area.

A fire alarm signaling system is provided for the facility. The system is electrically supervised and has a 24-hr emergency battery power supply. Manual fire alarm stations are provided at each end of the connecting ramp and are connected to the Fire Alarm Control Panel. Upon detection of water flow in the sprinkler system or activation of a manual fire alarm, the Fire Alarm Control Panel rings local fire alarm bells and transmits an alarm to the Plant Fire Station.

The environmental chamber is designed to perform environmental testing and conditioning at controlled high and low temperatures.

The chamber interior is provided with two adjustable shelves constructed of stainless steel angle and #16 gauge metal mesh. Each shelf is capable of supporting one 27.2 kg (60 lb) load over 929 cm^2 (1.0 ft^2) in the center of the shelf. Interior surfaces of the main console, plenum, access ports, and other areas exposed to the chamber interior environment are constructed of nonsparking stainless steel. The stainless steel liner has all seams welded to provide the chamber interior with a vapor tight seal. Air circulation fan blades are made of non-spark producing material. A machinery compartment is situated beneath the chamber enclosure and is gasketed and sealed. Purge air is supplied to the machinery compartment as a supplied utility and cooling is accomplished by passing air across a water cooled heat exchanger.

The chamber interior is heated by recirculation of air across a finned low watt density bank of heaters. The chamber is cooled by a water-cooling cascade refrigeration system using two 2-horsepower compressors. The refrigeration compressor is provided with a water-cooled condenser. The chamber temperature is monitored by a separate thermocouple wired to programmer/controller unit which maintains the temperature at the desired set-point.

The oven is an environmental oven that is heated by friction air. A blower sets the air in motion, and heat is generated directly within the air itself due to its turbulence and friction as it moves. Temperature inside the oven is regulated by adjustment of an air inlet vent which allows cooler ambient air into the circulated oven air.

Bay 1 contains an exhaust hood which is UL approved for Class I and Class II hazardous locations. Air is exhausted from the hoods to the outside of the building without recirculation. All operations involving toxic vapors or dust, or flammable solvents are performed under the hood.

An HE-contaminated vacuum system is provided in the facility for adjusting pressures and testing seals of test fire assemblies. The pump and receiver for the system are located in the mechanical room.

An air compressor and dryer are located in the mechanical room to supply compressed air for the facility. Compressed air is extended through piping to each of the bays for use in adjusting pressures and testing seals of test fire assemblies. Compressed air also provides purge air to the environmental chamber electrical panels and mechanical compartment in Bay 3.

The FS-11 facility is used to stage explosives, store inert material, and provide test fire shop buildup support for test fire sites. Functions include receipt, inspection, staging, and temperature conditioning of test fire shots as well as incorporation of detonators, explosives, switches, optical enhancement aids, and mechanical support into test fire shots. Preparatory work, for components which are to be demilitarized and/or sanitized at one of the other firing sites, is performed in FS-11. This includes processing paperwork for the components and resistivity testing prior to demilitarization and/or sanitization.

Inert materials such as shot stands, boxes, glass, mirrors, cables, etc., used in conjunction with the assembly and test firing operations are stored in inert storage FS-11S. This area is not to be an occupied area; only limited incidental work will be accomplished along with stocking supplies and obtaining material required in conjunction with test fire operations. Electrical control panels, the Fire Alarm Control Panel, an air compressor and dryer, and an HE-contaminated vacuum pump and receiver are located in the mechanical room. The mechanical room and the adjacent restroom are also occupied for limited durations.

Bay 1 is used for test fire assembly, limited storage of inert material, and tooling and staging of explosives. An exhaust hood is provided in this bay for operations involving toxic vapors or dust, and flammable solvents. Respiratory protection is required for personnel in Bay 1 during certain operations. Metal work stations with approved cushion top work surfaces and roll-off protection are installed along the north wall. A two-door metal storage cabinet and a HE laboratory press are positioned along the west wall.

Bay 2 is used for test fire assembly, limited storage of inert material, and tooling and staging of explosives. It contains one clean bench located along the south wall of the bay. Metal work stations with approved tops and roll-off protection are located along the north wall and two-door metal storage cabinets are positioned along the west wall.

Bay 3 is used for the primary explosives staging area, limited test fire assembly, and storage of inert material and tooling. It contains a refrigerator/freezer, a "Tenney" combination heating and cooling chamber, and a friction air oven used for environmental conditioning of explosives. Metal work stations with approved roll-off protection are located along the north wall, and two-door metal storage cabinets are positioned along the west and north walls.

Building FS-16. Building FS-16 is a moderate hazard facility built in 1980 from an old storage magazine, and is currently used for high-speed machining of explosives. Explosives are test-machined under worst-case conditions (dry machining over speed and over high feed rates) to determine safety guidelines for production machining[78].

FS-21. Building FS-21 is a moderate hazard facility which was constructed in 1970, and is used for explosives test fire to determine operational performance of explosives and components[79]. It also provides control for high-speed machining and HE waste disposal. Operations are similar to those in Buildings FS-4, FS-10, and FS-22.

Building FS-21A is a moderate hazard facility. It was built in 1979 and is currently used for storage of test fires during operating hours only[80].

FS-22. Building FS-22, Test Fire Facility, is a moderate hazard, one-story, 167 m^2 (1,798-ft^2) building with walls, floor, and roof made of reinforced concrete. This building was initially constructed in 1971[81]. The roof is approximately 0.8-m (2½-ft) thick and the north, east, and south outside walls are approximately 0.5-m (1½-ft) thick. The west wall, which faces an explosive test firing pad, is 1.7-m (5½-ft) thick and has three camera ports. The west wall is also covered with a 2.54-cm (1-in.) thick steel plate. Earthen barricades are built up to the north, west, and south of the building and firing pad.

The building interior consists of a control room, camera room, equipment room, dark room, restroom, and closet. Blast doors on the north and east sides provide access to the building into the control room.

Single bulb emergency lights, with battery backup, are provided in the control room and camera room. A lightning protection grounding system is provided in FS-22.

An automatic fire suppression system for Building FS-22 is provided by three total flooding Halon fire extinguishing systems: one for the control and camera rooms; one for the equipment room; and one for the dark room, restroom, and closet. The systems are connected to a Fire Alarm Control Panel and are actuated by heat detectors or manual system trip stations located on the Halon cylinder control heads. An adjustable time delay of 0 to 25 sec between activation of alarms and discharge of the Halon is provided for personnel evacuation.

A fire alarm signaling system is provided for this facility. The system has a 24-hr emergency battery power supply and is electronically supervised to transmit a supervisory alarm in FS-22 and the Plant Fire Station upon loss of power or detection of a fault condition.

Fire conditions are transmitted to the Fire Alarm Control Panel by actuation of heat detectors, smoke detectors, or manual pull stations. Upon detection of a fire condition, the HVAC system is shut down, electrical power is disconnected to the test equipment, local evacuation alarms (bells and lights) are initiated, and an alarm is transmitted to the Plant Fire Station. The Halon discharges after a preset time delay (0 to 25 sec) only when a fire condition is detected by the heat detectors.

The firing site area is equipped with a test fire interlock and warning system to assure that area personnel and transients are notified of impending test firing. The system consists of area roof-mounted sirens and rotating red lights, a barricade on the access road, and interlocks wired to the firing controls. The interlocks include limit switches on the access barricade and facility door, and switches at each of the area operational facilities (FS-4, FS-10, FS-22, and FS-23) and at the telephone booth located near the access barricade. The limit switches ensure that the barricade has been placed across the access road and that the facility door is closed. The switches at each facility must be turned to the "ON" position to ensure that personnel at these locations are aware of the impending test firing.

An emergency eyewash is located in the dark room of FS-22.

A firing chamber is located outside FS-22 for use in testing explosives. The firing chamber provides containment of the test fire materials for collection and examination after the test. The firing chamber can also be equipped with HEPA filters to contain hazardous materials from the test firing.

The FS-22 facility is used for qualification testing of explosive components. The components are placed in the firing chamber, or on blow-away shot stands which are positioned either on steel firing pads or over a gravel pit. The facility is also used for demilitarization and/or component sanitization.

Detonation of all explosive components, including those inside the firing chamber, is controlled from inside the FS-22 control room. Cameras are set up in the camera room to photograph the explosion through camera ports in the west wall of the camera room. The firing controls are interlocked with the facility doors, area access roadblock, other area firing sites, and area visual and audible alarms to ensure coordination of personnel protection in the area. Also, personnel are required to operate the sirens and lights for 4 min before initiating a test firing. HEPA filter installation and maintenance on the firing chamber, if required, shall be specified in the applicable procedures required for each test fire operation.

FS-23. Building FS-23 is a moderate hazard facility built in 1983, and is currently used to determine the operational performance of explosives and components using total containment firing chambers[82]. Test fire control and instrumentation systems are operated from this facility. Operations are similar to those in Buildings FS-4, FS-10, FS-21, FS-22, and FS-24. In the future, the facility will also be used to demilitarize and/or sanitize components similar to that of FS-22 and FS-24.

FS-24. Building FS-24 is a moderate hazard facility constructed in 1988, and is used for explosives test fires to determine operational performance of explosives and components[83]. Explosives test fire operations are conducted in firing chambers, with control and diagnostic equipment contained in control and camera rooms. Explosives may be heated or cooled in chambers in the environmental testing area. The facility is also used for demilitarization and/or sanitization of components.

3.3.4.5 *Building 12-21, Gas Analysis Laboratory*

Building 12-21 is a moderate hazard facility which houses two separate facilities, the Nondestructive Evaluation and Gas Analysis Laboratory (Figure 3-2.). The Non-Destructive Evaluation facility will be discussed in Section 3.3.4.6.

Building 12-21 is located in the northeast quadrant of Zone 12 South. The building is rectangular in shape, with its long side running in a generally east-west direction. The building is scheduled for demolition in 2002.

The building is a noncombustible steel frame building with exterior clay tile walls[84]. The roof construction consists of a covering of urethane foam (UL Class A) over an asphalt and gravel built-up roof of cemesto board decking supported by steel roof purlins. The building is divided by concrete bay walls and interior clay tile and concrete block room walls and partitions.

Typical bay dimensions are 5.8 m ×7.6 m (19 ft × 25 ft) with a minimum 4.4 m (14 ft 5½ in.) clearance to the roof framing. The walls are constructed of 30.5-cm (12-in.) thick reinforced concrete. The exterior wall is a pressure relieving wall constructed of 20.3 cm (8 in.) hollow clay tile block. The majority of these typical bays are located in the Gas Lab portion of the building.

Two uninterruptible power supply systems can provide emergency power for 15 min to the Gas Lab area. An Onan diesel generator is connected to the uninterruptible power supply systems, providing a continuous power supply before the uninterruptible power supply battery system is depleted.

Building 12-21 is protected by two separate automatic, wet-pipe sprinkler systems. The system is complete with a 15.2 cm (6 in.) alarm check valve, water flow alarm switches, and outside water motor gong. The system is connected to the high-pressure fire loop by a separate 15.2 cm (6 in.) underground lead-in main, provided with a fire hydrant and a post indication valve. The available water supply at the existing main has a static pressure of 100 to 175 psi and a residual pressure of 28,124 to 49,217 kg/m^2 (40 to 70 psi) with 206.2 liters/sec (3,269 gpm) flowing.

The Gas Analysis Laboratory area of Building 12-21 is used to perform compatibility testing on weapons parts, most of which are in containers. Testing includes leak checks, volume determinations, backfills, sample extraction, cryogenic fractionation, sample analysis, and ambient aging of parts, including source material. Only material compatibility containers with no SNM are tested in the Gas Analysis Laboratory.

Gas Analysis Laboratory operations also include the analysis of samples from assembly and disassembly operations, 35 account gases, and other special samples, as needed. The analyses performed on these samples include mass spectrometry, gas chromatography, hydrogen getter testing, and cryogenic fractionations. Bay 9 is a HE special testing bay. Bays 11 through 14 are non-HE bays equipped for special testing. The Analytical Bay is an HE bay and houses the glassrack for cryogenic fractionation of compatibility containers.

3.3.4.6 *Building 12-21A, Nondestructive Evaluation Laboratory*

Building 12-21A was built in 1951 as an addition to Building 12-21 and is classified as a moderate hazard facility. The section of the building which houses the Accelerated Aging Units bay is a one-story, heavily reinforced, tornado-resistant concrete structure[85,86]. The Accelerated Aging Unit bay is 9.4 m × 12.5 m (30 ft 9 in. × 41 ft) with a ceiling height of 4.9 m (16 ft).

Building 12-21A is basically a four-wall facility with the floor, walls, and roof constructed of poured concrete. The entire east wall of the bay, although of concrete construction, is only lightly restrained around its perimeter, thus becoming a blowout wall in the event of detonation. The building consists of a mechanical equipment room, a remote control room, and a bay area.

Building 12-21A is protected by an automatic wet-pipe sprinkler system. This system is separate from the system in Building 12-21. The system is complete with a 15.2 cm (6 in.) alarm check valve, water flow alarm switches, and outside water motor gong. The system is connected to the high pressure fire loop by a separate 15.2 cm (6 in.) underground lead-in main, provided with a fire hydrant and a post indication valve. The available water supply at the existing main has a static pressure of 87,888 kg/m² (125 psi) and a residual pressure of 56,248 kg/m² (80 psi) with a 206.2 liters/sec (3,269 gpm) flowing rate.

Operations are essentially the accelerated aging of weapons and analysis of the gases evolved. Weapons are placed in ovens and aged by heating them above ambient temperature for long periods of time. The temperatures can range from ambient to as much as 80°C (176 F). During this period of time, which may be as long as a year, the gases evolved in the weapon are monitored for moisture content and pressure variations.

3.3.4.7 *Building 12-31, High Explosives Subassembly Facility*

Building 12-31 is a moderate hazard facility presently being used for subassembly operations involving HE and IHE components[87]. Buildings 12-31, 12-32, and 12-33 are nearly identical in shape with their long axis running in an east-west direction in Zone 12 South (Figure 3-2.). All three are accessed through a ramp located at the east end of the building. The functional areas of these buildings consist of a central equipment room separating eight operating bays. Three walls of the operating bays are constructed of 30.5-cm (12-in.) thick reinforced-concrete "substantial dividing walls" providing a 1-hr fire rating. A common front for the row of bays is formed by the end walls along the corridor, which are constructed of 20.3 cm (8 in.) concrete block (clay tile) with double doors (some now removed). All of the floors are poured concrete with a resilient floor covering. The exterior walls, which provide 4.0 m (13 ft) corridors on each side of the building, are constructed of cemesto and supported by 20.3 cm (8 in.) steel purlins.

Building 12-31 is provided with individual automatic wet-pipe sprinkler system. The available water supply at the existing main has a static pressure of 80,857 kg/m² (115 psi), and a residual pressure of 61,873 kg/m² (88 psi) with approximately 107.2 liters/sec (1,700 gpm) flow. The system is equipped with 74°C (165°F) rated sprinkler heads.

Building 12-31 provides a variety of operations under the general heading of HE subassembly which includes the following: mixing of adhesive materials and epoxies; repair of minor defects on HE/IHE components; bonding and potting of pellets, detonators, cushions, and caps to explosives; quality assurance inspection and gauging; and compatibility studies. Demilitarization is also perfomed in the facility.

3.3.4.8 *Buildings 12-32 and 12-33, Inert Operations Facilities*

Buildings 12-32 and 12-33 are facilities presently being used for inert operations on weapons components[88]. Buildings 12-31, 12-32, and 12-33 are nearly identical in shape with their long axis running in an east-west direction in Zone 12 South (Figure 3-2.). All three are accessed through a ramp located at the east end of the building. The functional areas of these buildings consist of a central equipment room separating eight operating bays. Three walls of the operating bays are constructed of 30.5-cm (12-in.) thick reinforced-concrete "substantial dividing walls" providing a 1-hr fire rating. A common front for the row of bays is formed by the end walls along the corridor, which are constructed of 20.3 cm (8 in.) concrete block (clay tile) with double doors (some now removed). All of the floors are poured concrete with a resilient floor covering. The exterior walls, which provide 4.0 m (13 ft) corridors on each side of the building, are constructed of cemesto and supported by 20.3 cm (8 in.) steel purlins.

Each building is provided with individual automatic wet-pipe sprinkler system. The available water supply at the existing main has a static pressure of 80,857 kg/m² (115 psi), and a residual pressure of 61,873 kg/m² (88 psi) with approximately 107.2 liters/sec (1,700 gpm) flowing. The system is equipped with 74°C (165°F) rated sprinkler heads.

Building 12-32 North and 12-33 North are used for demilitarization and/or sanitization of inert weapon components. Building 12-32 South is used for records management. No explosives are permitted in Building 12-33.

3.3.4.9 *Building 12-56, Neutron Radiography Facility*

Building 12-56 lies at the eastern edge of Zone 12, south of Building 12-43, north and east of Building 12-26, and south and east of Building 12-55 Staging Bays. Building 12-56 formerly served as a weapons radiography facility that at one time utilized a cobalt-60 (Co-60) source, and most recently utilized Linac X-ray equipment. The Co-60 radiographic system was demolished in 1975. The Linac operations were moved to Building 12-84 upon completion of its construction. No operations currently occur in Building 12-56. The Radiography Bay and entry corridor is a reinforced concrete structure surrounded on two sides with an earth berm. The control room, panel room, and mechanical room are contained within a concrete block addition to the main building.

Building 12-56 is being modified to provide a neutron radiography system utilizing the existing Radiography Bay with associated control room, and electrical and mechanical rooms, and entry corridor. The new neutron radiography system will utilize neutrons from californium-252 (Cf-252) sources (max. quantity 150 mg or 0.005 oz) brought in from Oak Ridge National Laboratory (ORNL) in Department of Transportation (DOT) approved shipping casks.

The neutron radiography facility will be used to radiograph small components filled with HE.

The main portion of Building 12-56 comprises a 7.3-m (24-ft) high reinforced concrete radiography bay and access corridor. The control room, electrical distribution room, and mechanical room are housed in a 13.0-m (10-ft) high concrete block extension on the west side of the radiography bay. The overall plan dimensions of the facility are app-roximately 11.6 m × 18.3 m (38 ft x 60 ft). There is an earth berm on the east and south sides of the building. The west end of the south side berm is riveted with a timber retaining wall. The timber revetment is restrained via cables buried within the berm and anchored with concrete pylons.

The main exterior walls of the building (i.e., Radiography Bay and entrance corridor) are constructed of cast-in-place concrete. All concrete used was 2.1 x 10^6 kg/m² (3,000 psi) compressive strength. The Radiography Bay walls are 0.6 m (2 ft) thick reinforced concrete to a height of 6.1 m (20 ft). From 6.1 m to 7.3 m (20 to 24 ft), the walls are 0.3-m (1-ft) thick. The wall separating the bay and the control room is 1.2-m (4-ft) thick to a height of 6.1 m (20 ft) at locations except the portion of the west wall contiguous with the control room. That portion of the west wall is 1.2 m (4 ft) thick to a height of 6.1-m (20-ft), and from there the wall is 0.9-m (3-ft) thick extending to a total height of 7.3 m (24 ft). The control room, electrical distribution room, and mechanical room are comprised of 25.4-cm (10-in.) thick concrete block walls to a height of 3.0 m (10 ft).

Modifications will be made to the floor slab of Building 12-56 as follows. The existing floor slab in the north end of the Radiography Bay, the entrance corridor, and approximately 15.2 m (50 ft) of Ramp 12-R-56 will be removed and upgraded to accommodate heavy forklift truck traffic. The new slab will be poured using 3.5 x 10^6 kg/m² (5,000 psi) compressive strength concrete to a depth of 20.3 cm (8 in.) This slab will be designed to accommodate the weight of a 5,261.8 kg (11,600 lb) forklift carrying a 4,536 kg (10,000 lb) source transfer container.

A new concrete pit will be constructed in the Radiographic Bay to accommodate the neutron source capsules, transfer system, and collimator. The area of the floor where the neutron source pit will be emplaced will be excavated to a depth of approximately 4.0 m (13 ft). A soil retention system will be added along the areas where the pit is adjacent to the existing concrete footing for the east and west walls of the Radiography Bay. This will be accomplished by jacking wide flange steel sections into the soil at a close spacing and then providing horizontal lagging as excavation progresses.

The excavation for the neutron source pit will be provided with a 1.2-m (48-in.) deep footing of 2.46 x 10^6 kg/m^2 (3,500 psi) compressive strength concrete. The neutron source pit itself will be monolithically cast from 2.8 x 10^6 kg/m^2 (4,000 psi) compressive strength Limonite/Steel concrete, a neutron shielding material composed of concrete with an aggregate of limonite ore and steel punchings, and impregnated with 5 wt-% boron as a poisoning agent. The Limonite/Steel concrete will have a density of approximately 4,662 kg/m^2 (291 lb/$ft^{3)}$. The neutron source pit will have a minimum wall thickness of 1.2 m (48 in.) and will be flush with the surrounding bay floor. An auxiliary source storage pit will be located east of the neutron source pit against the east wall of the Radiography Bay. The excavation for the auxiliary source storage pit will be concurrent with the excavation of the neutron source pit and provided with the same 1.2 m (48 in.) deep footing of 2.46 x 10^6 kg/m^2 (3,500 psi) compressive strength concrete, except at the west wall of the bay, where 0.9 m (36 in.) will be sufficient because of the exterior wall and the earth berm. The auxiliary source storage pit will also be monolithically cast from 2.8 x 10^6 kg/m^2 (4,000 psi) compressive strength Limonite/Steel concrete. The auxiliary source storage pit will have a minimum shield thickness of 1.5 m (60 in.) and will be flush with the surrounding bay floor.

A new concrete pad and inclined ramp will be installed outside the west side of Ramp 12-R-56 at a point approximately 12.2 m (40 ft) north of the facility to allow for loading and unloading of materials from the new caliche access road. The unloading area will be "L"-shaped, and designed to allow the forklift to perform a 360° turn without leaving the pad. The new slab will be poured using 3.5 x 10^6 kg/m^2 (5,000 psi) compressive strength concrete to a depth of 20.3 cm (8 in.) This slab will be designed to accommodate the weight of an 5,262 kg (11,600 lb) forklift carrying a 4,536 kg (10,000 lb) source transfer container.

Penetrations through blast-resistant, fire resistant, and radiation shielding elements will be located, designed, and installed to minimize their effects on the performance of important safety features of the building design.

The main structural penetration to the Radiography Bay will be the entrance doors through the north wall. The door and frame construction will be steel, with an equivalent UL 2-hr Class B fire rating. The doors exit into the entrance corridor, which connects to existing Ramp 12-R-56.

Penetrations have been provided in the roof of the Radiography Bay and entrance corridor to accommodate roof-mounted ducts for the building HVAC system. These ducts serve as intake air for those areas. Return air from the Radiography Bay is by underslab ducts.

The roof of the Radiography Bay is equipped with a sealed access hatch. This hatch will be used to remove demolished equipment from the bay, after which it will be permanently resealed.

The west wall of the Radiography Bay is provided with a large (25.4 cm or 10 in.) pipe penetration that was utilized for Linac power and control cables. This penetration slopes down at a 30° angle into the electrical room.

The juncture of the entrance corridor and Ramp 12-R-56 will be provided with a new pair of sliding doors. These doors will span the 3.7-m wide × 2.7-m high (12-ft wide x 9-ft high) entrance. The door and frame construction will be steel, complete with tracks and locks, with an equivalent UL 2-hr Class B fire rating. The top of the door assembly will be designed to prevent water from entering the frame and track assembly and then into the building, and the bottom of the door will run on a recessed track set in the new ramp floor. This track will be formed to fit in conjunction with a heavy-duty ductile iron drainage trough and grate that will prevent water from entering the facility under the new door.

The doorways between Ramp 12-R-56 and the Building 12-56 control room and between the control room and the electrical room will each be provided with a new personnel door. The door and frame construction will be steel with a UL 2-hr Class B fire rating.

Ramp 12-R-56 is being modified with a roll-up equipment door on the west side at approximately 12.2 m (40 ft) north of the facility. This roll-up door will be periodically used to transfer sources to and from the facility.

The roof of the Radiography Bay was designed as a "blow-out" (i.e., venting) roof to relieve overpressure in the event of an HE explosion in the bay. It is framed with wide flanged structural I-beams set in receiver pockets in the bay walls. The roofing is held with 11B bulb tees, and is composed of 2.54 cm (1 in.) formboard, 6.4 cm (2.5 in.) gypsum board, and built-up roofing.

A sealed 3.1 m × 3.7 m (10-ft x 12-ft) roof hatch is located in the southeast corner of the bay. The roof hatch will be opened to allow for removal of demolished equipment from the Radiography Bay, after which the hatch will be permanently resealed. The "blow-out" design of the existing roof is not permitted to be compromised by the work.

The roofing of the entrance corridor and concrete block addition (i.e., control room, electrical room, mechanical room) is held with 25B bulb tees, and comprises 1 in. formboard, 6.4 cm (2.5 in.) gypboard, and 4-ply built-up roofing.

Building 12-56 currently has an approved HE load capacity of 222.3 kg (490 lb.) This will be reduced to 2.8 kg (5 lb) HE for the new mission of the facility. The exterior walls of the Radiography Bay were designed to direct the blast pressure up and out of the facility through the roof of the bay. The roof of the Radiography Bay was apparently designed as a "blow-out" (i.e., venting) roof to relieve explosive overpressures. The reduced HE loading is not expected to challenge the design of the exterior walls and roof of the Radiography Bay. The facility is designed and will be constructed to sustain loadings resulting from an explosion at the closest facilities containing HE (Building 12-55, Bays 1, 2, and 3).

The original fire design requirements of this facility are not known. The walls comprising the structural shell surrounding the Radiography Bay and entrance corridor appear to have been designed to prevent structural collapse and to act as a confinement structure during the design basis fire. Fire resistance of this shell is provided by the structural elements. A design basis fire has not been specifically designated for this facility. However, the requirement to provide 2-hr rated doors indicates that the design basis fire for Building 12-56 has been determined to be not less than 2 hr. Because of the unprotected noncombustible support system for the roof deck of the Radiography Bay, the building would be classified as a Type II-N Construction in accordance with the 1991 Edition of the UBC, and Type II (0,0,0) in accordance with NFPA 220, 1992 Edition.

Noncombustible and heat-resistant materials were used throughout the facility in its initial construction and subsequent modifications, particularly in locations vital to the functioning of confinement systems, to controlling hazardous materials within the facility, and to maintaining safety control functions. All new interior finishes will have a flame spread rating not exceeding 25, and a smoke development rating not exceeding 50 per ASTM E84.

The 12-56 Neutron Radiography Facility will provide the capability to neutron radiograph a variety of objects, including explosive objects, on site under secure conditions. The facility will utilize a spontaneously fissioning neutron source, Cf-252, which will be supplied by the DOE's Oak Ridge National Laboratory. The neutron radiography system will provide film type neutron radiographs at a throughput rate of nine per day. The film quality will be similar to that at an optimized nuclear reactor-based system. The system will also provide the capability to inspect items using electronic real-time imaging and remote control of part orientation.

The neutron source will comprise eight separate sources of Cf-252, with a maximum total of 150 mg (0.005 oz). Each source will be doubly encapsulated at Oak Ridge National Laboratory and shipped in a Department of Transportation (DOT)-approved transport cask provided by the laboratory. After its initial loading, the source will be replenished at approximately annual intervals with the two weakest sources (< 12 mg each or .0004 oz) returned to Oak Ridge National Laboratory in exchange for two full-strength sources (26.6 mg or 0.001 oz each).

The neutron radiography system will be used to check weapon components for manufacturing defects. The majority of components are small (less than 1 lb), although the system will have the ability to radiograph components weighing up to 9.1 kg (20 lb). A maximum of 2.3 kg (5 lbs) HE is permitted in the facility, regardless of component size. The weapons components will be comprised of HE which has been extruded into shaped metal components of various configurations. No fissile or radioactive components will be radiographed in this facility.

HE components will be brought into Building 12-56 via a wheeled cart on an as-needed basis. No long-term staging will be conducted in this facility. Components may be brought in for radiographing directly from their place of manufacture in Zones 11 or 12, or they may be temporarily staged in one of the Building 12-55 bays until needed.

The components will be brought into the Radiography Bay on the cart and hand-carried by the Nondestructive Evaluation Department operators to elevated parts trays located within the exposure table. The exposure table is a movable platform comprising: (1) a remotely controlled multiple component tray and manipulator table, (2) a multiple film canister holder, and (3) a radiation shield (beam stop). The exposure table is normally located above the neutron collimator. Anywhere from 10 to 50 weapons components at a time may be loaded into each tray, and four to nine film canisters may be loaded into the film holder.

The operators arrange the components and films perpendicular to the neutron beam path. After ensuring that no one has remained behind, the operators then exit the Radiography Bay and lock the gate in the entrance corridor. In the control room, the operators verify via CCTV cameras that no one is within the Radiography Bay. The operators then insert the control key (which also unlocks the gate in the entrance corridor) into the key switch in the control panel to activate the controller, set the desired exposure shot time, and begin the run. The system will automatically begin the radiography program without further assistance. The operators may leave the facility afterward while the shot is performed. A film exposure will typically take about 22 hr to complete.

The hazards associated with operations in Building 12-56 are primarily related to radiation exposure and the potential for an explosion of HE components being radiographed. Activities include transferring the eight separate Cf-252 capsules (a maximum of 26.6 mg or 0.001 oz per trip) from the shipping cask to the transfer cask, bringing the source capsules into the facility, transferring the capsules from the transfer cask to the storage pit, loading the capsules from the storage pit into the neutron exposure pit, and the reverse of these procedures, and moving HE components into and out of the facility.

This facility will be provided with a fire protection system, composed of an automatic wet-pipe sprinkler system, automatic and manual fire detection and alarm system, and HVAC interlocks. The purpose of the sprinkler system is to prevent the spread of and extinguish fires of a magnitude up to and including the design basis fire.

A radiography control system will provide monitoring, alarm, and safety interlock features designed to prevent personnel exposure to neutron and gamma radiation in the Radiography Bay. The radiography control system, located in the control room, supervises the safety interlocks for the neutron radiography system.

The radiography control system will be furnished with interlocks such that the system controllers will initiate an operation warning when the radiography system is being readied for use, and an emergency stop in the event that a system permissive is in alarm. Failure of an interlock check prevents operation of the radiography system. An annunciator and flashing light within and outside the bay will function for a variable 30 to 60 seconds before the initiation of an exposure. A muted dinging and flashing light will be provided during radiographic operations. The operation of these devices will function similar to operations in other radiation exposure facilities (e.g., Linac bays) operated by the Non-Destructive Evaluation Department. CCTV cameras are also provided for visual observation of the Radiography Bay. All alarms will be supervised, as will the source sled grip solenoid. Failure of an alarm will result in an alarm condition.

The radiography control system will comprise a host computer, a hardwired logic controller, an area radiation monitoring system, audible and visual hazard warning devices, and door monitors. The control software of the radiography system controller will provide interlocks between the operating controls and the bay neutron and gamma detectors, panic switches, warning lights, warning chimes and horns, door switches, and fire alarms. The control panel will be in the control room.

Radiation detection and monitoring will be accomplished via a standard Area Monitoring System. The system comprises three dual neutron/gamma-ray detectors and one gamma-ray detector and accompanying readout modules.

The radiation detectors will be located in the following areas: one neutron/gamma detector in the control room; one neutron/gamma detector in Ramp 12-R-56 outside the entry corridor; one neutron/gamma detector on the east wall of the Radiography Bay; one gamma-ray detector in the neutron source pit; and one neutron detector at the roof gate over the Radiography Bay.

Panic mushroom pushbutton switches will be located in the Radiography Bay and on the control console in the control room. Activation of a panic pushbutton will cause a controlled shutdown of the radiography operation within milliseconds of activating the panic circuitry. The panic (emergency stop) control will be hardwired and independent of the software control. The switches will be wired in series, and an open switch will cause an emergency stop activation.

Warning lights, horns, and chimes will be located in the Radiography Bay, the entry corridor outside the bay, in Ramp 12-R-56 outside the entry corridor, and near the outside access ladder, which leads to the roof of the Radiography Bay.

The control system host computer and logic controller will both monitor inputs from the warning device test switch, the high radiation alarm and alert alarm, personnel door closure switches, panic switches, outputs from the AC current transductors, and the fire detection and alarm system. The control system will provide outputs to the external warning devices, "30-sec delay on" indicator, "ready for radiation beam" indicator, and warning device and safety device failure indicators.

The software program of the host computer will be such that the state of the inputs allow the computer to enter a "Failsafe Ready" mode or a "Failsafe Failure" mode.

A grounding system is provided in accordance with the mandatory requirements of Article 250 of the National Electrical Code, as well as the applicable "advisory rules" of Article 110-3. The lightning protection system for the facility is required to meet the requirements of NFPA 780, UL 96A, DOE Explosives Safety Manual (DOE/EV/06194), and Pantex Safety Standard Index 317. The lightning protection system consists of roof-mounted tubular copper point terminals connected with copper conducting wires to both the roof ridge conductor and the counterpoise. All new equipment in the Radiography Bay will be required to have static grounding per NFPA 77 tied to the lightning protection system, and will be required to have electrical isolation or a double bypass failure mode per the requirements of DOE/AL Order 5610.3.

An uninterruptible power supply will be provided. The uninterruptible power supply will provide emergency power to the host computer and its video screen, the logic controller, the sled release solenoid, the sled step motor, the emergency sled winch motor, the bay area video cameras (two), and the radiation monitors.

3.3.4.10 *Building 12-26, Bays 22 and 26*

Building 12-26 is located in the southeast quadrant of Zone 12 (Figure 3-2.)[89]. Bays 22 and 26, which are moderate hazard facilities within the building, are referred to as the Material Compatibility Testing Bays. A description of Building 12-26 is contained in Section 3.1.3.1.

Operations in Building 12-26, Bays 22 and 26 consist of exposing weapon components to the temperature environments expected during their lifetime. The aging studies can involve explosive core samples or weapon components. The core samples are HE specimens encapsulated in a compatibility container. Time periods for exposure vary from a few months to 2 years or more depending on the Design Agency specifications. The testing also includes leak checking, volume determination, backfilling, and sampling.

The environmental chambers are monitored 24 hours a day, 7 days a week, by the Gas Analysis Laboratory and the Utilities Department. Monitoring is required whenever a test item is in the environmental chamber. Gas samples are extracted and cryogenically fractionated using an apparatus referred to as a glass vacuum system. The glass vacuum system is designed and fabricated to separate components of the gas through the use of cold traps. Gas samples are taken from special test compatibility containers using either a leak detector or vacuum station.

3.3.5 Demilitization, Sanitization, Thermal Treatment and Decontamination

This section discusses the structural design and operations that involve the demilitization, sanitization, thermal treatment and decontamination of HE and HE components. These facilities include:

- Burning Ground (BG-2, BG-2, BG-3, and BG-4) (Section 3.3.5.1)
- Building 12-73, High Explosives Decontamination Facility (Section 3.3.5.2).

3.3.5.1 *Burning Ground (BG-1, BG-2, BG-3, and BG-4)*

The HE burning ground (BG) is a moderate hazard facility located north of Zone 5 and west of the firing site area (Figure 3-5.). The area is encircled by a security fence with limited access to the facility. The burning ground consist of 12 burning pads, 3 flashing pits, three storage buildings (Buildings BG-1, 3, and 4), and a control room/office building (Building BG-2)[90,91].

BG-1, which serves as a storage building, is a one-story building constructed with structural steel framing and siding. The building is 8.3 m × 4.9 m (27 ft 4 in. × 16 ft) with a steel roof. Industrial exit doors are located on the east side of the building. An earthen barricade is provided on the other three sides of the building to provide protection against accidental detonations either on the burning pads or within the storage buildings. The earthen barricade on the south side contains Building BG-2.

BG-2, BG-3, and BG-4 are similarly constructed buildings. All three buildings are 3.1 m × 3.1 m (10 ft × 10 ft) one story structures constructed with reinforced concrete floors, walls, and roofs. Earth mounding covers the top and three sides of Building BG-2 to provide protection against accidental detonations either on the burning pads or within the storage buildings. BG-2 contains the control room and firing panel for all shots utilizing electric ignition. It houses the operating personnel and casuals during the Class I burning and flashing operations. BG-3 operates as a storage facility for explosives material to be burned. BG-4 operates as a storage area for igniter squibs used as the ignition source at the burning ground.

A lightning protection and grounding system is also provided at the burning ground.

Four fire hydrants are located on the burning ground, which are served by the 15.2 cm (6 in.) pipe of the combined system. Domestic water is supplied to Building BG-1 from the combined system by means of a 1.9 cm (¾ in.) pipe. Buildings BG-2, 3, and 4 have no water supply. The stock tank located on the burning grounds is served by a ¾ in. pipe connected to the combined system.

No automatic fire suppression systems are provided at the burning ground. All four buildings located on the burning ground have portable fire extinguishers.

A fire break stretching at least 15.2 m (50 ft) in all directions is maintained around the buildings. In addition to the firebreak, control is maintained over extraneous combustible materials such as dry grass and leaves within 61.0 m (200 ft) of the burning/flashing operations.

The burning ground is equipped with a warning system to assure that area personnel and transients are notified of impending burning activities. The warning system consists of a roadblock barricade gate, flashing red lights, and a horn. The railroad type roadblock barricade gate is located at the perimeter fence and serves as a safety feature to prevent access to the area when burning operations are to be performed. Also located at the gate area are flashing red lights used with the barrier during burning operations. The warning horn is located on a pole above Building BG-2. The warning horn is activated and required to function at least 4 min prior to a burning activity. The barricade gate must be lowered and the lights must be flashing prior to any burning activities. This is a necessary step as the gate is interlocked with the firing panel and must be lowered before the firing circuit can be completed. The gate with the red lights must remain in the lowered position for the duration of any burning activities on the burning pads. Prior to initiating a burn, the operators must visually verify the barricade gate is lowered. If the gate is not properly functioning, the Supervisor must manually lock the gate in the lowered position.

Since this system can be manually verified and operated, it is an Administrative Safety Control. Activities in the flash pits or cages, however, are an exception. The barricade is permitted to be raised as long as the area is evacuated and the metal fence is closed.

An interlock is a safety mechanism by which two or more parts or systems are connected so that neither part can be operated independently. Interlocks are required in the wiring of all test fire and burning mechanisms to make sure personnel access controls and notification systems are operational before burning HE. The firing panel has an interlocked key system as an additional safety measure. The Supervisor possesses the key to Firing Panel Number 2 and the key to the lock-out hand switch box. The operator accompanying him possesses the key to Firing Panel Number 1. Since Key Number 2 cannot be removed from the firing panel unless it is locked out, the Supervisor's poss-ession of it ensures that the firing circuit is in the locked out position. This interlock system is a safety mechanism since it is possible to proceed with the burning operations only when both required operating personnel (with their appropriate keys) are present. Operation of the barricade gate, flashing red lights, and warning horn are also interlocked with the firing mechanism. Telephone service is provided to Building BG-2 at the burning ground. The telephone system serves as the only means of communication between the burning ground personnel and other Pantex Plant personnel. No sooner than 1 hr before the initiation of a burn, the telephone system is used to communicate with the Operation Center Atmospheric Release Advisory Capability weather tower to obtain the average wind speed and direction. The telephone system is also used by Pantex personnel to notify burning ground personnel of inclement weather or other emergency conditions.

Burning ground employees are required to wear flame retardant coveralls and safety shoes during burning operations. Other safety equipment such as respirators, gloves, etc., are readily available for use during clean-up operations.

The HE burning ground is used to demilitarize, sanitize, and thermally treat HE components, HE-contaminated combustible trash, and flash HE-contaminated metal. These operations occur on open pads and are classified as explosives Class I operations. The burning ground also handles high explosives (within and/or encased in foams, plastics, metals, string filters, charcoal, and very small amount of radionuclides). Though the vast majority of the high explosives tainted with radionuclides will be in the form of U-238, high explosives defiled with tritium, thorium, and natural uranium metal will also be handled at the burning ground (plutonium, thorium-232, and enriched uranium are excluded).

3.3.5.2 *Building 12-73, High Explosives Decontamination Facility*

Building 12-73 is a moderate hazard facility dedicated to HE decontamination of tooling, equipment, and parts (Figure 3-2.). Building 12-73, constructed in 1976, is a one-story, 136.6 m^2 (1470 ft^2) facility located behind (to the southeast end of) Building 12-19 East[92]. All of the construction is noncombustible, consisting of a concrete block structural frame, concrete block walls, and an uncurbed concrete floor. The roof is prestressed concrete tee built up over insulation board.

Functional areas within the facility consist of an operations and storage bay and a washdown bay. The operations and storage bay is used as temporary housing for equipment that is awaiting HE decontamination, as well as equipment that is waiting pick-up after decontamination. The operations and storage bay is equipped with an overhead electric monorail hoist. This hoist runs from approximately 12 ft west of the washdown bay to near the east wall of the washdown bay. The hoist is used to transport parts or equipment weighing more than 25.0 kg (55 lb), but not exceeding 1,814 kg (4,000 lb). The washdown bay consists of a sump pit, a settling pit, two 2,120 liters (560-gallon) holding tanks, two filters, two pumps, water and steam lines, and a pneumatic operating system.

Emergency lighting is supplied by a battery-operated emergency light. The battery charger for the emergency light is hardwired into the main building circuit to provide continuous charging. A lightning protection and grounding system is provided in Building 12-73.

The entire facility is protected by an automatic wet-pipe sprinkler system. Upon detection of water flow in the system or activation of a manual fire alarm station, local evacuation alarms sound; and a coded fire alarm signal is transmitted to the Plant Fire Station. A fire alarm signaling system is electrically supervised and has a 24-hour emergency battery power supply.

Building 12-73 is equipped with a HE Decontamination System which consists of a Pump and Tank System and a Water Overflow Warning System. The Pump and Tank System consists of a settling pit with several concentric settling tanks, a sump pit, two pumps, two filters, and two 2120 liter (560-gallon) storage tanks. During normal operation, effluent flows through the center floor drain into the settling pit and overflows several concentric plastic settling tanks, capturing most of the large solids present in the effluent. The effluent then flows into the sump pit. Effluent in the sump pit is pumped through a filter into Tank 1.

When the effluent level in Tank 1 reaches a prescribed level, the collected effluent is automatically pumped through a second filter and into Tank 2. When Tank 2 is full, the high level shut-off switch activates, and the pump is automatically shut off. The Building Manager is notified so that effluent samples can be obtained from Tank 2. Upon receipt of proper notification that the Tank 2 samples are acceptable, Tank 2 is manually drained to the sanitary sewer by means of a pneumatic dump valve. If the effluent samples indicate that contaminants exceed specified allowed amounts for flushing into the sanitary sewer, the effluent must be recirculated through the filtration system by allowing effluent to return to the floor sump. The decontamination process is repeated until a satisfactory sample reading is achieved.

The HE Decontamination System is also equipped with a water overflow warning system to automatically shut off operations if levels reach a specified point. This system is very important since it is designed to prevent an overflow of effluent.

Protective equipment (face shields, rubber aprons, rubber boots, rubber insulated gloves, etc.) are permanently located in the facility. Personnel performing decontamination work and using hot water or steam are required to wear the above protective items. Operations in the HE Decontamination Facility include washing HE-contaminated parts and equipment, which are Hazard Class II operations.

Before equipment that has been exposed to explosives is handled and/or processed for repair, storage, layaway, sale, shipment, or transfer within the Pantex Plant, it is necessary that the equipment be decontaminated. The HE Decontamination Facility operations consist of washing and decontaminating tooling, parts, and equipment.

Contaminated items are brought into Building 12-73 and temporarily stored in the storage bay area pending decontamination. The contaminated items then go through the decontamination process, being washed using the pump and tank system. After the items have been certified and tagged decontaminated, they are returned to Building 12-26, Tooling Storage Warehouse, for storage and reissue. The decontamination of nylon straps, nets, safety straps, etc., does not require a decontam-ination tag, since they are to be returned for reuse. These items must be forwarded to Building 12-1 for further washing after decontaminating.

3.4 Onsite Transportation

Transportation operations involving hazard materials, including plutonium and HE, occur throughout the entire Plant area.

The following sections provides brief facility descriptions for facilities involved in on-site and off-site transportation operations. They include:

- Building 12-117, Weapons Transfer Station (Section 3.4.1)
- Loading Docks (Section 3.4.2).

The facilities discussed in these sections are all non-nuclear facilities.

Chapter 5.0 presents onsite and offsite transportation information in more detail, including vehicles, containers, processes, organization, etc. A Draft On-site Transportation Safety Analysis Report has recently been written and describes onsite transportation in further detail.

3.4.1 Building 12-117, Weapons Transfer Station

Building 12-117, the Weapons Transfer Station, has recently been constructed and will go into operation sometime in 1996. Building 12-117 will be an all weather enclosed loading station for loading and unloading weapons and components for off-site and on-site transportation and is located in Zone 12 South[93]. Building 12-117 provides approximately 6,200 ft^2 of dock space for two trucks and dock levelers.

Building 12-117 is equipped with a sodium vapor lighting system and four impact-resistant dock lights, emergency lighting, fire protection, communication, and ramp security systems.

Building 12-117 provides an area where transfers of HE may be conducted. A lightning protection and grounding system is also provided.

3.4.2 Loading Docks

At Pantex Plant, numerous loading docks are used for the loading and unloading of hazardous materials. As most hazardous materials must pass through a loading dock, the commonly used docks are described in the following paragraphs.

General Stores, Building 16-19, contains several loading docks for the receipt of materials from off-site vendors. Both hazardous and non-hazardous materials are loaded and unloaded at these docks. The docks are "high docks," which means they are designed so that a forklift may be driven from the dock directly onto the bed of a trailer.

Zone 4 has only one loading dock, located in Building 4-26[94]. The dock utilizes a 7,212 kg (15,900-lb) capacity dual hydraulic lift platform. It is suitable for loading and unloading all nuclear explosives systems and containerized nuclear components. Normally, all nuclear explosives are unloaded in front of the magazine in which they are to be staged, however, some special instances require unloading at the dock.

All transfers into and out of Zone 11 go through the loading dock of Building 11-42, although operations at this dock will soon be discontinued. A new dock has been built approximately 45.7 m (50 yards) west of the old dock. The new dock is connected to ramp 11-R-22 and is not associated with a particular building. It is a "low-dock," which means that the floor of the ramp is even with the concrete pads outside the ramp.

Zone 12 South utilizes eight loading docks for HE and SNM shipments. All but one, Loading Dock 12-83, is located in the MAA.

Loading Dock 12-83 is located in Ramp 12-R-29 and is a part of Building 12-83 (Service Magazine). Dock 12-83 is the focal point for the transfer of HE between Zone 12 South and other zones. HE transfers between Dock 12-83 and Zone 12 MAA is through the ramps through Section A or C. Dock 12-83 is the primary starting point for transfer of HE (coming from disassembly) for transport to the burning ground. The dock is about a foot above the depressed pad on which a truck would park, so material must be lifted up from the dock to a truck bed. Since forklifts cannot drive directly onto the back of most trailers using Dock 12-83, it should be considered a low dock.

Loading Dock 12-79 is a high dock located in an extension on the south end of Building 12-82. It is used for the receipt and shipment of tritium reservoirs, SNM, RTGs, and other hazardous and non-hazardous materials. Loading Dock 12-98 is used for loading and unloading nuclear explosives and nuclear components.

Dock 12-98 is a low dock and requires the use of hardened/flatbed trailer and forklift operations. It is located in the area between Buildings 12-98 and 12-99. It consists of a roll-up door and a ground-level concrete runway opening into Ramp 12-R-98 from the outside. There is no covering over the concrete runway.

Loading Dock 12-99 is a low dock located southeast of Building 12-99 and consists of a roll-up door and a ground-level concrete runway opening to Ramp 12-R-84. It is sometimes called the 12-R-84 loading dock. It performs the same function as Dock 12-98.

Loading Dock 12-42 is located on the south end of Building 12-42. It is a high dock, and can accommodate one truck. It is sometimes known as the "Waste Management Dock," and a wide variety of materials are loaded and unloaded there. Account 35 materials, which may or may not be hazardous, are often unloaded at this dock.

Loading Dock 12-26 is a high dock which leads to Building 12-26. It is primarily used for moving pits.

Loading Dock 12-104A is a fully enclosed high dock used primarily for moving nuclear explosives and nuclear components.

Loading Dock 12-117 is located in the southwest corner of Zone 12 South across the ramp from Building 12-116. It is a fully- enclosed facility with two high docks to allow forklifts to drive from the ramp onto the back of the trailer. The loading dock is used primarily for moving nuclear explosives and nuclear components.

3.5 Support Facilities

The following sections describes structural design and operations for various support facilities located throughout the entire Plant area. The operations conducted in these facilities include:

- Testing and Evaluation (Section 3.5.1)
- Waste Staging and Processing (Section 3.5.2)
- Other Support Facilities (Section 3.5.3).

The facilities discussed in these sections are all non-nuclear facilities.

3.5.1 Testing and Evaluation

The following section describes the structural design and operations that involve the testing and evaluation of inert components and materials. These facilities include:

- Building 12-86, Inert Assembly and Test Facility (Section 3.5.1.1)
- Building 12-82, Reacceptance Facility (Section 3.5.1.2)
- Buildings 12-42A, B, C, and F, Sandia Weapons Evaluation Test Laboratory (Section 3.5.1.3).

3.5.1.1 *Building 12-86, Inert Assembly and Test Facility*

Building 12-86 is located in the Zone 12 South (Figure 3-2.), was built in the late 1980s, and is classified as a moderate hazard facility. The building is a 4,262 m² (45,876-ft²) structure with 0.3-m (1-ft) thick concrete walls and floors. The work areas are separated by removable steel walls. Each area has a 1,814 kg (4,000-lb) capacity bridge crane and hoists[95].

Utility and service systems in Building 12-86 include electrical power, process compressed air, and vacuum systems. The only hazardous materials expected to be present in this building are limited to cleaning solvents, hazardous waste generated from the cleaning operations, and a small quantity of petroleum products such as hydraulic oils and lubricants.

The major operations conducted in Building 12-86 are Class II uncased and cased HE activities. The assembly area build-up operations involve adding and testing simulated SNM, detonators, their connectors and cables, cases, necessary hardware, electrical components, and other prescribed materials in sequential stages. The build-up assembly is then inspected in the testing area. No plutonium is allowed in this facility and exposed explosives are kept to a minimum and in very small quantities.

3.5.1.2 *Building 12-82, Reacceptance Facility*

Building 12-82 is an approximately 1,282 m² (13,800-ft²) building located in the south central portion of Zone 12 (Figure 3-2.) between Buildings 12-61 and 12-66[96]. Building 12-82, a low hazard facility, is the Component Reacceptance Facility and operations consist of rework and reacceptance of weapon components, cables, and covers that are part of the weapon assembly and disassembly processes.

The reacceptance process includes a large amount of "35" account materials and generates many different types of waste as listed in Pantex Plant O&I Standard 7-0034. No explosives are included in the reacceptance process. Equipment used in the building include a hoist, table top fans, vibroetcher, bench grinder, power driven tools, heaters, heat guns, heat sealers, soldering guns, soldering irons, micro sand blaster, and a lettering gun.

3.5.1.3 *Buildings 12-42A, B, C, and F, Sandia Weapons Evaluation Test Laboratory*

Sandia National Laboratories has several buildings adjacent to the 12-42 Warehouse operated by Mason & Hanger. The Weapon Evaluation Test Laboratory facilities are located in Building 12-42A, 12-42B, 12-42C, 12-42D, and 12-42F as shown in Figure 3-2. Building 12-42A is 1,852 m² (19,938 ft²) and was constructed in 1965. The building is a double span pre-fabricated steel building. The east side has three pre-fabricated appendages, 12-42B, 12-42C, and 12-42D. Building 12-42B is a small 4.0 m × 4.9 m (13 ft × 16 ft) room and is an explosive containment room certified for up to 25 grams of TNT. Building 12-42C is an attached pre-fabricated structure. Building 12-42D is an attached room approximately 4.3 m × 9.1 m (14 ft by 30 ft) and is used for parachute deployment. Building 12-42A is separated by a fire wall from building 12-42. Building 12-42 is used as a staging area by Waste Operations and also for administrative offices. Building 12-42F is an attached two level structure that houses a large 50,000 G-lb centrifuge. The building is 116 m² (1250 ft²) and was completed in 1970. A second 50,000 G-lb centrifuge is located in the lower level of 12-42A. The arms of both centrifuges are loca-ted underground. The centrifuges have a diameter of 4.9 m (16 ft). Building 12-42F is reinforced concrete centrifuge pit covered by an insulated metal building with steel troweled floors. Fire protection in 12-42A is a wet sprinkler system and in 12-42F is a Halon system with heat detection.

Test material is received from Mason & Hanger after weapon disassembly in the form of individual components or as an assembled test unit. If individual components are received, they are assembled into a test unit by lab personnel. Some test units undergo temperature conditioning in a temperature range of -51°C to 71°C (-60°F to 160°F). Some test units are subjected to internal environments on the 50,000 G-lb centrifuge. Each weapon system has a unique set of test equipment designed for that program. The test units interface with the test equipment which provides inputs normally provided by missing parts of the weapon system and monitors the test unit responses. The response is analyzed by the data acquisition and processing equipment and a test report is generated. The test unit is removed from the test system and returned to Mason & Hanger for additional processing.

Lifting equipment with a capacity 907 kg (2,000 lbs) is used in the handling of weapon parts. The temperature conditioning process uses liquid CO_2 or electric heat. Twelve-thousand, seven-hundred kg (14-ton) and 5,443 kg (6-ton) storage liquid CO_2 tanks are located outside the building with a distribution system to service the building. An electric handcart is used for moving some test packages and parts to the test area. Weapon explosive components are tested in specially designed and proof-tested containment fixtures. Gases from explosive component tests are purged through a fume precipitator consisting of an electrostatic air cleaner and HEPA filter or vented outside the building.

As a result of some test, lead fumes and tritium contaminated (solid form) components may be generated due to the explosives and materials involved. Thermal batteries are present in some test and may present toxic gas and thermal hazards if venting occurs. Maintenance of the equipment may involve the use of a band saw, grinder, drill press, hand tools (both manual and powered), lubricants, adhesives, and solvents.

Barium-133 references sources are used with the neutron detectors. They are less than 10 microcuries encased in a fixture and do not constitute a personnel hazard because of the low level of energy and double containment housing. Neutron generators are included with some test units. They contain less than 100 millicuries of tritium in solid form. The flux density and number of tests do not constitute a personnel hazards although precautions are established. A neutron calibration source is used in test equipment calibration. Krytrons are present in some older firesets, but do not present a personnel hazard. They are potted inside the fireset and present a hazard only during disposal.

Explosive components are tested in the Weapon Evaluation Test Laboratory as part of the weapon evaluation process. Various explosive components are stored for use in test units, checkout of test equipment after major modifications, and noise immunity test. The components are stored in the Sandia area of the 12-42 Warehouse. In addition, test units containing explosives are stored in the 12-42 staging area where unit testing is initiated.

3.5.2 Waste Staging and Processing

The following section discusses the structural design and operations that involve processing and staging waste materials and components. These facilities include:

- Building 16-16, RCRA Hazardous Waste Staging Facility (Section 3.5.2.1)
- Building 11-7N, Waste Storage Pad (Section 3.5.2.2)
- Building 11-9N, Waste Storage Facility (Section 3.5.2.3)
- Building 11-9S, Treatment and Processing Facility (Section 3.5.2.4)
- Building 4-28, Magazine - Storage (Section 3.5.2.5)
- Building 4-50, Hazardous/ Mixed Waste Storage Facility (Section 3.5.2.6)
- Building 4-72, Explosive Waste Storage Facility (Section 3.5.2.7)
- Building 12-42, Compaction Facility (Section 3.5.2.8).

3.5.2.1 *Building 16-16, RCRA Hazardous Waste Staging Facility*

This section contains a brief description of the operations associated with the RCRA Hazardous Waste Staging Facility, Building 16-16[97]. This low hazard facility is being constructed near the Steam Plant between Zone 11 and Zone 12. The primary function of the facility is to provide warehouse space for the storage or temporary staging of hazardous waste, mixed waste, and low-level radioactive waste (LLW).

Building 16-16 will include a mechanical room, an office, a restroom, and a shipping/receiving truck dock.

The utilities and services for Building 16-16 include electric power and natural gas, HVAC, water supply and sanitary drains, and waste handling. Other important service systems include fire alarms and sprinklers, containment sump monitors and alarms, ventilation interlocks and alarms, grounding and lightning protection, telephones and a public address system.

Building 16-16 is intended for short-term staging of wastes but will possess a permit allowing for long-term storage. The facility is being designed to comply with the requirements of the RCRA, and will be used to stage different categories of waste (except for flammable liquids), such as acids, bases, cyanides, oxidizers, heavy metals, and others (e.g., LLW and mixed waste).

Building 16-16 will be a Bulk Material Staging Area containing up to 1,600 208-liter (55-gal) drums or 330 wood or metal boxes. It will be provided with spill containment trenches designed to capture and segregate spilled materials from incompatible materials and unaffected containers. These trenches will slope to spill containment sumps. The trenches will be designed to have a liquid-tight seal. The floor outside of each staging zone will be slightly pitched toward its trench such that the flow of liquids will be toward the trench and away from the other staging zones. Material movement aisles between staging zones will be a minimum of 3.1-m (10-ft) wide. Material movements will be accomplished via forklift.

Three basic activities will occur in this facility. These are materials transportation, materials staging, and waste package inspection.

It is anticipated that waste consolidation will not be done in these buildings. The transportation, staging, and inspection activities are discussed below. Procedures have not yet been developed for this facility. It is assumed that existing

Pantex Plant procedures, especially those used at Pad 11-7 and Building 11-9, will be adapted to operations in this facility.

Waste packages will be prepared as if for off-site transport before placement in a staging facility. This includes verification that the package meets all waste acceptance criteria. Containers staged prior to shipment will be identified with a unique Pantex Plant identification number. Staged containers will have applicable hazardous and radioactive mark-ings and labels. When a waste package has been approved for shipment to Building 16-16, the waste package will be loaded onto a transport vehicle and transported to the facility truck dock. The prefer-red vehicle used for intraplant movement of waste containers is a flat bed/tractor. However, other types of vehicles (e.g., stake-bed trucks) may be used. Approved tie-down procedures will be used. When a truckload of waste packages arrives at Building 16-16, it will be off-loaded by electric forklift at the truck dock. Drums may be handled with a drum handling device or may be placed on pallets for movement by forklift. Boxes are manufactured with skids attached to the bottom for easy handling by a forklift.

At the truck dock, the containers will be inspected for any damage which may have occurred during transport. Containers without properly completed and approved papers will be corrected before being placed into inventory. Containers accepted for staging will be added to the inventory log of the facility. Waste materials will be moved to the appropriate area and zone of each building for staging prior to shipment or longer term storage.

Containers staged in the facility would consist primarily of steel boxes, although 208-liter (55-gal) drums could also be staged in these areas if their contents are compatible with the boxed materials. Drums will be stacked using pallets and support legs. Boxes can be stacked atop one another with no special preparation.

Adequate aisle space is required so that the condition and control number of each container may be verified as needed without movement of the containers. Each staging and containment zone within an area will consist of two double rows of staged containers (e.g., boxes, drums).

The double rows will be separated by a 0.4-m (3-ft) wide aisle to allow for visual inspection of the containers on both sides of the rows and emergency exit. Aisles between staging zones will be a minimum of 3.1-m (10-ft) wide. This will allow material movements to be accomplished via an electric forklift.

Weekly inspections are made of permitted RCRA staging facilities, including those where mixed waste is staged. This inspection is designed to determine container condition, including accumulation of dirt, dust, broken straps, rusted drums, leaks, and other discrepancies. When Building 16-16 becomes operational, it will be added to the list of facilities requiring such inspections.

3.5.2.2 *Building 11-7N, Waste Storage Pad*

Building 11-7N is a low hazard, above grade permitted concrete storage pad that is partially covered with two sheds on the north end. The sheds have a metal corrugated roof but no protection on the sides. Secondary containment is provided for some wastes at the facility, as required. This facility is used to repackage and store Pantex Plant wastes pending offsite disposition. Building 11-7N waste storage pad has a permitted capacity of 124,919 liters (33,000 gallons)/600 containers.

Normal operations include the receiving, staging or interim storage, retrieving, and shipment of hazardous wastes for off-site treatment/disposal. Additionally, inspection, inventory, and record keeping activities are performed periodically. No process-related operations are conducted.

The most serious hazards associated with the storage operations are related to extreme weather conditions. The open sided sheds with corrugated roof provide only partial protection for stored wastes during extreme weather conditions.

3.5.2.3 *Building 11-9N, Waste Storage Facility*

Building 11-9N, Waste Storage, is a low hazard facility in Zone 11 (Figure 3-1.). The purpose of this facility is to store waste awaiting shipment or transportation, periodic sampling, and repackaging of waste materials[98]. All types of waste except flammable and combustible liquids are stored at this facility. Flammable and combustible materials are stored at the Building 11-7 North Pad.

The most significant hazards associated with the storage operations include hazards associated with corrosive and reactive materials. Since flammable and combustible materials are not stored at this facility and no ignition sources are present in the immediate vicinity of this building, fire hazards are reduced significantly.

3.5.2.4 *Building 11-9S, Treatment and Processing Facility*

Building 11-9S, Treatment and Processing Facility, is a 50-year-old frame building with a concrete floor. The low hazard facility is located in Zone 11. The south portion of the building is being used to conduct sampling and repackaging of MW in containers. This part of the facility may be used to treat some MW in containers to meet LDR treatment standards specified in 40 CFR 268. The "Class 1 Modification to Pantex Plant Hazardous Waste Permit (HW-50284)" was approved by TNRCC to allow for treatment of the wastes.

The estimated maximum inventory of wastes in the treatment section of this facility at one time is 5,680 liters (1,500 gal). building 11-9S is also used as a 90-day accumulation area for HW and MW. Treatment activities are to be determined by the Pantex Plant Site Treatment Plan or its successor. LLW may also be processed in this building for offsite disposal in the future.

3.5.2.5 *Building 4-28, Magazine - Storage*

Magazine 4-28 is a Richmond magazine that has not been modified like those used for weapons and weapon components staging. The magazine is located in the western portion of Zone 4 as shown in Figure 3-4. The magazine has approximately 96.7 m^2 (1,040 ft^2) interior space and consists of a concrete slab floor and three reinforced concrete walls with earth cover sloped up to the top of the exterior sides. The fourth wall is constructed of wood frame with asphalt-type slate siding and has a 2.4-m (8-ft) wide roll-up door which opens to a concrete driveway. The roof is made of a wood deck of composition shingles supported by wood trusses.

No utilities are provided in the magazine. The magazine is not equipped with fire protection systems, communications systems, heating or cooling systems or forced-ventilation systems. There are two portable fire extinguishers mounted on poles outside the magazine. Ventilation occurs by natural convention through vents in the roof. Each magazine is provided with a lightning protection grounding system in accordance with the requirements of DOE/EV/06194 and NFPA 780.

The magazine consists of one room with two separate fenced-in areas. The one side is used by the security force for the storage of security material and the other side was used by waste management for the staging of hazardous waste such as PCB oil. The PCB oil was staged in 208-liter (55-gal) drums which were a secondary containment. Currently no waste is staged in the second side of the facility.

Normal operations include the receiving, staging or interim storage, retrieving, and shipment of materials. No process-related operations are conducted at this facility. Forklifts are used during the movement of material into and out of the facility. During normal operations this facility is not occupied but during movements of material there are about six persons present.

3.5.2.6 *Building 4-50, Hazardous/Mixed Waste Storage Facility*

Magazine 4-50, a moderate hazard facility, is a Richmond magazine that has not been modified like those used for weapons and weapon components staging. The magazine was constructed in 1944. The magazine is located in the eastern portion of Zone 4, which is approximatly in the center of the Plant site (Figure 3-4.). The magazine has approximately 96.7 m^2 (1,040 ft^2) interior space as a single room and consists of a concrete slab floor and three reinforced concrete walls with earth cover sloped up to the top of the exterior sides. The fourth wall is constructed with concrete block and has a 5.5-m (18-ft) wide roll-up door which opens to a concrete driveway. A 76.2-cm (30-in.) wide personnel access door is also provided through the wall. The roof is made of cemesto board on top of wood deck supported by wood truss. The magazine is not equipped with radiation monitoring systems, fire protection systems, communication systems, heating or cooling systems, or forced-ventilation systems.

Normal operations include the receiving, staging or interim storage, retrieving, and shipment of hazardous/mixed wastes off-site for treatment/disposal. Additionally, inspection, inventory, and recordkeeping activities are performed periodically. No process-related operations are conducted[100].

3.5.2.7 *Building 4-72, Explosive Storage Facility*

Magazine 4-72, a moderate hazard facility, is a Richmond magazine that has not been modified like those used for weapons and weapon components staging. The magazine was constructed in 1944. The magazine is located in the eastern portion of Zone 4, which is approximatly in the center of the Plant site (Figure 3-4.). The magazine has approximately 96.7 m² (1,040 ft²) interior space as a single room and consists of a concrete slab floor and three reinforced concrete walls with earth cover sloped up to the top of the exterior sides. The fourth wall is constructed with concrete block and has a 5.5-m (18-ft) wide roll-up door which opens to a concrete driveway. A 76.2-cm (30-in.) wide personnel access door is also provided through the wall. The roof is made of cemesto board on top of wood deck supported by wood truss. The magazine is not equipped with radiation monitoring systems, fire protection systems, communication systems, heating or cooling systems, or forced-ventilation systems.

Normal operations include the receiving, staging or interim storage, retrieving, and shipment of explosive wastes for treatment/disposal. Additionally, inspection, inventory, and recordkeeping activities are performed periodically. No process-related operations are conducted.

3.5.2.8 *Building 12-42, Compaction Facility*

Building 12-42 is located in the south central portion of Zone 12 (Figure 3-2.) and was originally constructed as a warehouse[102].

This building contains the compactor facility for all low-level radioactive waste and hazardous low-level radioactive waste for the MAA operations. These low-level radioactive wastes are contaminated with alpha radiation and possibly toxic or carcinogenic substances. The wastes may also be contaminated with small amounts of tritium.

Dry wastes are stored in 208-liter (55-gal) drums, and all low-level radioactive wastes are bagged and stored in dumpsters.

The compactors are rated at a pressure of 60×10^6 kg/m² (86,000 psi) and have an enclosed chamber. They are fitted with a HEPA filter system.

3.5.3 Other Support Facilities

The following section discusses the structural design and operations that involve staging various assembly/disassembly, testing and evaluation, and other process materials and components. These facilities include:

- Building 11-34, Acid Storage Facility (Section 3.5.3.1)
- Building 11-39, Flammable Liquid Storage Facility (Section 3.5.3.2)
- Building 15-29, Chlorine Building (Section 3.5.3.3)
- Building 13-47, Sewer Control Building (Section 3.5.3.4)
- Building 12-67, Gas and Oil Storage Facility (Section 3.5.3.5)
- Buildings 12-68 & 68A, Tool & Die Shop/Shipping and Inspection (Section 3.5.3.6).

3.5.3.1 *Building 11-34, Acid Storage Facility*

Building 11-34 is a 55.7 m² (600-ft²) building located in the west-central portion of Zone 11 (Figure 3-1.), east of Building 11-36[103]. The building is used for the storage of acids and other materials used in the synthesis of HE.

The floor slab of Building 11-34 is 6.1 m × 9.1 m (20 ft × 30 ft) and is reinforced concrete with expansive shrinkage compensating cement. The slab was poured on top of a 15.2 cm (6 in.) sand fill which was compacted to a relative density of 70 percent. Footings, piers, and grade beams were designed to support the live and dead loads of the structure. The design live load for the floor slab is 146 kg/m² (250 psf). The floor is sloped toward a drain near the west end of the building, and the drain line is run to the outside of the building. The floor has a smooth trowel finish and is sealed with a penetrating type hardener sealer. The sealer is a type that will not react with the acids stored in the event of a spill.

The roof-deck and support system are noncombustible material with a design loading of 30 psf live load. The ceiling height is 2.4 m (8 ft) minimum, and the roof has a slight slope for drainage.

The walls are constructed of concrete block, and the west wall of the building has a 2-hr fire rating. The paint used on the interior walls, joists, and ceilings was of such composition and applied heavily enough to protect the surfaces from the effects of acid fumes.

The 1.8 m × 2.1 m (6 ft × 7 ft) ramp entrance to the building has double doors with a matching frame. The doors are equipped with panic hardware with automatic fusible-link closers. An emergency exit door is in the east end of the building and is a single 0.9 m × 2.1 m (3 ft × 7 ft) door with panic hardware and a threshold. The hinges are peened and seal eyelets have been provided.

A portable partition divides the room along the shorter dimension into two areas of variable size.

The building has two manual central steam radiators to supply heat. The building also has a turbine-type ventilator sized for a maximum average exhaust rate equal to two complete air changes per hour.

The building has an eyewash and shower, which are located near the floor drain at the west end of the building. A water faucet with standard hose connection is inside the building for use in washdown operations.

Building 11-34 operations consist of the storage of nitric acid (100 percent and 90 percent solutions), phosphoric acid, sulfuric acid (20 percent - oleum), and hydrochloric acid (5 percent - 37 percent solutions) for use in the synthesis of HE in Building 11-36. The acids are stored primarily in small-quantity containers. The acid storage capacity of Building 11-34 is limited to 2,650 L (700 gal).

3.5.3.2 *Building 11-39, Flammable Liquid Storage Facility*

Building 11-39 is located in the west-central portion of Zone 11 (Figure 3-1.), 12.2 m (40 ft) from Building 11-36[104]. It does not meet the 30.5 m (100-ft) siting requirement, but a permanent exemption from this requirement has been granted by the DOE/Albuquerque Operations Office.

Building 11-39 was constructed in 1944, upgraded in 1967, and is a noncombustible single-story structure of 74.3 m² (800 ft²) measuring 6.1 m × 12.2 m (20 ft × 40 ft). The building construction is steel structural frame with clay tile non-load bearing walls and reinforced-concrete floor slab. The roof assembly is built-up asphalt and gravel roofing on an insulated metal deck supported by steel beams. The building is connected to Building 11-36 by a noncombustible steel frame enclosed ramp with corrugated asbestos panel walls and roof. The 11-39 door to the ramp is 3-hr fire-rated.

Building 11-39 is protected by an automatic wet-pipe sprinkler system, extra-hazard schedule, with 74°C (165°F) heads. The system is an extension of the Building 11-36 system.

Building 11-39 operations consist of the storage of process chemicals for use in HE synthesis in Building 11-36. The storage limit for Building 11-39 is 2,271 liters (600 gal) of flammable liquids (NFPA Class I, B) and dry chemicals. No dispensing of these chemicals is done in Building 11-39.

3.5.3.3 *Building 15-29, Chlorine Building*

Building 15-29, the Chlorine Building, is a moderate hazard facility and provides the chlorination required for the Pantex Plant fresh water supply system. The facility is located north of Building 12-36 adjacent to south 14th street as shown in Figure 3-3. Building 15-29 is a small cement block building with a surrounding brick layer. The building is adjacent to Buildings 15-27 and 15-28. Building 15-27, the Pump House is used to pump fresh water to the Pantex Plant water distribution system. Principal equipment includes water pumps, fire pumps, and a sump pump. Building 15-28, the facility is a 2.5 million gallon water storage tank for the Pantex Plant water system. There are no hazards uncommonly encountered associated with these facilities that could affect the operations in Building 15-29.

The operations at Building 15-29 are to chlorinate fresh water before distribution into the water system. Equipment at this facility consists of a chlorine monitor, a chlorinator, and scales similar to that of the municipal chlorine facility for the City of Amarillo. The facility is equipped with a mechanical exhaust vent that opens when chlorine is detected. When the vent opens, an audible and visible alarm is activated. There are no hazards uncommonly encountered beyond those normally associated with similar large capacity systems. However, there may be up to 454 kg (1,000 lb) of chlorine on hand in the facility. All cylinders stored at the facility are protected with robust cylinder valve caps. The chlorine at this facility is stored in 68 kg (150 lb) compressed gas cylinders inside the facility. At any given time, a maximum of two cylinders are hooked up to the chlorinator system. Subject to casual personnel, there are no dedicated personnel to this building.

3.5.3.4 *Building 13-47, Sewer Control Building*

Building 13-47, the Sewer Control Building, is a moderate hazard facility and serves as the waste water facility for the Pantex Plant. The facility is located south of Playa 1 in the center of the Plant. The building consists two cinder block sections. The northern section houses the electrical equipment and the southern sections houses the chlorinator. South of the building is a retention or contact chamber where is water travels in serpentine path to allow for chlorine retention. To the southwest of the facility is a facultative lagoon that has two 20 hp aerators. As water flows out of the lagoon and toward the retention chamber, chlorine is injected into the stream.

Equipment at this facility consists of two irrigation pumps, a chlorine cabinet detector, and chlorine scales. The facility is equipped with a mechanical exhaust vent that opens when chlorine is detected. When the vents open, an visible and audible alarm is activated. The facility is the accumulation point for all wastewater at Pantex Plant. There are no hazards uncommonly encountered beyond those normally associated with similar capacity systems. However, there may be 454 kg (1,000 lb) of chlorine on hand in the facility. The chlorine at this facility is stored in 68 kg (150 lb) compressed gas cylinders inside the facility. All cylinders stored at the facility are protected with robust cylinder valve caps. At any given time, a maximum of two cylinders are hooked up to the system. In addition compressed air cylinders are also present at the facility. Subject to casual personnel, there are no dedicated personnel to this building.

3.5.3.5 *Building 12-67, Gas and Oil Storage Facility*

Building 12-67, the Gas and Oil Storage Facility, is used for the storage of significant quantities of hazardous materials[106]. The facility was constructed in 1972 and is 554 m^2 (5,964 ft^2).

The facility is located at the north end of Zone 12 North as shown in Figure 3-3. There have been no modifications or additions since that time. The facility consists of a rectangular dock constructed of steel reinforced concrete. A blank wall divides the dock into two approximately equal parts. The west side is used for the storage of gas cylinders and the east side is used for the storage of liquids. The cylinder storage area is open at both the north and south ends and is therefore directly open to the environment. Both storage areas are covered by a roof. The roof is equipped with vents. A dry sprinkler system is located throughout the facility.

The building is used for the storage of high pressure cylinders and flammable liquids. Much of the movement of material is done by either forklifts or handcarts. Examples of material stored in this facility are tens of cylinders of acetylene and oxygen; tens to hundreds of gallons of paints; tens of gallons of solvents. There are no hazards uncommonly encountered beyond those normally associated with similar capacity systems. No high explosives are allowed in this facility. Typically there about 20 personnel in the building during normal operations. There are no hazards beyond that normally associated with the storage of chemicals.

3.5.3.6 *Buildings 12-68 & 68A, Tool & Die Shop/Shipping and Inspection*

Buildings 12-68 and 12-68A, the Tool and Die Shop and the Metrology Tooling Facilities are used for the fabrication of special tooling and support of plant maintenance. Building 12-68, a concrete block structure of 3,601 m² (38,760 ft²), was constructed in 1966. Building 12-68A, a concrete block structure of 372 m² (4,000 ft²), and was constructed in 1990. The facility is located in Zone 12 north as shown in Figure 3-3.

Operations in Buildings 12-68 and 12-68A are to perform fabrication, and receiving and inspection activities to ensure compliance to drawing specification of all tooling items fabricated at Pantex or purchased from outside vendors. This includes conducting electronic and programmatic tooling acceptance and the certifications of cutters and the repairing of tooling. The machine shop manufactures highly specified tooling for use throughout Pantex. The operations consist of machining (grinding, boring, and drilling), heat treating, chemical cleaning, and surface cleaning. The chemical processes involve aqueous acid and caustic solutions maintained in both heated and unheated baths. These include organics along with sulfuric, nitric, and phosphoric acids. Large tanks (757 liters or 200 gal) in the heat treatment room contain acids and dyes. There are modest quantities of cleaners (qts) on hand along with the lifts and hoists necessary to support such operations. Typically there about 30 personnel in the buildings during normal operations.

3.6 Classification and Description of Structures, Systems, and Components

3.6.1 Pantex Classification of Structures, Systems, and Components

This section describes safety structures, systems, and components (SSCs) that are identified for safe operation of the facility. At Pantex Plant, a classification scheme is used for SSCs that includes the consideration of facility worker safety, as well as the protection of members of the public. In the Pantex classification, SSCs are classified as belonging to one of three classes: safety-class SSCs, safety-significant SSCs, and balance of plant.

Table 3.6.1-1. provides the definitions for Safety-Class SSCs and Safety-Significant SSCs from DOE-STD-3009-94[107]) and a definition of Balance of Plant. These system definitions make reference to various consequence categories which

TABLE 3.6.1-1.—*SSC Classification Categories*

Safety Classification	Definitions
Balance of Plant	SSCs whose failures initiate (or fail to prevent, mitigate, or detect) a credible accident sequence with no greater than negligible consequences to personnel, the public, the environment, or the conduct of mission operations.
Safety-Class SSC	SSCs, including primary environmental monitors and portions of process systems, whose failure could adversely affect the environment, or the safety and health of the public, as identified by safety analyses.
Safety-Significant SSC	SSCs not designated as safety class SSCs but whose preventive or mitigative function is a major contributor to defense in depth (i.e., prevention of uncontrolled material releases) and/or worker safety as determined from hazard analysis.

are summarized in Table 3.6.1-2. The safety classification of a system depends upon the technical basis for the assignment as supported by accident analyses. Thus, a system classified as belonging to safety class SSC for one facility could be classified as a safety significant SSC for use in another building. Section 3.6.2 provides a brief description of SSCs in place at Pantex Plant.

3.6.2 Description of Structures, Systems, and Components

3.6.2.1 *Radiation Monitoring and Protection Systems*

Radiation Alarm Monitoring System (RAMS). The purpose of this system is to provide warning to personnel in the event of a catastrophic failure of the containment system for radioactive materials and to provide remote notification of system status (normal/alarm/malfunction). This system will provide prompt evacuation alarms for personnel in the event of a release of radioactive materials.

The RAMS monitors for the presence of airborne alpha and beta radiation in the facility. Alpha and beta continuous air monitors (CAMS) are used to detect airborne radiological contamination.

Data from the monitors is transmitted over an electronic network used exclusively for transmitting airborne contamination monitoring information. The CAMs, associated bay electronics, alarm indicators, microcomputers, stand-alone modems, minicomputer, and terminals are collectively referred to as the RAMS. The contaminated vacuum system is used to move bay air through the alpha CAMs. The beta CAMs incorporate fans that move air through an ionization chamber. Safety functions provided by the RAMS include: (1) warning bay workers and personnel in the ramp outside a bay that a radiation release has occurred inside the bay, (2) remote notification of Radiation Safety that a radiation release has occurred, and (3) warnings of RAMS malfunctions so that operations requiring RAMS can be stopped.

The monitors have "low" and "high" alarm set-points. Detection of radiation corresponding to the low level setpoint provides only a remote alarm. High level detection produces both remote and local visual and audible alarms. The RAMS has an alarm capability and is sufficiently sensitive to alert personnel that immediate evacuation is necessary to minimize or terminate inhalation exposures. Visual and audible alarms are located in each bay and in the corridor adjacent to the bay. Visual annunciation in the bays is provided by four lights (red, blue, amber, and green) on the Evacuation Alarm Unit. A red light indicates beta detection, a blue light indicates an alpha detection, an amber light indicates a RAMS malfunction, and a green light indicates no radiation detection. A bell indicates beta detection; and a warble indicates alpha detection. The RAMS is hardwired and interlocked with other systems (i.e., HVAC, fire, etc.) in the facility to assist in taking appropriate mitigation actions and may warn of possible system failure. The RAMS have the capability to shut down the HVAC upon an alpha alarm where interlocked. The RAMS also have the capability to shut down the air intake and start or continue to exhaust air in the event of a beta alarm where interlocked. The beta alarm will override the alpha alarm if both alpha and beta radiation are detected. The fire alarm will shut down the HVAC and also overrides the alpha or beta alarms.

Rad-Safe (Linac Bays). The purpose of this system is to ensure that the Linac equipment will not inadvertently expose personnel in the facility to radiation.

Alpha Continuous Air Monitor. The purpose of this system is to provide warning to personnel in the event of a catastrophic failure of the containment system for alpha radioactive materials. This system will provide prompt evacuation alarms for personnel in the event of a release of radioactive materials. The failure of

TABLE 3.6.1-2.—*Qualitative Consequence Categories*

Consequence Magnitude	
Catastrophic	A failure that may cause deaths, or the total loss of the facility or process, or severe damage to the environment.
Critical	A failure that may cause severe injuries or occupational illnesses, major damage to the facility or process, or major damage to the environment.
Marginal	A failure that may cause minor injuries or occupational illnesses, minor damage to the facility or process, or minor damage to the environment.
Negligible	A failure that most likely will not result in injuries or occupational illnesses, damage to the facility or process, or damage to the environment.

this system would result in the lack of exposure protection and warning to all involved personnel.

Tritium Continuous Air Monitor. The purpose of this system is to provide warning to personnel in the event of a catastrophic failure of the containment system for tritium radioactive materials. This system will provide prompt evacuation alarms for personnel in the event of a release of radioactive materials. The failure of this system would result in the lack of exposure protection and warning to all involved personnel.

3.6.2.2 *Fire Protection Systems*

Fire Detection and Alarm System. The purpose of this system is to protect life, property, and the continuity of operations by giving early warning of a fire. The system provides warning to facility occupants for evacuation from the facility, and provides notification to the Fire Department for response. Depending on the facility, Fire Department notification is initiated upon the detection of water flow in the fire suppression system and/or the presence of smoke in the facility. The fire protection system overrides the alpha and beta alarm systems and interlocks except for assembly cell Blast Door Interlocks. Fire detection is provided by, but not limited to, smoke detectors, UV detectors, and heat detectors.

In the event of power loss, batteries that are appropriately charged will maintain adequate auxiliary power for the fire protection system in the event of a power loss.

High Pressure Fire Loop. The high pressure fire loop System supplies fire water to the fire suppression systems of each facility. The high pressure fire loop consists of looped, well gridded, and valved distribution mains; two ground storage reservoirs; and two fire pump stations. The high pressure fire loop is dedicated solely for fire protection. The high pressure fire loop has sufficient water capacity to supply at least 2 hr of water to a facilities fire suppression system. The high pressure fire loop system is replenished by the Pantex Plant water distribution system.

Fire Door. The purpose of the fire door system is to retard the progress of a fire in order to allow a sufficient amount of time for the Fire Department to respond to the fire signal. In the event of an external fire, the fire door system should also retard the progress of a fire from entering a facility that may contain hazardous materials.

Fire Extinguisher. The purpose of fire extinguishers is to provide personnel with a fire suppression device to extinguish a fire or to retard the spread of a fire for a sufficient time to allow the Fire Department to respond to the fire signaling system. Fire extinguishers are not a safety class system but are an administrative control.

Fire Suppression System. The purpose of the fire suppression system is to detect and extinguish a fire that could potentially lead to an HE detonation and provide life safety, and property protection. An HE detonation would result in facility loss and possible dispersal of radioactive material. The fire suppression system would minimize the potential fire loss within a facility, and also delay the spread of a fire in order to give the Fire Department adequate response time.

Adequately charged fire protection batteries will maintain auxiliary power for the fire protection system in the event of a power loss.

Fire suppression systems may include, but are not be limited to, sprinkler systems and water supply systems. Deluge systems and Halon systems are examples of sprinkler systems.

Vent Cover (Fire Damper). The purpose of this system is to retard the spread of fire into the vent system and to delay the fire to allow the Fire Department an adequate amount of time to respond to the fire signal system.

3.6.2.3 *Grounding and Lightning Protection Systems*

Grounding System. The purpose of this system is to provide static protection and grounding for equipment requirements and electrical safety.

Lightning Protection. The lightning protection system is a static system designed to mitigate the effects of lightning striking a given building.

3.6.2.4 *Electrical Power Distribution*

Uninterruptible Power Supply. The purpose of this system is to ensure that all critical safety equipment that requires electrical power will operate properly and provide safe shutdown of operations in the event of a power loss to the facility. This system is necessary for the proper continuous operation of other safety systems.

Diesel Generator for Auxiliary Power. The diesel generators for auxiliary power will supply electrical power to facilities' uninterruptible power supply in the event of a long term normal electrical power failure (> 30 min). The diesel generator is not relied upon to place the facility in a safe and stable configuration. The uninterruptible power supply is relied upon to provide the electrical power to the critical systems that are required to be operable for that short period of time required to place the facility in a safe and stable configuration.

Emergency Lighting. The purpose of emergency lighting is to provide the required illumination automatically in the event of any interruption of normal lighting. This lighting will allow safe shutdown of operations in and egress from the affected facility in the event of a loss of power.

Automated Energy Management System. This controls and monitors the operating status of certain mechanical systems in Building 12-84 (East) and 12-104. AEMS is not provided for other facilities.

3.6.2.5 *Ventilation and Exhaust*

Heating, Ventilating, and Air Conditioning System (HVAC). The HVAC system provides environmental control within a facility. Systems are provided for heating and cooling building air, for humidity control, and for local point/hood or task exhausts. Components of an HVAC system may include, but are not limited to, the following.

Facility Ventilation Exhaust or Task Exhaust: The purpose of the exhaust system is to provide localized exhaust for the control of nonradioactive hazardous material, toxic vapors, dust, or flammable solvents to prevent health hazards to personnel. Therefore, a properly functioning ventilation system is important both when the facility is occupied and when it is secured to mitigate the consequences of hazardous material release accidents in the facility.

HEPA Filters: The purpose of HEPA filters in the ventilation ducts is to provide protection from nonradiological contaminants and a second level of defense by mitigating the potential release of plutonium to the environment through the ventilation duct work in the event of a operational accident. For external releases in which the radioactive plume intersects the air intake to a facility, the HEPA filters provide protection to personnel within the facility.

Exhaust Hood: The exhaust hood is used to support operations in laboratories and other facilities during operations that may require the control of nonradioactive hazardous material, toxic vapors, dust, or flammable solvents to prevent health hazards to personnel.

3.6.2.6 *Communications*

Communication Systems. The purpose of this system is to notify personnel in the facility of an external explosion, earthquake, tornado, fire, or a release of radioactive materials which may require certain types of actions inside the facility or to communicate with personnel. Different types of communication systems are used Plant-wide, including telephones, public address system, Maintenance Communication Systems (MCS), Protected Distribution System (PDS) and the Pantex Plant Local Area Network (PLAN). A brief description of MCS, PDS and PLAN is given below:

Public Address System: The public address system allows for emergency/protective action information to be broadcast to all personnel. Public Address speakers are located throughout the Plant.

Telephone System: The system allows for direct communication in the event of an emergency. Telephones are located throughout the Plant.

MCS: The MCS consists of a multi-party paging system with wall stations and paging speakers.

PDS: The PDS uses Data Processing Terminals and red telephones. The red phones are used to transmit information associated with the movement and control of special nuclear materials.

PLAN: The PLAN system is an electronic broadband communication system used to support the transfer of security and utility information.

3.6.2.7 *Domestic Water Supply and Drain Systems*

Water Supply and Drains. Domestic water is provided to the office areas for drinking, lavatories, and janitorial use. Drains are provided to direct acceptable waste to the sanitary sewers.

Contaminated water and solid waste are handled separately. Contaminated water is collected in approved storage barrels. Collection tanks are used widely to collect contaminated water. Solid waste is segregated, collected, and disposed of separately.

3.6.2.8 *Other Systems*

Environmental Chamber Fan Circulation Sensor. The purpose of this sensor is to disconnect electrical power from the heaters in the system to provide maximum protection to protect nuclear explosives and subassemblies from overtemperatures. The sensor will also provide local and remote alarms. In the event the circulation fan fails to provide adequate flow through the Environmental Chamber, the heater elements are self limiting (i.e., fail-safe).

Facility Structure. The purpose of the facility structure is to provide a significant barrier that prevents accidents external to the structure and natural phenomena (e.g., tornados, earthquakes, external blasts, external fires, missiles, and credible aircraft crashes) from damaging the facility and, subsequently, the facility contents and releasing hazardous materials. For facilities that are not sited to afford a Class II level of protection for their occupied areas, the facility structure has been designed and constructed to provide that required level of protection against explosive propagation, blast overpressure, severe structural collapse, and secondary missiles. Additional protective features are provided, based on the type of operations performed within a given facility, to minimize the release of radioactive material in the event of an accidental HE detonation within the facility.

The blast door interlock system is to assure that at least one set of blast doors is closed at all times to mitigate the impact of wind borne missiles and the pressure effect of a tornado or external accidental HE detonation.

The purpose of the blast valves is that in the event of an accidental HE detonation within a cell the valves will be closed from the blast pressure and prevent the release of radioactive material to the environment through the ventilation system.

The purpose of the contaminated waste isolation valves is to prevent the communication of a blast pressure between cells that share a common waste tank, in the event of an accidental HE detonation within a cell. The valves would also prevent the release of radioactive materials in the event of accidental HE detonation.

The purpose of the door fragment suppression system (door catchers) is to minimize the fragment hazard to adjacent facilities.

Steel Doors and Concrete Barriers. The steel doors and concrete barriers provide a barrier that prevents accidents external to the structure and natural phenomena (e.g., tornados, earthquakes, external blasts, external fires, and missiles) from damaging the magazine contents and releasing hazardous material. They also provide a partial barrier that mitigates the effects of potential releases occurring within the magazine.

Magazine Structure. The purpose of this system is to ensure that the facility meets the quantity-distance criteria for specified amounts of explosives allowed in the facility. This system also minimizes the release of radioactive materials in the event of accidental HE detonation. Sandbag compartment barriers are provided for the storage of nuclear explosives to allow the KG limit for an individual magazine to be increased, and to prevent explosive propagation between sandbag compartments.

The purpose of this system is also to provide a significant barrier that prevents many types of accidents external to the structure and natural phenomena (e.g., tornados, earthquakes, external blasts, external fires, missiles, and credible aircraft crashes) from damaging the facility and, subsequently, the facilities contents, and releasing hazardous materials.

Environment Chamber Air Temperature Control Primary Interrupters. The purpose of this system is to provide maximum protection to personnel through control monitors and design features that disrupt heaters, fans, and the primary power source, and provide local and remote alarms to avoid a possible explosive detonation in the event of an emergency.

Staging Containers. The purpose of this system is to provide a confinement barrier that protects the packaged components and maintains proper spacing (when required) in the event of an internal flood. Also, the system provides a barrier preventing the release of hazardous material in the event of a fire in the facility. Several types of containers are used as packages for weapon components, high explosives, material movement, and weapons at Pantex Plant.

Vault Door. The vault door, together with the vault structure, protects the contents of the Pit Vault from various natural and man-made phenomena, such as earthquakes, tornados, external fires, explosions, and missiles.

Robot Collision and Entry Alarm. The robot collision and entry system reduces damage caused by collisions of the robot with containers or any other object. The robot collision and entry alarm also provides protection to personnel (robotic safety).

Compressed Air. The compressed air system provides pneumatic power for equipment such as overhead cranes, hoists, and miscellaneous tools and equipments.

Mercury Monitors. The purpose of this system is to provide warnings to the facility personnel about possible exposure to mercury that might escape during a process.

3.7 References

1. DOE Order 5480.23, *Nuclear Safety Analysis Reports*, U.S. Department of Energy, April 10, 1992.

2. DOE/AL Order 5481.1B, *Safety Analysis and Review System*, U.S. Department of Energy, Albuquerque Operations Office, January 27, 1988.

3. DOE, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, DOE-STD-1027-92, U.S. Department of Energy, December 31, 1992.

4. Lawrence Livermore National Laboratory, *Design and Evaluation Guidelines for Department of Energy Facilities Subject to Natural Phenomena Hazards*, UCRL-15910, June 1990.

5. DOE Order 5481.1B, "Safety Analysis and Review System," Change 1. U.S. Department of Energy, May 19, 1987.

6. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Assembly Facilities W80 Surge Bay Complex, 12-84 Add-on,* Pantex Plant, Amarillo, Texas, January 1986.

7. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, (Seven Bays Plus Linac Complex)*, Pantex Plant, Amarillo, Texas, March 1984.

8. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Nuclear Weapons Stockpile Improvement Bay Complex,* Pantex Plant, Amarillo, Texas, March 1986.

9. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, High Explosive Subassembly Facility,* Pantex Plant, Amarillo, Texas, September 1988.

10. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 12-64, Assembly Bays*, Pantex Plant, Amarillo, Texas, November 9, 1993.

11. Linac is the trade name for a Varian linear accelerator. However, "Linac" is used in the generic sense in this document as an abbreviation for "linear accelerator" rather than as a specification for a particular manufacturer.

12. DOE Order 5610.11, *Nuclear Explosive Safety*, U.S. Department of Energy, October 1990.

13. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Assembly Cells*, Pantex Plant, Amarillo, Texas, March 1981.

14. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, 2 Assembly Cells with Associated HE Service Magazine*, Pantex Plant, Amarillo, Texas, January 1984.

15. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Assembly Cell Complex*, Pantex Plant, Amarillo, Texas, April 1986.

16. Southwest Research Institute, *Blast Measurements for the Full-Scale Gravel Gertie Test at Nevada Test Site*, December 1982.

17. DOE Order 6430.1A, *General Design Criteria*, U.S. Department of Energy, April 6, 1989.

18. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 12-26 Bays 27 and 28*, Pantex Plant, Amarillo, Texas, November 9, 1993.

19. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 12-41*, Pantex Plant, Amarillo, Texas, November 9, 1993.

20. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 12-50*, Pantex Plant, Amarillo, Texas, November 23, 1992.

21. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 12-60,* Pantex Plant, Amarillo, Texas, November 9, 1993.

22. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Building 12-94, Weapon Aging Facility*, UCNI, Pantex Plant, Amarillo, Texas, March 1984.

23. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Safety Analysis Report, Weapons Special Purpose Bays Replacement Complex*, Pantex Plant, Amarillo, Texas, July 1988.

24. DOE Order 5480.11, *Radiation Protection for Occupational Workers*, Change 1, U.S. Department of Energy, July 20, 1989.

25. Mason & Hanger - Silas Mason Co., Inc., *(SAD) Safety Assessment Document, Pit Storage Vault*, Pantex Plant, Amarillo, Texas, January 1980.

26. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 12-42, North Vault*, Pantex Plant, Amarillo, Texas, November 11, 1992.

27. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, 12-42 South Vault*, Revision 0, Pantex Plant, Amarillo, Texas, August 1986.

28. Mason & Hanger - Silas Mason Co., Inc., *12-44 Cell 8, Safety Analysis Report*, Pantex Plant, Amarillo, Texas, February, 1995.

29. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Building 12-58*, Pantex Plant, Amarillo, Texas, July 1986.

30. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Safety Analysis Report, Special Nuclear Materials Component Staging Facility*, Pantex Plant, Amarillo, Texas, Rev. A, April 1989.

31. Mason & Hanger - Silas Mason Co., Inc., *Zone 4 Magazines, Final Safety Analysis Report*, Pantex Plant, Amarillo, Texas, December 1992.

32. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, SNM Staging Facilities*, Issue A, Pantex Plant, Amarillo, Texas, September 1986.

33. PX-USQD-94-20, *Refrigerated Air Introduction Into Magazines*, Pantex Plant, Amarillo, Texas, June 6, 1994.

34. DOE, *Explosives Safety Manual,* DOE/EV/06194, Revision 7, U.S. Department of Energy, August 1994.

35. National Fire Protection Association, *National Electric Code*. NFPA 70, Batterymarch Park, Quincy, Massachusetts.

36. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 11-17,* Pantex Plant, Amarillo, Texas, January 24, 1994.

37. DOD, *Ammunition and Explosive Safety Standards*, DOD 6055.9-STD, U.S. Department of Defense, October 1992.

38. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 11-22,* Pantex Plant, Amarillo, Texas, January 24, 1994.

39. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Projectile Impact System and Modified Facility (11-38)*, Revision 2, Pantex Plant, Amarillo, Texas, November 1986.

40. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Assessment Document (FSAD), Weapon Materials Analytical Laboratory (11-51)*, Pantex Plant, Amarillo, Texas, March 1982.

41. National Fire Protection Association, *Standard for the Installation of Sprinkler Systems*. NFPA 13, Batterymarch Park, Quincy, Massachusetts, 1989.

42. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Safety Analysis Report, High Explosives Synthesis Facility (11-55)*, Pantex Plant, Amarillo, Texas, April 1991.

43. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 12-8*, Pantex Plant, Amarillo, Texas, January 5, 1993.

44. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 12-19EA*, Pantex Plant, Amarillo, Texas, January 24, 1994.

45. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 12-19 West*, Pantex Plant, Amarillo, Texas, January 24, 1994.

46. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 12-59*, Pantex Plant, Amarillo, Texas, January 24, 1994.

47. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Building 12-62 (PETN Processing)*, Pantex Plant, Amarillo, Texas, March 1983.

48. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report Building 11-36, High Explosives Synthesis Facility*, Pantex Plant, Amarillo, Texas, December 1975.

49. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Building 11-20, Development Support Facility*, Pantex Plant, Amarillo, Texas, September 1975.

50. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, HE Development Machining Facility (HEDMF)*, Issue A, Pantex Plant, Amarillo, Texas, August 1984.

51. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazard Analysis, Building 12-17A*, Pantex Plant, Amarillo, Texas, January 24, 1994.

52. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazard Analysis, Building 12-17B*, Pantex Plant, Amarillo, Texas, January 24, 1994.

53. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Building 12-63 (High Explosive Pressing)*, Pantex Plant, Amarillo, Texas, December, 1980.

54. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Safety Analysis Report, High Explosives Machining Facility*, Issue A, Pantex Plant, Amarillo, Texas, January 1989.

55. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 12-24NO*, Pantex Plant, Amarillo, Texas, January 24, 1994.

56. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazard Analysis, Building 12-24S*, Pantex Plant, Amarillo, Texas, April 13, 1994.

57. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazard Analysis, Building 12-43*, Pantex Plant, Amarillo, Texas, January 24, 1994.

58. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 11-42*, Pantex Plant, Amarillo, Texas, January 24, 1994.

59. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Zone 4 SAC Magazines*, Pantex Plant, Amarillo, Texas, January 19, 1992.

60. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 11-23*, Pantex Plant, Amarillo, Texas, January 24, 1994.

61. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 11-25*, Pantex Plant, Amarillo, Texas, January 24, 1994.

62. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 11-37*, Pantex Plant, Amarillo, Texas, January 24, 1994.

63. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 11-45*, Pantex Plant, Amarillo, Texas, January 24, 1994.

64. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 11-46*, Pantex Plant, Amarillo, Texas, December 31, 1992.

65. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 12-55*, Pantex Plant, Amarillo, Texas, January 24, 1994.

66. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report for Building 12-65 Service Magazines*, Pantex Plant, Amarillo, Texas, February 1981.

67. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report for Building 12-71 Class "C" Storage*, Pantex Plant, Amarillo, Texas, April 1984.

68. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report: Production High Explosive Service Magazines (12-83)*, Pantex Plant, Amarillo, Texas, June 1983.

69. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report for Pantex Building 12-95 (Small Explosive Component Staging)*, Pantex Plant, Amarillo, Texas, August 1983.

70. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazard Analysis, Building 11-5*, Pantex Plant, Amarillo, Texas, April 6, 1993.

71. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 11-16*, Pantex Plant, Amarillo, Texas, January 24, 1994.

72. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 11-18*, Pantex Plant, Amarillo, Texas, November 18, 1992.

73. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building FS-2*, Pantex Plant, Amarillo, Texas, November 18, 1992.

74. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building FS-3*, Pantex Plant, Amarillo, Texas, January 24, 1994.

75. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building FS-4*, Pantex Plant, Amarillo, Texas, January 24, 1994.

76. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building*

FS-10, Pantex Plant, Amarillo, Texas, November 18, 1992.

77. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Addition to FS-11*, Pantex Plant, Amarillo, Texas, September 1977.

78. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building FS-16*, Pantex Plant, Amarillo, Texas, November 18, 1992.

79. Mason & Hanger - Silas Mason Co., Inc., *Safety Analysis Report, FS-21, Development High Explosives Test Firing*, Pantex Plant, Amarillo, Texas, May 1981.

80. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building FS-21A*, Pantex Plant, Amarillo, Texas, November 18, 1992.

81. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building FS-22*, Pantex Plant, Amarillo, Texas, January 24, 1994.

82. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, The Interim Total Containment Test Fire Facility (FS-23)*, Pantex Plant, Amarillo, Texas, September 1983.

83. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, FS-24*, Pantex Plant, Amarillo, Texas, November 1987.

84. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 12-21 Gas Analysis Lab*, Pantex Plant, Amarillo, Texas, January 24, 1994.

85. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 12-21 NDE*, Pantex Plant, Amarillo, Texas, January 24, 1994.

86. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report: Weapons Material Evaluation Facility (12-21A)*, Pantex Plant, Amarillo, Texas, October 1973.

87. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 12-31*, Pantex Plant, Amarillo, Texas, January 24, 1994.

88. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report for High Explosives Subassembly Building (12-32)*, Pantex Plant, Amarillo, Texas, November 1974.

89. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazard Analysis, Building 12-26, Bays 22 and 26*, Pantex Plant, Amarillo, Texas, January 24, 1994.

90. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building BG-3*, Pantex Plant, Amarillo, Texas, January 14, 1993.

91. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building BG-4*, Pantex Plant, Amarillo, Texas, January 14, 1993.

92. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 12-73*, Pantex Plant, Amarillo, Texas, January 24, 1994.

93. Mason & Hanger - Silas Mason Co., Inc., *Design Criteria for Security Enhancement, Subproject: SNM Component Staging Facility*, Project No. 88-D-123, Pantex Plant, Amarillo, Texas, November 1987.

94. Battelle Pantex, *Basis for Interim Operation, Transportation Module, Loading Docks 4-26, 12-98, and 12-99*,

Risk Management Department, Pantex Plant, Amarillo, Texas, October 20, 1994

95. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Building 12-86, Inert Assembly and Test Facility*, Pantex Plant, Amarillo, Texas, December 1987.

96. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazard Analysis, Building 12-82*, Pantex Plant, Amarillo, Texas, January 24, 1994.

97. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Safety Analysis Report, Buildings 16-16 and 16-17*, Rev. 1, Pantex Plant, Amarillo, Texas, March 4, 1994.

98. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazard Analysis, Building 11-9N*, Pantex Plant, Amarillo, Texas, January 24, 1994.

99. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 4-45*, Pantex Plant, Amarillo, Texas, November 19, 1992.

100. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 4-50*, Pantex Plant, Amarillo, Texas, November 19, 1992.

101. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis, Building 4-56*, Pantex Plant, Amarillo, Texas, November 19, 1992.

102. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazard Analysis, Building 12-42, Compaction Facility*, Pantex Plant, Amarillo, Texas, January 24, 1994.

103. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazard Analysis, Building 11-34*, Pantex Plant, Amarillo, Texas, January 24, 1994.

104. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazard Analysis, 11-39*, Pantex Plant, Amarillo, Texas, January 24, 1994.

105. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazard Analysis, Building 12-25*, Pantex Plant, Amarillo, Texas, January 24, 1994.

106. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Hazards Analysis Report, Building 12-67.* Pantex Plant, Amarillo, Texas, February 22, 1994.

107. DOE, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports*, DOE-STD-3009-94, U.S. Department of Energy, July 1994.

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4.0 ACCIDENT/EVENT ANALYSES

This chapter provides results of previous hazards assessments, safety analysis reports (SAR), accident analyses, and other studies that identify potential risk to onsite and offsite personnel at Pantex Plant. Facilities that rank as Moderate or Low Hazards, which contain hazards not routinely accepted by the public as defined in Chapter 3.0, are included in the analyses. Information in this chapter was extracted from those documents that were based upon the best and most recent available information. In some instances, the accident analyses summaries were obtained from draft or final SARs not reviewed previously by DOE. Final SARs not approved by DOE and draft SARs may undergo further revision prior to approval, and therefore the information obtained from these documents should be carefully considered. In instances where the accident analyses summaries were obtained from reviewed final SARs, the document has been referenced. Analysis has not been conducted for certain types of activities which occur at Pantex Plant. These include transportation (i.e., DOE Transportation Safeguards Division airport pad), Sandia operations, and U.S. Army Corps of Engineers activities. Analysis of transportation activities is in process, but results are not yet available to be referenced in this report.

The basis for this chapter is a series of hazards assessments[1,2,3,4] conducted to categorize operational accidents or natural phenomena by degree of severity and the type of response needed to protect workers, the public, and the environment:

- Chemical High Explosives Hazards Assessment
- Hazardous Materials Hazards Assessment
- Radiological Hazards Assessment Recalculation
- Natural Phenomena Hazards Assessment.

The assessments provide general information related to the hazards of various facility types, whereas the SARs provide building-specific hazards assessments, accident analyses, and event consequences. There are efforts in progress at Pantex Plant to update many of the accident analysis scenarios, using more realistic meteorological conditions. Emphasis has been placed on these hazards assessments and accident analyses because they use up-to-date regulatory guidelines and procedures for determining the consequences of worst-case accident and event scenarios that may occur at Pantex Plant. It should be noted that, although the worst-case accident is presented, that accident is not likely to occur in any particular facility.

Changes in safety and environmental requirements, format, and content of SARs have occurred that provide greater facility and operational detail for analysis since the inception of the SAR process. A higher level of detail has been necessary to meet new DOE requirements. DOE Order 5480.23 provides the most recent guidance to determine the safety basis for facilities discussed in this document[5]. However, safety analysis has been conducted at Pantex Plant for more than a decade, using a gradually-evolving chain of guidance documentation. The safety analyses used as the basis for this document represent a continuum of products written to satisfy the guidance in effect at the time. Therefore, older SARs may not address current needs, and the presentation of hazards analysis in those documents may appear to be less exhaustive in comparison with newer SARs. Pantex Plant is currently upgrading all SARs to meet the new requirements, with completion scheduled within the next few years[6].

The Pantex Plant facilities requiring SARs have adequate controls and interim measures in place to assure their continued safe operation. Currently, over 35 facilities have DOE-approved SARs.

Although the SARs were approved according to applicable DOE Orders at the time of submittal, some are not written to the current format and content requirements directed by DOE. Several of the facilities with outdated SARs have newer draft SARs, pending review and approval. However, many of these draft SARs have been prepared according to DOE and AL 5481.1B content and format[7,8]. Analyses resulting from the verification and validation efforts for existing DOE-approved SARs serve as the basis for the modification of the documents, which provide the baseline and justify the continued use of that document as the safety basis for that facility. This process pertains to existing SARs approved before 1992. Future modifications will be addressed in the unreviewed safety question program, with the supporting analyses and change pages to these existing SARs submitted to DOE for approval. This will be the interim measure and a means to correct the existing documents until the SAR upgrade process is completed.

The compensatory measures for DOE Order 5480.23 are the basis for interim operations in existing Moderate and Low Hazard facilities without a final safety analysis report (FSAR). These measures are based on safety documentation derived from facility design and analysis and operational procedures that have been in place and have evolved over approximately 40 years of operation. The DOE-approved SAR or FSAR is the final safety document for individual facility operation.

A functional approach is being used for preparing SARs at Pantex Plant. With the implementation of DOE Order 5480.23 requirements for safety analyses, a number of potential difficulties became apparent. These difficulties were associated with the large number of facilities for which SARs would have to be prepared, the added time and cost of satisfying DOE Order 5480.23 requirements, the incompatibility among SARs prepared to different requirements, and the cost and coordination effort required to update annually so many SARs. To minimize these difficulties, the Pantex Risk Management Department developed a functional SAR approach.

The five functional SARs will consist of one general information document and 14 facility-specific modules. The general information document provides the generic material for the Pantex facility, consistent with the DOE-STD-3009-94, "Format and Content Guide for DOE 5480.23 Facilities"[9]. To the extent possible, general information about Plant programs is incorporated in this document, rather than repeated in the facility-specific modules, unless the information directly affects the safety basis.

Each functional SAR is composed of modules that represent aggregations of facilities that involve similar operations. For example, the nuclear explosives bays module includes Buildings 12-64, 12-84, 12-99, and 12-104. Each module will be composed of 17 chapters, following the DOE-STD-3009-94 Format and Content Guide. Facility-specific information will be included in each chapter. Generic material will be included by making reference to the appropriate section of the general information document. A list of the buildings associated with each module is provided in Table 4-1. Facilities scheduled for retirement in the very near future were evaluated against the time to prepare or upgrade SARs. Where the time required to develop SARs would extend beyond planned use, the facility was excluded from the SAR schedule.

The hazards assessments (chemical high explosives, hazardous materials, radiological, and natural phenomena hazards assessments) only assess the possible consequences from bounding accident scenarios for the Plant (i.e., any likely accidents are less severe than those analyzed). The building-specific SARs provide further accident analyses with more facility-specific analyses of operational, severe events. The information presented in this chapter is based upon the hazards assessments supplemented by information identified in previous SARs where

TABLE 4-1.—*List of Functional SARs, Modules, and Specific Facilities*

Functional SAR	Modules	Buildings
Nuclear Explosive Facilities	Bays	12-64, 12-84, 12-99, 12-104
	Cells	12-44, 12-85, 12-96, 12-98
	Special Purpose	12-26 Bays 27 & 28, 12-41, 12-50, 12-60, 12-94, 12-104A
Nuclear Staging Facilities	Zone 12 Staging	12-26 PV, 12-42 SV, 12-42 NV, 12-44-8, 12-58 Bays 4 & 5, 12-116
	Zone 4 Staging	SAC Magazines, MR Magazines
Explosive Processing Facilities	Development	11-17, 11-22, 11-38, 11-51, 11-55, 12-8, 12-19, 12-59, 12-62
	Manufacturing	11-20, 11-50, 12-17 A&B, 12-63, 12-121
	Staging	4-45 to 4-75, 11-23, 11-25, 11-37, 11-42, 11-45, 11-46, 12-55, 12-58, 12-65, 12-71, 12-83, 12-92, 12-95
	Testing & Evaluation	11-5, 11-16, 11-18, Firing Sites, 12-21, 12-21A, 12-31, 12-32, 12-33, 12-56
	Disposal	BG-3, BG-4, 12-73
Onsite Transportation		Onsite transportation of weapons, components, and hazardous materials and loading docks.
Support Facilities	Testing & Evaluation	12-86
	Security	Live Fire Range, Security Upgrade
	ORO Staging	12-66
	Waste Staging and Processing	16-16, HWTPF, 4-50, 4-56, 12-42Com

appropriate. Appendix E provides a summary of the accident/hazard analyses conducted in each available SAR.

The accident scenarios presented in this chapter include design basis accidents and maximum credible events. Design basis accidents are the postulated incidents and consequences that the facility and its associated systems must be able to withstand to adequately protect the health and safety of the workers, the public, and the environment. Design basis accidents can be initiated by natural phenomena or may be operational accidents. Maximum credible events are bounding accident scenarios. Maximum credible events include both natural phenomena that have a greater magnitude (and a correspondingly lower probability) than design basis accidents, and any other reasonably conceivable accident scenario that could affect the facility and its contents.

Throughout this chapter, the units used (from English, metric, and other standards) do not necessarily reflect those most commonly used at Pantex Plant. For example, at Pantex Plant, quantities of plutonium are generally given in kilograms (kg) whereas quantities of chemical high explosives are typically provided in pounds (lb).

4.1 ACCIDENT ANALYSIS PROCESS

The analysis process used in previous safety documentation begins with identifying all potential accident initiating events. The set is established by examining prior SARs, other risk assessments (including failure mode and effects analyses), generic initiating event compilations, and DOE guidance, in addition to site-specific reviews (e.g., walkdowns, interviews, etc.) of potential initiators.

The initiating events are screened to identify those that may have less severe consequences than another event (e.g., roof snow loadings may be subsumable under other events such as tornados), are trivial (e.g., sleet or rain on the roof of an earth-covered bay), or implausible (e.g., tsunami at an inland site). This process results in ranking the events so resources can focus on the most credible events, eliminating many from further consideration. Those events that could not be eliminated are carried forward into the quantitative analysis. The probabilities of the initiating events are estimated using information from a variety of sources (i.e., UCRL-15910, UCRL-53851, etc.)[10,11].

The quantified initiating event probabilities are compared to the accident sequence probability criteria of DOE/AL guidance for DOE Order 5481.1B. This guidance indicates that accident sequences with an annual probability less than 1 x 10^{-6}/yr are considered incredible and may be dropped from further analysis. If an initiating event has a probability less than 1 x 10^{-6}/yr, any sequences that might result from the initiator will have probabilities less than 1 x 10^{-6}. Unlike the SARs, the hazards assessments may analyze scenarios having probabilities less than 1 x 10^{-6}.

Accident sequences are then defined in terms of the source of material at risk, an initiating event, intermediate events that lead to the dispersal of material, and the effectiveness of mitigative systems. Event trees are used to systematically identify potential accident sequences, quantify probabilities, and compare to the 1 x 10^{-6}/yr criterion.

The next step in the accident analysis process is to define the potential consequences from the retained sequences (or for any specific situations for which consequence estimates are desired regardless of the likelihood). After consequences are identified, they are quantified on a conditional basis. That is, the consequence of concern is quantified assuming the accident has occurred.

The results from the analyses of accident sequences and consequences are combined to generate an estimate of the risk for each retained sequence. The risk is the product of the sequence probability and conditional consequence and is expressed as annual probability. In addition, the risk level associated with each event is tabulated using a broadly defined categorization scheme. Failure mode and effects analyses (FMEA) were conducted in the hazards assessments[1,2,3,4].

The purpose of the FMEA is to identify and characterize the hazards associated with the failure of the process- or safety-related features in the facilities and to characterize the impacts of process or safety equipment failures on normal operations.

The first step in the FMEA is to identify the potential events (or "failure modes") that could adversely affect each of the individual system elements. Failure modes describe, in general terms, the types of failures that could affect a system element. For example, one failure mode of a system could be that it fails to actuate when needed. Finally, consequence estimates and probability classifications are assigned to these events using broadly defined categories (see Tables 4.1-1. and 4.1-2.). The definition of the consequence categories has remained relatively stable in the last 10 years, however the likelihood categories have changed periodically. The likelihood categories presented below are considered the most recent.

4.2 OPERATIONAL EVENT ANALYSIS

The facilities and operations at Pantex Plant have undergone many safety and risk assessments in the past. Each subsequent set of assessments has made more unclassified information available to the public, particularly to those public officials responsible for emergency response to potential accidents that may have offsite radiological consequences. Increasingly more information is available for analysis to determine risk.

This section provides the information obtained from the hazards assessments, SARs, and other safety documentation to assist in the development of the Pantex Plant Site-Wide Environmental Impact Statement (SWEIS). It is important to note that new work is currently being conducted to determine bounding meteorological conditions at Pantex Plant. Recent data indicate that for analytical purposes, meteorology at Pantex Plant can be conservatively characterized by 1.5 m/s (3.4 mph) wind speeds and a Pasquill Stability of Class E. This is not consistent with many of the analyses presented. Once the new work is completed, new analyses will be conducted, and the resulting site boundary doses will be included in this document as it is revised.

This section is divided into the three categories of most concern: radiological releases, hazardous material releases, and explosive releases.

4.2.1 Radioactive Material Releases

Radioactive material release scenarios were developed through an objective process that considers the combinations of events and conditions that could potentially cause releases[12]. Five materials were identified as being available in sufficient quantity at Pantex Plant to have a potential for offsite radiological consequences:

- Plutonium-239
- Plutonium-238
- Tritium (H-3)
- Cobalt-60
- Uranium.

Table 4.2.1-1. summarizes consequences and probabilities based upon material presented in the "Radiological Hazards Assessment Recalculation." The matrix provides the type of material released and the initiating event. A listing of the unclassified building limits for radioactive materials at Pantex is provided in Appendix B.

The common accident initiators in the cells and bays were identified by estimating the probabilities of the initiating events, using information from a variety of sources. For natural phenomena, the Site Environmental Impact Statement[13] and various DOE-sponsored studies[11,14,15] were used. If site-specific studies or generic sources were not

TABLE 4.1-1.—*Qualitative Consequence Categories*

Consequence Magnitude	
Category I Catastrophic	A failure that may cause deaths, or the total loss of the facility or process, or severe damage to the environment.
Category II Critical	A failure that may cause severe injuries or occupational illnesses, major damage to the facility or process, or major damage to the environment.
Category III Marginal	A failure that may cause minor injuries or occupational illnesses, minor damage to the facility or process, or minor damage to the environment.
Category IV Negligible	A failure that will not result in injuries or occupational illnesses, damage to the facility or process, or damage to the environment.

TABLE 4.1-2.—*Likelihood Categories*

CATEGORY	ESTIMATED OCCURRENCE RATE (per yr)	DESCRIPTION
A - Anticipated	$> 10^{-2}$	The event is likely to occur (more than once) during the lifetime of the facility; incidents that may occur several times during the lifetime of the facility; incidents that commonly occur.
B - Unlikely	10^{-2} to 10^{-4}	The event is unlikely, but may reasonably be expected (i.e., a one percent or ten percent probability) to occur during the lifetime of the facility; accidents that are not anticipated to occur during the lifetime of the facility; natural phenomena of this probability class include: uiform building Code-level earthquake, 100-year flood, maximum wind gust, etc.
C - Extremely Unlikely	10^{-4} to 10^{-6}	The event is extremely unlikely and is not expected to occur during the lifetime of the facility; accidents that will probably not occur during the life cycle of the facility; this class includes the design basis accidents.
D - Beyond Extremely Unlikely	$< 10^{-6}$	The event is so unlikely that it is not credible; all other accidents.

TABLE 4.2.1-1.—*Consequences and Probabilities of Radiological Material Releases*

Consequence	Probability			
	Incredible	Extremely Unlikely	Unlikely	Likely
Catastrophic	Pu-239 Fragmentation Pu-239 Criticality	Pu-239 Fire/Melt		
Critical	H-3 External Forces	Pu-239 Mechanical Failure Pu-239 Dissolution H-3 Fragmentation H-3 Overpress/Temp.		
Marginal	Pu-238 Dissolution Pu-238 Fragmentation Pu-238 Fire/Melt Pu-238 Mechanical Damage Pu-238 Other Barriers Co-60 Mechanical Damage Co-60 Fragmentation Co-60 Dissolution Co-60 Loss Shielding	H-3 Squib Release H-3 Reservoir Fails	H-3 Delayed Release	
Negligible		H-3 Fire		

Note: The empty blocks indicated that no accident has been identified with that probability and consequence.

available, new analyses were performed to generate the required probabilities. The quantified initiating event probabilities were compared to a discrimination level of 1×10^{-6}/yr. If an initiating event had an annual probability of less than 1×10^{-6}, any sequences that might result from the initiator would, by definition, have annual probabilities less than 1×10^{-6}. It was also possible to eliminate some initiating events on deterministic grounds. That is, it was possible to demonstrate quantitatively, with relatively straightforward analyses, that there was no significant adverse response to the maximum credible challenge associated with a particular initiating event.

Three categories (fire, electrical, and mechanical) of credible challenging environments were identified, and the probability of the high explosive (HE) detonation was assessed. In addition, those mitigating features that prevent or decrease the probability of explosion were identified.

Some basic assumptions about the frequency of disassembly operations were developed to support the estimation of accident probabilities. These assumptions tended to be conservative estimates that avoided the use of classified information on specific nuclear explosive systems. Estimation of the probabilities of plutonium dispersal accidents relies also on the database of unusual occurrence reports for Pantex Plant[16], data on the sensitivity of explosives to drops and punctures, experience in similar types of facilities, the assessment of human reliability, and equipment failure rates for similar equipment. The uncertainties in estimating the risk from these operations are very large because of the unique nature of nuclear explosive assembly/disassembly operations. The extent of applicable data is very limited (particularly as used to estimate very improbable events). Fault trees were also found to be of limited value because of the nature of the operations and safety systems. Additionally, the capability of the individual nuclear explosive systems to withstand different levels of threat is only known approximately. As a result of these limitations, many of the assessments in cell hazard and accident analysis are, by necessity, highly subjective.

4.2.1.1 *Plutonium-239*

Several scenarios were presented in the "Radiological Hazards Assessment Recalculation" that have the potential to release quantities of plutonium within certain facilities and to the environment under certain conditions. None of these scenarios are necessarily specific to any one facility; however, several of the scenarios could occur in any one particular facility. Facility design features may help limit or mitigate radiological releases that would otherwise be more likely to occur. The radiological release scenarios include:

- Fragmentation due to explosion
- Mechanical damage
- Dissolution
- Melting due to fire
- Damage by a critical excursion
- Effects of other barriers.

Fragmentation Due to Explosion. Explosive dispersal of a plutonium pit would be most complete where HE is in direct contact with the pit, which occurs in several handling and storage operations at the Plant, during an explosion or fire. Damage to a pit would be least when the pit is just in the room during an explosion or fire. The FMEA shows that a Pu-239 release caused by melting in a fire is extremely unlikely with catastrophic consequences. The FMEA shows that a Pu-239 release caused by an explosion with catastrophic consequences is incredible.

The detonation of HE, were it to occur, would obviously present a variety of challenges to any nuclear explosives in a cell. The "Nuclear Explosives Abnormal Environments Report" concludes that HE detonation is a credible threat during assembly/disassembly operations in the cells[17]. In the analysis of the consequences of HE detonation in the cells, it is conservatively assumed that all the HE and all the plutonium in the cell would be involved.

In an explosive event within an assembly/ disassembly cell, the structure of the cell would effectively absorb the energy associated with the explosion[18]. The "Radiological Hazards Assessment Recalculation" document provides modeling results and sensitivity studies using the HOTSPOT computer code[19]. (NOTE: HOTSPOT PC codes have not been approved by DOE for use in accident analyses in future SARs. The HOTSPOT code was chosen as the most flexible, simple to use, and accurate program of its type for the hazards assessments [see Section 4.4 for more detail]). The resulting calculations assumes 6 g (0.2 oz) of respirable plutonium aerosol at a release height of 2 m (6.6 ft) would exceed 160 rem at 100 m (328 ft) from the explosion. Analyses at the Pantex Plant and Los Alamos National Laboratory indicated that an explosion of 84 kg (185 lb) of HE and 14.2 kg (31.3 lb) of plutonium may be expected to result in a release of slightly less than 6 g (0.2 oz) of respirable plutonium aerosol[20]. A one-rem protective action guidelines (PAG) dose could be exceeded at 1.13 km (0.7 mi). Assuming a 4.25 m/sec(9.5 mph) wind speed, the plume from the closest cell would arrive at the site boundary in 4.8 min.

Estimated probabilities of accident sequences in cells have been coarsely binned into four categories, as indicated in Table 4.1-2. The probability of HE detonation with plutonium dispersal was found to be marginally credible. The consequences of this event would be catastrophic to the workers in the cell and the facility itself. The calculated 50-yr committed effective dose equivalents (CEDE) at the nearest site boundary are below 25 rem. Consistent with requirements imposed on the U.S. nuclear industry, the consequences of design basis accidents must meet the criteria of 10 CFR 100 in that the maximum dose that could be received by an individual at the site boundary is limited to 25 rem whole-body dose or 300 rem thyroid dose[21].

An internal explosion in the cells would have catastrophic consequences for any workers present in the cell and the structure itself (unless the explosion involved very minor amounts of HE). The revolving personnel blast door would be expected to shear at its center pins and jam itself into its cavity, thus preventing the door from being blown free and thereby keeping the cell closed to the outside. This is designed to prevent an appreciable increase in the leak area around this door. The steel blast doors protecting the equipment passageway are expected to remain intact and closed. The blast valves in the intake and exhaust air supply ducts, as well as the contaminated waste isolation valve system (except for Building 12-44), will prevent radioactive particles from escaping through these pathways.

Based upon the scenario presented in the "Radiological Hazards Assessment Recalculation," personnel in the facility and up to a distance of 100 m could receive 150 rem from a contained HE explosion in which 6 g of aerosol Pu-239 would be released within a cell. From the same release, personnel could receive 0.85 rem from 100 m to the site boundary. The maximum distance for that event in which the one-rem PAG is exceeded would be 1.13 km. No fire scenario would release Pu-239 in quantities sufficient to exceed the one-rem PAG. The calculated site border CEDEs for radiological releases from a cell are below the 25 rem guideline.

The most recent work from SARs involving a plutonium release resulting from an internal HE detonation in a cell has assessed such an event to be extremely unlikely rather than marginally incredible as described in the "Radiological Hazards Assessment Recalculation." For a scenario where the cell roof does not collapse during an HE detonation the following assumptions were made:

- The cell contains 40 kg (88.2 lb) of plutonium, the maximum allowable quantity of plutonium.

- The maximum quantity of HE that could detonate without leading to collapse of the gravel gertie supports, 45 kg (100 lb) (59 kg or 130 lb TNT-equivalent), are involved in the explosion.

- There are 271 cm² (42 in²) of gaps around the personnel and equipment doors.

- The entire mass of plutonium is aerosolized in the explosion. This is based on data from the Roller Coaster Test Series in 1963[23]. The aerosolized plutonium in the cell leaks out the gaps until the pressure inside the cell equilibrates with the outside pressure.

- The consequences are assessed for average as well as conservative meteorological conditions.

The CEDE at the nearest site boundary (1.5 km or 0.9 mi) is 0.92 rem using average meteorology of D stability and 6.25 m/s (14 mph) wind and 6.4 rem using conservative meteorology of E stability and 1.5 m/s (3.4 mph) wind. This analysis was performed using MELCOR input into ERAD to calculate plume dispersion. The ERAD analysis was based on a 1 m (3.3 ft) elevation non-buoyant plume.

Similarly, the following assumptions were made concerning the internal explosion accident scenario of cells involving a gravel gertie roof collapse:

- The cell contains 40 kg (88.2 lb) of plutonium and 192 kg (423 lb) of HE (250 kg or 550 lb TNT-equivalent).

- The entire mass of plutonium is aerosolized in the explosion. This is based on data from the Roller Coaster Test Series in 1963[23]. This test series indicated that 15 to 20 percent of the plutonium aerosol was small enough to be respirable, and was therefore significant with regard to potential adverse radiological effects following inhalation exposure.

- The fraction of plutonium calculated to be released through the gravel gertie roof in the explosion is 1.5×10^{-3} of the initial 40 kg (88.2 lb) involved. All of this release is assumed to be in the respirable range, with the particle size distribution observed in the gravel gertie verification program[24].

- In addition to the release through the gravel roof, there is plutonium leakage (0.4 kg or 0.9 lb) past the personnel and equipment doors during the 1 second that the cell is at high pressure. The particle size and respirable fraction assumed for this release are based on the data from the Roller Coaster Test Series. The amount of respirable aerosol that leaks past the door seals was determined from the ability of aerosol particles to follow gas flow streamlines.

- The consequences are assessed for average as well as conservative meteorological conditions.

- The plume dispersion is calculated with the ERAD code using the non-buoyant plume model for airborne plutonium dispersal[25]. The elevation of the release through the gravel roof is 57 m (187 ft), one-half of the total plume rise observed in the Sandia test. The release past the door seals is at an elevation of 1 m (3.3 ft).

A combined release of 0.12 kg (0.26 lb) of respirable plutonium through the gravel roof and 0.0057 kg (0.01 lb) respirable release past the doors resulted in a CEDE of 0.63 rem using average meteorology of D stability and 6.25 m/s (14 mph) wind and 4.8 rem using conservative meteorology of E stability and 1.5 m/s (3.4 mph) wind.

The above recent dose derivations for both of the scenarios described are very similar to those found in the "Radiological Hazards Assessment Recalculation," and believed to be conservative for many of the same reasons.

Personnel in a cell at the time of an HE explosion would suffer catastrophic effects from an explosion that would be greater than the effects of Pu-239 exposure.

Currently, Sandia National Laboratories is studying the radiological consequences of an accident involving high explosives and plutonium in a Pantex assembly cell. While work is still ongoing, their findings indicate a bounding dose of approximately 34 rem for the maximally exposed offsite individual using conservative meteorological conditions. This latest work by Sandia assumes different conditions than work performed previously. The amount of plutonium at risk with HE is assumed to be 20 kg (44 lb) and 32 kg (70 lb) is assumed to detonate in the facility. An inertial deposition factor of 2 reduction is assumed and the dispersion modeling utilized MACCS code. The gap size around the facility doors where leakage would occur has been reduced considerably down to approximately 32 cm^2 (5 in^2).

The results of probability and accident analyses for the bays indicate that explosive dispersal of plutonium is an incredible event in bay operations. Operations involving both uncased HE and plutonium are not permitted in any of the bays. Uncased HE operations may be conducted in the bays if no plutonium is present. Buildings 12-64, 12-84, 12-99, and 12-104 are not designed to fully confine plutonium in the event of a HE detonation.

The most recent work from SARs involving a plutonium release resulting from an internal HE detonation in a bay assessed such an event as "beyond extremely unlikely" rather than incredible as described in the "Radiological Hazards Assessment Recalculation." For a scenario where an HE detonation occurs in a bay, the following assumptions were made:

- The bay contains 25 kg (55 lb) of plutonium, the maximum allowable quantity of plutonium.
- The bay contains 136 kg (300 lb) of HE (177 kg or 390 lb TNT-equivalent), the maximum allowable quantity of HE.
- The entire mass of plutonium is aerosolized in the explosion. This is based on data from the Roller Coaster Test Series in 1963[23]. This test series also indicated that 15 to 20 percent of the plutonium aerosol was small enough to be respirable, and was therefore significant with regard to potential adverse radiological effects following inhalation exposure.
- The consequences are assessed for average as well as conservative meteorological conditions.

The resulting CEDE at the nearest site boundary (1.6 km or 1.0 mi) was 20 rem using average meteorology of D stability and 6.25 m/s (14 mph) wind and 37 rem using conservative meteorology of E stability and 1.5 m/s (3.4 mph) wind. This analysis was performed using ERAD to calculate plume dispersion. Higher site boundary doses, on the order of approximately 120 rem, have been calculated for HE detonations in a bay involving operations with specific weapon programs where the ratio of plutonium relative to HE is much larger than the amounts assumed above.

Like the work underway with the cell accident scenarios, there are studies currently underway on the radiological consequences of an accidental detonation in a bay involving both high explosives and plutonium. The most recent calculations indicate a bounding dose of around 80 rem for the maximally exposed offsite individual using conservative meteorology and assuming 25 kg (55 lb) of plutonium and 22.7 kg (50 lb) of high explosive.

<u>Mechanical Damage</u>. General mechanical damage of a pit is unlikely during normal operations

because of the mechanical strength of the pit, and punctures of the container would likely deflect the puncturing object from the spherically shaped pit. Simple mechanical damage would only cause large fragments with little or no off-site respirable releases. The FMEA shows that a Pu-239 release caused by mechanical damage is extremely unlikely with critical consequences.

At Pantex, Pu-239 is handled and stored entirely in the form of encapsulated metal-clad pits. For the purposes of the "Radiological Hazards Assessment Recalculation," a pit is generically defined as a 6 in. (15.2 cm), 6.5 kg (14.3 lb) spherical shell clad in a thin metal alloy. The solid material structure of the metal-clad Pu-239 pit is the primary barrier used in the analysis conducted in the "Radiological Hazards Assessment Recalculation."

A number of operational scenarios have the potential to result in the release of small quantities of plutonium to a cell or bay. Any event that breaches the cladding of a pit or a pit tube can expose a plutonium surface to the atmosphere and could result in some airborne release of plutonium. Possible scenarios include:

- Dropping a pit onto the floor or onto a stand during assembly or disassembly
- Cracking the external cladding of a pit due to stress during disassembly
- Pulling out a pit tube or breaking a pit tube during assembly or disassembly
- Breaching a container and the external cladding of a pit with the tine or boom of a forklift
- Hitting a pit with a crane or other handling equipment.

During the history of Pantex Plant, several accidents have involved uncased pits during manual handling. However, in approximately 1,000,000 hand-carrying operations, only one incident involving the handling of a pit resulted in any radiological contamination. For one or less events in one million trials, the maximum failure rate at 90 percent confidence is 3.9×10^{-6} per handling operation. If 1,600 disassembly operations on physics packages are performed per year, the frequency of pit failures would be 6×10^{-3}/yr. If 400 disassembly operations for physics packages are performed per year in the bays, the frequency of failures would be 2×10^{-3}/yr. Thus, the pit breach accident sequence in either the cells or the bays falls in the unlikely category.

Transportation of nuclear explosive components within a facility has the potential to lead to mechanical challenges to pit integrity. However, pits are transported into and out of the cells in their shipping containers. Therefore, to result in a breach type of release of plutonium during transportation within the facility, the incident must damage the container as well as the pit. The use of qualified protective containers for transportation and for staging when special operations are not being performed is an important aspect of minimizing the frequency of operational accidents that could result in the release of radioactive materials.

However, of two incidents in the unusual occurrence reports database involving dropping uncased pits in cells or bays, which suggests a pit drop frequency of approximately 0.2/yr, neither led to pit failure. An estimate of the probability of a release during a pit drop incident is in the range of 1:10 to 1:100. The frequency of small releases would be in the range of 2×10^{-2} to 2×10^{-3} per yr. Thus, this approach indicates that the pit drop sequence is at the boundary of the likely and unlikely categories. It will be conservatively assigned to the likely category.

The probability of a pit drop accident with plutonium release to a cell is unlikely. The most likely outcome of a pit drop is no plutonium release, since the pit cladding and tube are expected to remain intact. In the event of a pit drop involving failure of the cladding integrity, the most likely outcome will be the shutdown of the heating, ventilating, and air conditioning (HVAC) by the Radiation Alarm Monitoring System (RAMS) interlock, thus limiting the potential contamination to the cell of occurrence. The potential for a pit breach type of accident to result in consequences external to a cell depends on the operability of building confinement features. If the HVAC system should fail, the total CEDE of an unfiltered release in the event of a pit drop is about 7×10^{-6} rem at the site boundary. A pit drop accident is used to characterize the category of events leading to violation of pit integrity. Assumptions for the release of plutonium in the cells, bays, Building 12-116, and Building 12-104A (pit drop scenario) for the above operational accident are:

1. Pit is dropped while being transported to or from a pit container.

2. The total amount of weapons grade plutonium available in powder form that may be released from the damaged pit is 0.02 grams (0.001 oz)[26].

3. The plutonium becoming airborne during the release is 100 percent respirable (a very conservative assumption), it is uniformly distributed within the cell immediately, and all inhaled plutonium goes straight to the lungs.

4. The plutonium in the affected pit contains about 0.5 percent americium-241, resulting in a specific alpha activity of 0.093 Ci/g (2.64 Ci/oz).

5. Material release occurs immediately, alpha monitor alarms at 5 sec, personnel respond and start leaving the cell at 15 sec, and personnel completely exit at 90 sec (55 sec in the bays, 40 sec in Building 12-116, 30 sec in Building 12-104A).

6. Personnel exposure stops after exiting the facility.

7. The breathing rate of the workers is 20 liters per minute (L/min) or 5.3 gal/min.

8. The volume of the cell round room is approximately 4×10^5 L (14,124 ft^3); the total volume up to the inner blast door is approximately 9×10^5 L. Use of only the round room volume represents the most conservative estimate. The volume of a small assembly/disassembly bay is approximately 4.7×10^5 L (16,596 ft^3). (A small bay represents the most conservative estimate.) The volume of the NDT Bay in Building 12-116 is approximately 5.3×10^5 L (18,714 ft^3). The volume of Cubicle 4 in Building 12-44 Cell 8 is approximately 1.85×10^4 L 653 ft^3).

The release fraction from the pit drop accident is estimated using the conservative, empirical fit bounding equation developed by Halverson and Mishima cited in NUREG-1230, "Nuclear Fuel Cycle Facility Accident Analysis Handbook"[27]. During a pit drop accident, the exposure of greatest concern is to the workers in the facility. If 60μg (2.0×10^{-6} oz.) of plutonium become airborne, the plutonium released into the air in the cell is 5.6 μCi Pu. The concentration of plutonium within the cell round room is assumed to be uniform for the period of time the workers are exposed, or 1.4×10^{-5} μCi Pu/L (4.0×10^{-4} μCi Pu/ft^3). The concentration of plutonium within a bay is 1.2×10^{-5} μCi Pu/L (3.0×10^{-4} μCi Pu/ft^3).

If the HVAC does not trip (shut off) in a cell, the contents of the cell would be exhausted at a rate of roughly one volume per hour for the normal exhaust rate of approximately 18,690 L/min. If the HVAC does not trip in a bay, the contents would be exhausted at a rate of approximately one-half volume per hour for the normal exhaust rate of approximately 5,000 L/min (177 ft^3/min). If the HVAC does not trip, the contents of the

NDT Bay in Building 12-116 would be exhausted at a rate of approximately five volumes per hour for the normal exhaust rate of approximately 42,480 L/min (1,500 ft^3/min).

The workers in the cell during this accident could receive a 50-yr CEDE of about 0.14 rem, which is much less than the annual occupational limit and is less than the average annual exposure of the general population from all sources of radiation. The workers in the assembly/ disassembly bay during this accident could receive a 50-yr CEDE of about 0.073 rem. The workers in the NDT Bay of Building 12-116 could receive a 50-yr CEDE of about 0.05 rem, which is 1/20 of the annual occupational limit during this accident. The overall consequences to the workers and the facility from this postulated accident are judged to be small. The dose to facility workers would be within the range of normal operational doses. If the operating staff does not evacuate due to failure of the radiation alarm or some other reason, significant doses could result. The annual whole body dose limit of 5 rem would be reached in approximately one hour in the cell or bay.

The corresponding pit drop accident in a cell or bay with an unfiltered release to the environment is extremely unlikely (and unlikely for Building 12-64, which does not have High Efficiency Particulate Air [HEPA] filters). In the event of an accident involving a pit breach, the RAMS would shut down the ventilation system to prevent spread of contamination. With the shutdown of the ventilation system, there would be no driving force for the spread of the released plutonium. Under these conditions, the CEDE at the site boundary would be approximately 7×10^{-6} rem. Because the off-site public consequences are minor, this scenario is also assessed to have small consequences.

As with the offsite public analysis, the effects on the off-site public from a pit drop accident in a cell, bay, or Building 12-116 are negligible. The consequences fall within the low consequence category.

The Building 12-44 Cell 8 SAR provides two credible scenarios in which respirable plutonium may be released[28]: Uncased pit drop during handling, and cladding or stem tube failure during leak testing. The probability per handling event that a pit will be dropped in a manner that causes radiological contamination was determined to be 3.0×10^{-3}. This operational accident is considered a credible event and categorized as unlikely. The probability of a stem tube failure during a leak test that causes radiological contamination is 8.3×10^{-4}. This operational accident is considered a credible event; however, it is categorized as extremely unlikely.

The two scenarios discussed in Building 12-44 Cell 8 SAR could result in a CEDE that ranges from 12 percent to 61 percent of the annual as low as reasonably achievable (ALARA) goal. The overall consequences from either scenario are judged to be negligible for the Plant workers, the environment, and the general public.

The pit breach accident scenario discussed in the Zone 4 SAR and environmental assessment[29,30] consists of a forklift puncturing a pit container and pit to the extent that the pit stem breaks and the pressure cause the release of plutonium into the atmosphere. The Zone 4 SAR noted that because the design of the forklift/pallet system to be used in Zone 4 was not yet completed, a complete quantitative analysis was not conducted to determine the probability of a forklift accident.

The pit breach event was considered likely according to DOE guidance. The workers in the magazine during this accident could receive a CEDE of about 6.6 rem. The potential amount of off-site (2.1 km) exposure (calculated using HOTSPOT and conservative meteorological conditions) would be 1.3×10^{-4} rem, which is considered negligible.

Dissolution. Dissolution could occur as a result of extended residence in water, acid, solvent, or corrosive substances. A release would require release of the water, acid, solvent, or other corrosive material first. The cladding and metal structure of the plutonium provides substantial resistance to dissolution. Dissolution could occur only on bare pits and requires days or weeks of submersion in liquid. It is unlikely that the conditions could be met to release respirable quantities of Pu-239. In the FMEA provided in the "Radiological Hazards Assessment Recalculation" document, dissolution was determined to be extremely unlikely with critical consequences and was not quantitatively analyzed.

Melting Due to Fire. The only mechanism by which Pu-239 would be likely to reach temperatures high enough to melt would be a sustained fire. Fires involving radiological releases, including Pu-239, are discussed in Section 4.3.6.1.

Critical Excursion. Damage by critical excursion is discussed in Section 4.3.2.

Effects of Other Barriers. Barriers that may prevent dispersal of plutonium during accidents and other events include the container in which pits are stored and the structure and design features of the buildings. These secondary barriers also reduce the possibility of damage to the facility, and therefore to the plutonium, from natural phenomena hazards and external events. The effects of other barriers was not quantitatively analyzed in the "Radiological Hazards Assessment Recalculation" document. However, the effects of other barriers are used to support analysis in the other scenarios as a mitigating factor to minimize releases.

4.2.1.2 *Plutonium-238 in RTGs*

The "Radiological Hazards Assessment Recalculation" document identifies five scenarios that may result in the release of Pu-238. The scenarios include mechanical damage, dissolution, melting due to fire, fragmentation due to explosion, and effects of other barriers. The fire scenario is discussed in Section 4.3.6.

Mechanical Damage. Mechanical damage of a radioisotopic thermoelectric generator (RTG) during handling or temporary in-process storage could occur as a result of dropping, puncture by external impact (e.g., being rammed by a forklift tine), or any event in which the RTG received a sharp blow or large sustained crushing force. The FMEA shows that a Pu-238 release caused by mechanical damage with marginal consequences is incredible and was not quantitatively analyzed. Little or no material in the respirable range would be released in this type of event.

Dissolution. Dissolution of an RTG could result from extended residence in acid, water, solvent, or corrosive substances. The Pu-238 solution then could contaminate surfaces and provide a mechanism for the plutonium to become airborne. Dissolution was determined in the "Radiological Hazards Assessment Recalculation" document to be incredible and was not quantitatively analyzed. Little or no material in the respirable range would be released in this type of event.

Fragmentation Due to Explosion. Fragmentation due to explosion could only occur if the RTG is placed in proximity with explosives. The results from the FMEA for a Pu-238 release caused by an explosion are incredible with marginal consequences. RTGs staged in the Zone 4 staging magazines are in DT-6M containers, and those in the Building 12-42 North Vault are packaged in 6M containers as well[20]. Explosive dispersal of Pu-238 could not be accomplished in these areas without bringing the RTGs into direct contact with the explosives.

Calculations were done in the "Radiological Hazards Assessment Recalculation" for explosive and fire dispersal of 10 g (0.30 oz) of Pu-238. Fire dispersal is discussed in Section 4.3.6. The CEDE in the immediate area of Pu-238 explosively dispersed (by an equal mass of explosives and without containment) would exceed 120 rem with the corresponding one-rem PAG dose exceeded as far away as 1.32 km (0.83 mi). This calculation assumes that the wind speed is

4.25 m/sec (9.5 mph). The arrival time at the Pantex Plant site boundary of 0.75 mi (1.22 km) would be 4.8 min with a corresponding dose of 1.1 rem.

Effects of Other Barriers. Barriers that may prevent dispersal of Pu-238 during accidents and other events include the container in which RTGs are stored and the structure and design features of the buildings. These secondary barriers also reduce the possibility of damage to the facility, and therefore to the plutonium, from natural phenomena hazards. The effects of other barriers were determined in the "Radiological Hazards Assessment Recalculation" document to be incredible with marginal consequences and were not quantitatively analyzed.

4.2.1.3 *Tritium*

The "Radiological Hazards Assessment Recalculation" document identifies six scenarios that may result in the release of tritium (gaseous or liquid) into the atmosphere. The scenarios include direct reservoir failure, inadvertent activation of an explosive squib, fragmentation, delayed reservoir release, internal overpressure with external overtemperature, and failure due to externally generated forces.

If a reservoir fails for reasons other than fire or explosion, it was assumed that the release would be in the elemental form (gaseous). The HOTSPOT code was used (ground-level release that maximizes the dose at the distances of interest) to model a release of 300 kCi, the typical maximum inventory of most facilities excluding storage facilities. The HOTSPOT analysis is linear and can be directly scaled to other quantities of tritium.

Direct Reservoir Failure. Failure of the reservoir would result in rapid release of the entire contents. The causes of reservoir failure include fracture, puncture, manufacture or design defect, mechanical damage, cracking, valve failure, internal or external deterioration, or corrosive attack. Initiating events that could cause a breach of the reservoir include drop, impact, spontaneous fracture, or leakage from a defective valve. The FMEA for a tritium release caused by a reservoir failure shows it to be extremely unlikely with marginal consequences.

Inadvertent Activation of Explosive Squib. The only active component found on some reservoirs is a small explosive squib that operates the valve mechanism used to release the tritium from the reservoir to the weapon upon command. Squibs, when attached to the stored tritium reservoirs, are shorted to prevent static electrical buildup and are insensitive to activation by other than intentional means. Inadvertent actuation of a squib would release the entire contents of the reservoir. The FMEA in the "Radiological Hazards Assessment Recalculation" shows that a squib malfunction causing a tritium release is extremely unlikely with marginal consequences.

The scenario used for bays and cells was that during assembly or disassembly of a nuclear explosive, conditions could be encountered in which an electro-explosive device is accidentally fired and releases tritium from a tritium reservoir. Building 12-26 (Bays 27 and 28) does not currently have an SAR; however, operations involving tritium sources conducted in this facility are similar to operations conducted in Building 12-104 Bay 16 and operations to be conducted in Building 12-104A. The analysis of this scenario serves as a bounding case for all operational accidents resulting in a tritium release. The tritium release scenario caused by inadvertent squib activation was analyzed. To have a significant release of tritium to a cell, the squib valve must fire, releasing tritium from the reservoir, and the stem tube must be breached or disconnected from the pit. The latter is a normal step of disassembly.

Based on the number of tritium reservoirs that have been produced, the probability of inadvertent squib activation during the assembly/disassembly/

replacement operation was estimated as 1×10^{-5} per operation. The vast majority of reservoir installation/removal operations (~90 percent) are performed in the bays, but about 10 percent take place in the cells. Using the assumption of 2,000 disassembly operations per year, the frequency of tritium release accidents in the bays is estimated as 2×10^{-2}/yr. Assuming 2,000 disassembly operations per year, the frequency of tritium release accidents in the cells is estimated at 2×10^{-3}/yr.

Thus, a tritium release accident in the cells falls within the unlikely category, and a tritium release accident in the bays is considered likely over the life of the facility. In the Building 12-42 South Vault SAR, the probability of a tritium reservoir dropping accident is estimated at 4.1×10^{-6}/yr. Exposure of personnel in the affected cell prior to evacuation was considered, as was tritium release to the environment from the building exhaust system. The following conservative assumptions were made concerning this accident scenario:

- Elemental tritium is released in the accident.
- Personnel are in the immediate vicinity of the release point.
- The entire amount of tritium in the reservoir is immediately released into the cell in gaseous form and is instantaneously and uniformly distributed within the volume of the cell.
- The breathing rate of the workers in the facility is 20 L/min.
- The volume of the round room is approximately 4×10^5 L (14,124 ft^3); the total volume up to the inner blast door is approximately 9×10^5 L (31,779 ft^3). Use of only the round room volume represents the most conservative estimate. The volume of a small bay is approximately 4.76×10^5 L (16,808 ft^3).

  The volume of the SRO Inspection Bay in Building 12-116 is approximately 5.3×10^5 L (18,714 ft^3).
- Only hydrogen tritide will be considered in this assessment.
- Material release occurs at t = 0 sec, beta monitor alarms at t = 5 sec, personnel respond and start leaving the cell at t = 15 sec, and personnel completely exit at t = 90 sec (t = 55 sec in the bays, t = 40 sec in the SRO Inspection Bay).
- Personnel exposure stops after exiting the cell.
- Personnel are not wearing self-contained breathing apparatus equipment when the release occurs.
- The CEDE factors for elemental tritium are 3.7×10^{-8} rem/μCi to the lung, and 4.4×10^{-9} rem/μCi to the whole body[31].
- All elemental tritium is 100 percent respirable.

The CEDE in the immediate area of a tritium release without a fire or explosion as described in the "Radiological Hazards Assessment Recalculation," was calculated. The one-rem PAG dose would not be exceeded outside the facility boundary. This calculation assumes that the wind speed is 4.25 m/sec (9.5 mph). The arrival time at the Pantex Plant site boundary from the closest building (0.75 mi) for the dispersion would be 4.8 min.

The maximum estimated (i.e., conservative) amount of tritium that could be released from a cell due to a single reservoir accident (taken as a reservoir fracture, stem tube fracture, or inadvertent squib valve activation) was used in the analysis.

The consequence analysis shows that the estimated dose to the facility workers is within the range of normal occupational exposure. The actual doses received in such an accident would be highly dependent on the local concentration of tritium in the cell and the amount of exposure time to a particular level of tritium concentration.

For a release from Building 12-42 South Vault the estimated dose to the facility workers is within the range of normal occupational exposure. A larger value would result from release of multiple reservoirs. However, releases of this magnitude result from scenarios involving externally generated forces (i.e., explosions that generate missile fragments, structural collapse, explosion-generated shock waves, and other similar effects), which have been judged to be extremely unlikely. To release multiple reservoirs, these forces would damage the building itself to such an extent that facility workers would be severely or fatally injured. Therefore, multiple reservoir failure is not discussed further.

The potential off-site doses from the above tritium release would depend on the extent of tritium oxidation. For 1 percent tritium oxidation, and assuming the release takes place at the approximate elevation of the cells or bays, the CEDE at the nearest site boundary (1.2 km or 0.75 mi) would be below the one-rem PAG dose outside the facility boundary for a release from a cell or bay. These results are from GENII calculations assuming Pasquill Stability Class E and 4.25 m/sec (13.9 ft/sec) wind speed[32]. For the limiting case of 100 percent oxidation the CEDE would be below the one-rem PAG dose outside the facility boundary for a cell and a bay release. A release from Building 12-104A with 100 percent tritium oxidation would provide a CEDE at the nearest site boundary (2 km or 1.2 mi) would also be below the one-rem PAG dose outside the facility boundary. A release from Building 12-116 with 100 percent tritium oxidation would provide a CEDE at the nearest site boundary (0.5 km or 0.3 mi) below the one-rem PAG dose.

The potential off-site doses from tritium release at the Building 12-42 South Vault would depend on the extent of tritium oxidation. PX-USQD-95-13, dated June 7, 1995, establishes that the maximum CEDE at the nearest site boundary is between 1 and 30 rem.

The consequences to the facility (cell or bay) structure are considered severe because the facility would be unusable while the difficult and expensive task of tritium clean-up is performed. The RAMS and the use of self-contained breathing apparatus or task exhaust systems play an important role for both facilities in mitigating the consequences of this accident. If the operating staff did not evacuate in response to the radiation alarm, the dose could be substantially higher.

Fragmentation. Fragmentation or catastrophic breach of a metal reservoir could occur if the reservoirs are exposed to a significant level of external force (e.g., explosion) beyond the reservoir design limits. However, tritium reservoir failure as the result of an external force would be of minor consequence compared with the radiological effect of a plutonium release with the same initiating event. The FMEA shows that a tritium release by fragmentation is extremely unlikely with critical consequences.

Delayed Reservoir Release. Delayed reservoir releases could occur if the valve on the reservoir is open when it is removed from the weapon package. A delayed release could also occur if the reservoir is exposed to fire. The elevated temperatures of a fire could lead to an unexpected failure of the reservoir at a later time. The results from the FMEA for a delayed reservoir release show it to be unlikely with marginal consequences. Fire scenarios, accident analysis, and event consequences are provided in Section 4.3.6.

Internal Overpressure With External Overtemperature. Reservoir failure could occur at temperatures at or above 200°C (392°F) due to increased internal pressure or reservoir material failure. An overpressure/ overtemperature release could occur if the reservoir is exposed to fire. The results from the FMEA in the "Radiological Hazards Assessment Recalculation" for an overpressure/overtemperature release show it to be extremely unlikely with critical consequences.

Fire scenarios, accident analysis, and event consequences are provided in Section 4.3.6.

Failure due to Externally Generated Forces. Reservoirs can fail if subjected to large forces associated with external events such as explosions that generate missile fragments, structural collapse, explosion-generated shock waves, and other similar effects. The vast majority of reservoirs are staged in the Building 12-42 South Vault, a steel-reinforced concrete structure described in Chapter 3.2.1.3. The results of the FMEA in the "Radiological Hazards Assessment Recalculation" for a release of multiple reservoirs due to externally generated forces (the bounding accident) show it to be incredible with critical consequences.

4.2.1.4 *Cobalt-60*

The "Radiological Hazards Assessment Recalculation" document identifies six scenarios that may result in the release of Co-60 into the atmosphere. The scenarios include mechanical damage, dissolution, fire, fragmentation due to explosion, loss of source due to explosion, and loss of shielding. Since the "Radiological Hazards Assessment Recalculation" document was written, use of the Co-60 source has ceased at Pantex Plant and therefore the scenarios have not been presented here. Fire scenarios, accident analysis, and event consequences are provided in Section 4.3.6. Loss of source due to explosion was not quantitatively analyzed.

The quantity of the Co-60 source used in the hazards assessment from the "Radiological Hazards Assessment Recalculation" document was 136-Ci. However, since that time, the source has decayed to 107-Ci. Therefore, the analysis conducted in the "Radiological Hazards Assessment Recalculation" document is more conservative than anticipated in the existing conditions. The Co-60 source was used for nondestructive evaluation of weapon systems and other materials in Building 12-56. The source consists of a thin metal rod attached to a flexible metal fixture. The steel rod containing the Co-60 source is the primary barrier to release of respirable particles. This barrier could fail by one of the possible accident scenarios described. The cobalt is concentrated in the tip of the rod to act as a point source for radiographic purposes. The Co-60 source is stored in a massive lead container.

The Co-60 source is no longer used for operations at Pantex Plant; however, the bounding scenario for Co-60 dispersal was defined as the entire source dispersed explosively with no containment. This could represent a situation during the nondestructive assay process where an explosive detonates while the source is withdrawn from the massive lead container, with most of the energy going to breach the building. The CEDE in the immediate area would not be expected to exceed 0.011 rem, and the corresponding one-rem PAG dose would not be exceeded except in close proximity to the release. This calculation assumes a wind speed of 4.25 m/sec (9.5 mph). The arrival time at the Pantex Plant site boundary of 0.75 mi (1.22 km) would be 4.8 min, with a dose of 1.9×10^{-3} rem. The explosion scenario represents the worst case for Co-60 dispersal in aerosol form. A fire would result in a smaller release and dose commitment. The results from the FMEA for a release of Co-60 by fragmentation showed it to be incredible with marginal consequences.

Radiation shielding could be lost if the massive lead container were to fail, if the building shield (walls) were to fail, or if the irradiation source was intentionally removed from the container. This accident scenario could occur if the source mechanism were to fail to move the source back into the container after use or if an explosion were to occur and cause the walls to fail during the time the source is withdrawn from the container. With respect to worker safety, loss of shielding could result in large doses to workers in short periods of time. The safety of this configuration is controlled under the regulatory requirements of the DOE RADCON Manual.

4.2.1.5 *Uranium*

Uranium was identified as a radiological material existing in significant quantities at Pantex Plant. Criticality information involving uranium is discussed in Section 4.3.2. However, the "Radiological Hazards Assessment," dated August 1991, stated that its greatest hazard (as natural uranium) is as a toxicological agent[33]. Thus, uranium is also discussed in Section 4.2.2.6.

More recently, a USQD review evaluated the staging of highly enriched uranium (HEU) in Pantex Plant assembly bays with collocated explosives. The maximum offsite dose was established using HOTSPOT code. This scenario postulated the detonation of 136 kg (300 lb) of HE, complete aerosolization of 3,000 kg (6,615 lb) of HEU with a 20% respirable fraction, resulting in an offsite committed Effective Dose Equivalent (CEDE) of 3.3 rem. A second scenario, analyzed using ERAD, involved the detonation of 136 kg (300 lb) of HE, complete aerosolization of 3,000 kg (6,615 lb) of HEU with an assumed respirable fraction, resulted in an offsite dose of 1.03 rem CEDE. A third analysis, using HOTSPOT, which reduced the HE weight to 23 kg (50 lb), yielded a maximum offsite dose of 6.8 rem CEDE.[34]

4.2.1.6 *Other Radiological Releases*

A number of facilities conduct radiography operations that may result in accidental overexposure to facility workers. The radiation overexposure hazard does not involve the release of radioactive or toxic materials.

The accident analysis estimates for Building 12-84 show that the frequency of radiological incidents is 3×10^{-3}/yr and that, in the lifetime of the facility, an overexposure accident is not anticipated. The frequency of minor overexposures is in the unlikely range of 10^{-2} to 10^{-4}/yr.

4.2.2 Hazardous Material Releases

The "Hazardous Materials Hazard Assessment" identifies the type and scope of hazards and the potential consequences of accidents or events to provide the technical basis for the emergency management program. Information on types, quantities, and locations of hazardous materials was provided on inventories dated June 1992 and December 1991. Appendix B provides a listing of the hazardous chemicals located at various facilities at Pantex Plant.

The initial sorting and classification of the 8,513 Pantex chemical inventory items and 49 hazardous waste inventory items were made using the list of extremely hazardous substances found in 40 CFR 355 and the list of highly hazardous substances found in 29 CFR 1910.119[35,36]. Six substances were found to exist in sufficient quantities to warrant classification as hazardous materials in compliance with DOE Order 5500.3A[37]. Chlorine gas and sulfuric acid were present in quantities greater than their respective threshold limits; and nitric acid, toluene diisocyanate, and phosphoric acid had values of greater than 10 percent of the Threshold Planning Quantity (TPQ) or Threshold Quantity (TQ). Sufficient amounts of uranium were also identified as a hazardous material. Chlorine gas and sulfuric acid have been reduced below the threshold values as shown in Appendix B. Therefore, the analysis conducted in the "Hazardous Materials Hazards Assessment Recalculation" document is more conservative than anticipated in the existing conditions.

Table 4.2.2-1. provides a summary matrix of consequences and probabilities based upon

TABLE 4.2.2-1.—*Consequences and Probabilities of Hazardous Material Releases*

Consequence	Probability			
	Incredible	Extremely Unlikely	Unlikely	Likely
Catastrophic		Cl_2 Explosion		
Critical		Cl_2 Corrosion Sulfuric Acid Corrosion Phosphoric Acid Explosion	Cl_2 Puncture Cl_2 Fracture Nitric Acid Explosion Nitric Acid Fire Sulfuric Acid Explosion	
Marginal	Uranium Explosion Uranium Fire	Cl_2 Leakage Cl_2 Misoperation Sulfuric Acid Defect	Nitric Acid Barrier Fail Phosphoric Acid Barrier Fail Phosphoric Acid Defect Phosphoric Acid Puncture Sulfuric Acid Puncture TDI Barrier Fail	
Negligible		Sulfuric Acid Barrier Fail		

Note: The empty blocks indicated that no accident has been identified with that probability and consequence.

material presented in the "Hazardous Material Hazards Assessment." The matrix provides the type of material released and the initiating event.

Estimates of event concentration bounds were conducted for hazardous and toxic material releases using the Emergency Prediction Information (EPI) code[38] and compared with the current Emergency Response Planning Guidelines (ERPG) values. The EPI code is designed for modeling the airborne release of hazardous materials under various atmospheric conditions. The ERPGs dated May 1992 are published by the American Industrial Hygiene Association (AIHA) for about 45 chemical substances. Three levels of ERPGs for each substance are intended to provide estimates of concentration ranges above which one could reasonably anticipate observing adverse effects as a consequence of exposure to that substance. These three levels are described in Table 4.2.2-2. ERPGs have not been developed for three of the hazardous materials identified (phosphoric acid, uranium, toluene diisocyante); therefore threshold limit value—time-weighted averages (TLV-TWA) were used as substitute values. TLV-TWAs are the time-weighted average concentration for a normal 8-hour workday and a 40-hour work week to which nearly all workers may be repeatedly exposed day after day, without adverse health effects.

4.2.2.1 *Chlorine Gas*

Failure of the primary barrier was the scenario presented in the "Hazardous Materials Hazards Assessment" that could lead to dispersal of chlorine gas. Limited quantities of chlorine are located at two facilities: the water treatment facility (Building 15-29), and the sewage treatment plant (Building 13-47). The primary barrier could fail due to a puncture from an external impact, fracture by impact or metal defect, corrosive attack on the cylinder through weathering or by internal corrosion, misoperation of the cylinder stop valve, explosive release caused by lightning strike or sabotage, leakage of gas from piping manifold or regulator assembly, or overpressurization of the cylinder resulting from the increasing ambient temperature as a result of external fire. Corrosive attack, valve operation, and leakage from piping are not considered further because these failure types are similar to others (i.e., punctures). Fire scenarios, analyses, and event consequences are provided in Section 4.3.6.

All chlorine release scenarios identified in the "Hazardous Materials Hazards Assessment" were treated as gas. Although rapid release of chlorine will cause it to liquify, once it reaches equilibrium it will revert to gas. The scenarios for the accidental release of chlorine gas could occur in time frames ranging from instantaneous to 12 hr. An instantaneous release could occur if the cylinder was dropped and broken at the neck. The more likely scenario, damaged necks or punctures, would release chlorine at intervals of one to several minutes. The 12-hr release simulates damage to the valve seat or small pinhole punctures that could occur due to weak weld joints.

The analyses do not take into account other mitigating factors, such as remaining indoors or leaving the area to avoid exposure. The explosive event caused by sabotage is considered extremely unlikely due to the heightened security status of the Plant in comparison to other water treatment and sewage plants. Also, the amount of chlorine at Pantex Plant is significantly less than ordinary water and sewage treatment plants. For example, the City of Amarillo maintains a maximum amount of chlorine for its water and sewage treatment plant at a level 22 times that of Pantex Plant.

Misoperation of Valve. Cylinders are shipped and stored with protective caps requiring two separate acts to operate the valve. If the cap is removed during movement or system alignment, the valve could be operated inadvertently or damaged by accident. This scenario is similar to a puncture, but would vary based on the degree the valve is opened. The FMEA results show this to be extremely unlikely with marginal consequences.

TABLE 4.2.2-2.—*Emergency Response Planning Guidelines Categories*

ERPG	Description
ERPG-1	The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.
ERPG-2	The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective actions.
ERPG-3	The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

A bottle rack is anchored inside each of the two facilities and may hold up to six cylinders of chlorine. The event scenarios presented in the "Hazardous Materials Hazards Assessment" indicate that the most likely cause for chlorine releases is from either mishandling or faulty valve equipment. The analysis conducted based on these scenarios uses various release rates of 68 kg (150 lb) of chlorine.

Analysis was conducted for instantaneous, 3-min, 6-min, 10-min, and 12-hr chlorine releases. With an instantaneous release, the ERPG-1 concentration (1 ppm) would be exceeded to a distance of 10.5 km, the ERPG-2 concentration (3 ppm) would be exceeded to a distance of 6.5 km, and the ERPG-3 concentration (20 ppm) would be exceeded to a distance of 3.0 km (1.9 mi). The calculation assumes meteorological conditions of Pasquill Stability Class E and 4.25 m/sec (13.9 ft/sec) wind speed. It would take 5.5 min for the dispersion to travel off-site from the nearest point (1.37 km or 0.9 mi from Building 13-27).

Analyses of the longer release times (3-min, 6-min, 10-min, and 12-hr), showed that concentration levels are significantly reduced with increased release times. For example, an instantaneous release results in 220,000 ppm in the immediate area, a release of 3-min results in 1,700 ppm, a release of 6-min results in 580 ppm, and a 12-hour release results in 2.3 ppm.

Explosive Release. An explosive release caused by lightning strike or sabotage could result in the instantaneous release of chlorine gas and represents the worst-case scenario involving chlorine presented in the "Hazardous Materials Hazards Assessment." The results from the FMEA show this to be extremely unlikely with catastrophic consequences.

An explosive release of chlorine gas is possible because of the operations performed in the facilities where these materials are located. Lightning strike or sabotage was assumed as the explosive release mechanism for chlorine gas with a release height of 20 m (66 ft), which would provide the maximum concentrations at the site boundary.

Analyses were also conducted for explosive releases of 816 kg (1,800 lb) of chlorine gas (maximum amount at Buildings 13-47 or 15-29). These quantities were those that were applicable at the time the "Hazardous Material Hazards Assessment" was conducted. However, since that time these facilities have imposed an administrative limit of less than 454 kg (<1,000 lb). Also, at any given time, only 2 cylinders of chlorine are set up on the system such that if the system were to fail/rupture the maximum quantity of chlorine that could reach the environment would be the 2 cylinders or 136 kg (300 lb). Therefore the analysis conducted in the "Hazardous Materials Hazards Assessment" is extremely conservative. An Immediately Dangerous to Life and Health (IDLH) concentration analysis was also conducted for the explosive releases of chlorine. The IDLH limit, defined as the maximum concentration at which, in the event of respirator failure, no escape-impairing (e.g., severe eye irritation) or irreversible health effects occur, was estimated to be exceeded to distance of 7 km (4.4 mi) for the explosive release of 816 kg (1,800 lb).

Puncture by External Impact. Puncturing by an external impact could include being rammed by a forklift tine, caught in a hydraulic lift during unloading, or struck by a stray bullet. The quantity of the release is dependent upon the physical location of the hole and the position of the cylinder. The results from the FMEA show this to be unlikely with critical consequences. The "Misoperation of Valve" scenario provides information on the various release times that may be associated with a puncture by external impact.

Corrosion. Corrosive attack could cause the cylinder to breach or weaken, leading to leakage of contents. This scenario is also similar to a puncture. The results from the FMEA show this to be extremely unlikely with critical consequences. The "Misoperation of Valve" scenario provides information on the various release times that may be associated with a corrosion.

Fracture by Impact or Metal Defect. Fracture by impact or metal defect is essentially the same type of failure as puncture, but could result from mishandling or failure of the storage racks during high winds or tornados. The results from the FMEA show this to be unlikely with critical consequences. The "Misoperation of Valve" scenario provides information on the various release times that may be associated with a fracture by impact or a metal defect.

Leakage from Other Components. Leakage from other components such as service piping, manifold or regulator assembly, and valves is similar to the misoperation of the cylinder valve. The results from the FMEA show this to be extremely unlikely with marginal consequences. The "Misoperation of Valve" scenario provides information on the various release times that may be associated with leakage from and other components.

4.2.2.2 *Nitric Acid*

Nitric acid is stored and handled in many buildings in glass bottles ranging in size from one pint to one gallon. Only two locations currently contain quantities in excess of the 10% TPQ limit. These locations are Building 11-17, the Chemistry Laboratory, and Building 12-2A, the Industrial Hygiene Laboratory. Failure of the primary barrier was the scenario presented in the "Hazardous Materials Hazards Assessment" that could lead to dispersal of nitric acid. The primary barrier could fail due to breakage of the container during handling or storage, a manufacturing or design defect in the container, release initiated by a fire, or an explosion.

ERPGs used in the "Hazardous Materials Hazards Assessment" for nitric acid releases were developed as interim guidance by DOE since ERPGs from the AIHA did not exist at that time. The interim ERPG-1 was 2 ppm, the interim ERPG-2 was 15 ppm, and the interim ERPG-3 was 30 ppm. Each analysis assumed meteorological conditions of Pasquill Stability Class E and 4.25 m/sec wind speed.

Failure of Primary Barrier. Scenarios presented in the "Hazardous Materials Hazards Assessment" identify three possible situations that may result in a release of nitric acid. Release of 5.4 kg (12 lb) or 3.8 liters (1 gal) of nitric acid, as with the breakage of a single container, would not normally require emergency action, except on an area Satellite Spill Response Team basis. The results of the FMEA show this to be unlikely with marginal consequences.

Liquid spills were identified in the "Hazardous Materials Hazards Assessment" as a possible release scenario for nitric acid. Two different ambient temperatures were used to account for different evaporation rates in the modeling because these chemicals are stored both within and external to the facilities in which they are used. Indoor spill modeling used a temperature of 20°C (68°F) and outdoor spills used a temperature of 37.8°C (100°F) to represent the maximum concentrations afforded by higher evaporation rates during summer.

Analysis of liquid spills of nitric acid in the "Hazardous Materials Hazards Assessment" were conducted assuming that a one gal container was dropped or spilled at either room temperature or 37.8°C (100°F). The ERPG-2 (15 ppm) would not be exceeded at any distance with a concentration at the site boundary of 0.015 ppm.

Release of 22.7 kg (15.1 liters) or 50 lb (4 gal) of nitric acid in Building 12-2A, or 90.7 kg (200 lb) or 62.8 liters (16.6 gal) in Building 11-17 could be possible in a liquid spill or a vapor release in a fire or explosion. The results from the FMEA show this to be unlikely with critical consequences.

Explosive release of nitric acid was assumed to have release potential and consequences similar to the fire scenarios analyzed in Section 4.3.6.

4.2.2.3 *Phosphoric Acid*

Phosphoric acid is stored in Building 12-68, the Tool and Dye Shop, as a 5 percent solution in 208-liter (55-gal) drums. Failure of the primary barrier was the scenario presented in the "Hazardous Materials Hazards Assessment" that could lead to dispersal of phosphoric acid. The primary barrier could fail due to breakage of the container during handling or storage, a manufacturing or design defect in the container, release initiated by a fire, or an explosion. Fire scenarios, analyses, and event consequences are provided in Section 4.3.6.

ERPGs for phosphoric acid did not exist at the time of publication of the "Hazardous Material Hazards Assessment." The TLV-TWA of one mg/m^3 (1.0 x 10^{-6} oz/ft^3) was used to determine threshold values. Analysis of a spill of 416 liters (110 gal) of phosphoric acid would never exceed the one mg/m^3 TLV-TWA. Each analysis assumed meteorological conditions of Pasquill Stability Class E and 4.25 m/sec (13.9 ft/sec) wind speed.

Explosive release of phosphoric acid was assumed to have a release potential and consequences similar to the fire scenarios analyzed in the "Hazardous Materials Hazards Assessment." The assessment identified these types of releases to be extremely unlikely with critical consequences.

Liquid spills were identified in the "Hazardous Materials Hazards Assessment" as a possible release scenario for phosphoric acid. Two different ambient temperatures were used to account for different evaporation rates in the modeling because these chemicals are stored both within and external to the facilities in which they are used. Indoor spill modeling used a temperature of 20°C (68°F) and outdoor spills used a temperature of 37.8°C (100°F) to take advantage of the maximum concentrations afforded by higher evaporation rates during summer.

Failure of Primary Barrier. Failure of the primary barrier was the scenario presented in the "Hazardous Materials Hazards Assessment" that could lead to dispersal of phosphoric acid. The primary barrier could fail due to puncturing by external impact, a manufacturing or design defect in the container, release initiated by a fire or explosion, or corrosion of the container either internally or externally as a result of age or weathering. Building 12-68 is the only facility where significant quantities of phosphoric acid (as a 5 percent solution) are located. The storage shed where the drums are stored is not considered a mitigating factor in the release of fumes, but would limit the surface area of any spills that occur. The results of the FMEA show this to be unlikely with marginal consequences.

Puncture by External Impact. For puncturing by external impact (such as being struck with a forklift), the release rate of the phosphoric acid solution to the atmosphere would be determined by the size of the hole and rate of evaporation, depending on the ambient temperature. Manufacturing or design defects and corrosion of the container could lead to either a slow leak or a rapid release similar to a puncture. The results from the FMEA show this to be unlikely with marginal consequences.

The TLV-TWA of one mg/m^3 (1.0 x 10^{-6} oz./ft^3) was never exceeded for liquid spills of 416 liters (110 gal) at 20°C (68°F) and 37.8°C (100°F). Further analysis involving liquid spills was not conducted.

advantage of the maximum concentrations afforded by higher evaporation rates during summer.

The ERPGs for sulfuric acid were determined by the AIHA to be 2 mg/m^3 (3.0 x 10^{-6} oz/ft^3) for ERPG-1, 10 mg/m^3 (1.0 x 10^{-5} oz/ft^3) for ERPG-2, and 30 mg/m^3 (3.0 x 10^{-3} oz/ft^3) for ERPG-3. The scenario for each accident is based on the 416 liters (110 gal) of concentrated sulfuric acid located in Building 12-68. Each analysis assumed meteorological conditions of Pasquill Stability Class E and a 4.25 m/sec (13.9 ft/sec) wind speed.

Analyses conducted in the "Hazardous Materials Hazards Assessment" determined that a spill of 416 liters (110 gal) of sulfuric acid would not cause noticeable concentrations. A spill of 416 liters (110 gal) would produce concentrations at the facility boundary of 1 × 10^{-6} ppm and 1 × 10^{-8} ppm at the site boundary. The ERPG-2 would not be exceeded.

4.2.2.5 *Toluene Diisocyanate*

Toluene diisocyanate is stored and used at three locations onsite, two of which approach the 10% TPQ criterion. These are location 11-7N, a waste storage area, and Building 12-59, the Chemistry Laboratory. The primary barriers for toluene diisocyanate (TDI) are glass bottles in Building 12-59 and a variety of containers staged in a cardboard hazardous waste box at Building 11-7N. Failure of the primary barrier was the scenario presented in the "Hazardous Materials Hazards Assessment" that could lead to dispersal of TDI. The primary barrier could fail due to breakage of a container and a release initiated by a fire or explosion. Liquid spills were also considered in the "Hazardous Materials Hazards Assessment."

Failure of Primary Barrier. Breakage of a TDI container in Building 12-59 would result in a rapid release of the entire contents. The evaporation rate of TDI would not result in an airborne release hazard. A slow leak of TDI would be mitigated by the building ventilation system. The results from the FMEA show this to be unlikely with marginal consequences. Fire scenarios, analyses, and event consequences are provided in Section 4.3.6.

Explosive releases of TDI were assumed to have a release potential and consequences similar to the fire scenarios analyzed in the "Hazardous Materials Hazards Assessment."

Liquid Spills. Liquid spills were identified in the "Hazardous Materials Hazards Assessment" as possible release scenarios for TDI. Two different ambient temperatures were used to account for different evaporation rates in the modeling because these chemicals are stored both within and external to the facilities in which they are used. Indoor spill modeling used a temperature of 20°C (68°F) and outdoor spills used a temperature of 37.8°C (100°F) to take advantage of the maximum concentrations afforded by higher evaporation rates during summer.

ERPGs for TDI did not exist at the time of publication of the "Hazardous Materials Hazards Assessment." The TLV-TWA of 0.005 ppm was used to determine emergency planning threshold values. For modeling purposes, toluene-2,4-diisocyanate was used for data simulations and concentration calculations. Each analysis assumed meteorological conditions of Pasquill Stability Class E and a 4.25 m/sec (13.9 ft/sec) wind speed.

Analyses of spills in quantities of less than 94.6 liters (25 gal) at room or summer temperatures concluded that dangerous concentration levels would not be produced. A 3.8 liter (1 gal) spill would result in a concentration of 1 × 10^{-4} ppm at the facility boundary, and a 1 × 10^{-6} ppm concentration level at the site boundary.

A 208-liter (55-gal) spill of TDI would result in a concentration of 0.032 ppm in the immediate area, and the TLV-TWA concentration would be exceeded to a distance of 0.3 km (0.2 mi). The concentration levels beyond the site boundary would not exceed the 0.005 ppm TLV-TWA emergency planning threshold value.

4.2.2.6 *Uranium*

Failure of the primary barrier was the scenario presented in the "Hazardous Materials Hazards Assessment" that could lead to dispersal of uranium. The primary barrier in this case is the material itself. Under normal conditions, a spill of solid uranium would not present an immediate hazard. A fire or explosion could result in the release of uranium oxides into the atmosphere. In a fire, the uranium melts; and, in an explosion, airborne particulates are produced. The range of possible releases for this scenario was limited to an explosion in a single structure at any one time. The results from the FMEA show this to be incredible with marginal consequences. Fire scenarios, accident analyses, and event consequences are provided in Section 4.3.6.

Explosive Release. An explosive release of uranium was considered possible because of the operations performed in the facilities where these materials are located. ERPGs for uranium did not exist at the time of publication of the "Hazardous Materials Hazards Assessment." The TLV-TWA of 0.2 mg/m^3 (2.0 x 10^{-7} oz/ft^3) was used to determine emergency planning threshold values. The quantities used for the analyses are the same as those used in the "Radiological Hazards Assessment Recalculation." These limits are 2,150 kg (4,730 lb) and 4,300 kg (9,460 lb). The calculations for fire scenarios were conducted assuming the facility had HEPA filters rated at 99.97 percent for 0.3 micrometer particles, and assuming the facility either did not have HEPA filters or had paper filters that would not survive severe fires. Each analysis assumed meteorological conditions of Pasquill Stability Class E and 4.25 m/sec wind speed.

The full amount of uranium (2,150 kg or 4,741 lb and 4,300 kg or 9,482 lb) was used to determine the amount of uranium released. For facilities that contained 2,150 kg (4,741 lb) and had HEPA filters, the filters would reduce the effective release to 21.5 kg (47.4 lb), which further reduces to 10.75 grams (0.4 oz) of respirable uranium. For facilities that contained 4,300 kg 9,482 lb) and had HEPA filters, the filters would reduce the effective release to 43 kg (94.8 lb), which further reduces to 21.5 grams (0.8 oz) of respirable uranium. The fire analysis for 2,150 kg (4,741 lb) involved in a fire concluded that concentrations of 39 mg/m^3 (4.0 x 10^{-5} oz/ft^3) could result in the immediate area and concentrations of 0.018 mg/m^3 (2.0 x 10^{-8} oz/ft^3) could result at the site boundary. The TLV-TWA concentration could be exceeded to a distance of 0.825 km (0.5 mi). The fire analysis for 4,300 kg (9,482 lb) involved in a fire concluded that concentrations of 78 mg/m^3 (1.0 x 10^{-4} oz/ft^3) could result in the immediate area and concentrations of 0.03 mg/m^3 (3.0 x 10^{-8} oz/ft^3) could result at the site boundary. The TLV-TWA concentration could be exceeded to a distance of 1.05 km (0.7 mi).

The same calculations were conducted for facilities without HEPA filters. The analysis for 2,150 kg (4,741 lb) involved in a fire concluded that concentrations of 3,900 mg/m^3 (4.0 x 10^{-3} oz/ft^3) could result in the immediate area, and concentrations of 1.8 mg/m^3 (2.0 x 10^{-6} oz/ft^3) at the site boundary. The TLV-TWA concentration could be exceeded to a distance of 5 km (3.1 mi). The fire analysis for 4,300 kg (9,482 lb) involved in a fire concluded that concentrations of 7,800 mg/m^3 (1.0 x 10^{-2} oz/ft^3) could result in the immediate area and concentrations of 3.6 mg/m^3 could result at the site boundary. The TLV-TWA concentration could be exceeded to a distance of 7 km.

4.2.3 Explosive Material Releases

The "Chemical High Explosives Hazards Assessment" was performed to identify the type and scope of hazards associated with unplanned burning or detonation of chemical high explosives and the potential consequences of accidents or events to provide the technical basis for the emergency management program. Information on types, quantities, and locations of chemical high explosives was provided from an inventory dated June 1993. A listing of the maximum building limits for chemical HE and IHE located at the Pantex Plant is provided in Appendix B. The initial sorting and classification of the more than 100 chemical HE types (HE, IHE, and Mock) with 65 constituents were made using the list of extremely hazardous substances found in 40 CFR 355 and the list of highly hazardous substances found in 29 CFR 1910.119. Chemicals listed in the regulatory guidance were compared to the constituents identified in the inventory to the TPQ or TQ. Chemical constituents exceeding 10 percent of the established TPQ or TQ were classified as items of potential interest for emergency planning purposes. No items in the Pantex Plant explosives inventory were found to match the chemicals in 40 CFR 355. Chemical HE constituents not listed in the regulatory guidance were considered for modeling based on toxicological and physical characteristics. Four chemicals, cyclotrimethylenetrinitramine, cyclotetramethylenetetranitramine, triaminotrinitrobenzene, and trinitrotoluene were found in quantities exceeding 10 percent of the TPQ or TQ. The results from the FMEA show a chemical HE release caused by fire is unlikely with critical consequences. The results from the FMEA show a chemical HE release caused by an explosion is extremely unlikely with catastrophic consequences.

Three release scenarios were identified, including deliberate physical changes to the material, explosion, and fire. Fire scenarios, accident analyses, and event consequences are provided in Section 4.3.6. The quantities of chemical HE used for the analyses conducted in the "Chemical High Explosives Hazards Assessment" were derived from the Zone 4 inventory and a listing of facility limits. The potential amount of chemical HE lofted into the atmosphere in a respirable form due to an explosive event was determined by the XREFRAC (Explosive Release Fraction) computer code[39]. The dispersion of that quantity was then modeled using the EPI Code. XREFRAC and EPI Code are discussed in Section 4.4.

Table 4.2.3-1. provides a summary matrix of consequences and probabilities based upon material presented in the "Chemical High Explosives Hazards Assessment." The matrix provides the type of material released and the initiating event.

Release Through Processing Techniques. The chemical HE physical state is solid; it is received in bulk granular form, mixed with other HE and various constituents to the desired formulation, and either pressed into shape for processing or pressed directly into a component. The "Chemical High Explosives Hazards Assessment" identified physical changes as a likely, but marginal scenario for chemical HE release. Deliberate physical changes to the material such as machining, milling, or pressing may result in release through the generation of particulates. Release of particulates or dust through processing techniques depends on the fact that the operation being performed would be contained in the rooms, cells, containments, or buildings where the operations occur. Where applicable, HEPA filtration may prevent particulates or dust from being released into the atmosphere. If the HEPA system could fail, the operations would be halted quickly if not immediately. The release of particulates or dust would be negligible in comparison to total the amount of particulates generated prior to ceasing operation. No further analysis is provided on this scenario in the "Chemical High Explosives Hazards Assessment."

Explosive Release. Explosive release was identified in the "Chemical High Explosives Hazards Assessment" as a possible scenario for chemical HE release. Explosive events were expected to result in complete combustion of pressed materials. The potential amount of chemical HE lofted into the atmosphere in

TABLE 4.2.3-1.—*Consequences and Probabilities of Chemical HE Material Releases*

Consequence	Probability			
	Incredible	**Extremely Unlikely**	**Unlikely**	**Likely**
Catastrophic		Explosion		
Critical			Fire	
Marginal				Physical Changes
Negligible				

Note: The empty blocks indicate that no accident has been identified with that probability and consequence.

respirable form was determined using XREFRAC. The dispersion of the chemical HE release was then modeled using EPIcode. This release could range from no release to a release of up to 20 percent of the facility limit in particulate form. Parameters used for a fire release of chemical HE included a source term based on the amount of HE available, multiplied by the release fraction of 9 percent and the respirable fraction of 50 percent; 10 min release duration; E Pasquill Stability Class; 4.25 m/s (13.9 ft/sec) wind; and 2.1 m (7 ft) release height. A respirable fraction of 50 percent was used as default value to estimate the relative amount of particulate chemical HE available for exposure to receptors. This fraction is used by the U.S. Environmental Protection Agency as a default value for fugitive dust emissions. Parameters used for an explosive release of chemical HE included a source term based on the amount of HE lofted, instantaneous release duration, E Pasquill Stability Class, 4.25 m/s(13.9 ft/sec) wind, and 68 m (223 ft) release height for 4.5 kg (10 lb) of HE and 89.6 m (294 ft) for the detonation of 13.6 kg (30 lb) of HE. The amount of chemical HE lofted in particulate form that is respirable was determined from the amount of HE present in the facility or the facility limit and XREFRAC.

4.2.3.1 *Cyclotrimethylene-trinitramine*

Cyclotrimethylenetrinitramine (RDX) is a research department explosive (a.k.a., royal demolition explosive) holding United Nations Class 1.1 with the potential to mass detonate. RDX is generally used as a constituent in HE components, as a base charge for detonator devices, or as an ingredient in bursting charges or plastic explosives. RDX is staged in Zone 4 East, and Buildings 11-42, 12-65, and 12-83 until processing into HE components. Once processed, the components are relatively stable, insensitive, and require special detonators to initiate an explosion.

The TLV-TWA value established by the American Conference of Governmental Industrial Hygienists (ACGIH) is not currently available for RDX; however, a maximum exposure level of 1.5 mg/m^3(1.0 x 10^{-4} oz/ft^3) has been identified by Los Alamos National Laboratory. The TLV-TWA is conservative in that it is intended as an 8-hr exposure day after day for most healthy workers, whereas the ERPG is a one-hour exposure limit for the general public in an emergency situation. The analysis assumed instantaneous release, to heights of 68 m (223 ft) for a 4.5 kg (10 lb) HE explosion and 89.6 m (294 ft) for a 13.6 kg (30 lb) HE explosion. The scenario represented an explosive release of RDX in Building 4-60, which has an inventory of 2,432 kg (5,362 lb) of RDX. An explosion of 4.5 kg (10 lb) of HE would result in a release of 33 kg (72 lb) of respirable RDX at a height of 68 m (223 ft) and a release radius of 27 m (89 ft). The site boundary concentration was 0.2 mg/m^3 (2.0 x 10^{-5} oz/ft^3), less than the 1.5 mg/m^3 (1.0 x 10^{-4} oz/ft^3) TLV-TWA concentration. The detonation of 13.6 kg (30 lb) of HE caused by an act of sabotage would result in a release of 66.2 g (146 lb) of respirable RDX at a height of 89.6 m (294 ft) and a release radius of 36 m (117 ft). The site boundary concentration was 0.009 mg/m^3 (1.0 x 10^{-8} oz/ft^3), substantially less than the 1.5 mg/m^3 (1.0 x 10^{-4} oz/ft^3) TLV-TWA concentration.

4.2.3.2 *Cyclotetramethylene-tetranitramine*

Cyclotetramethylenetetranitramine (HMX) is a United Nations Class 1.1 high melting explosive. HMX is generally used in castable TNT-based binary explosives, as the main ingredient in high-performance plastic-bonded explosives, and in high-performance solid propellants. HMX is staged in Zone 4 East and Building 12-83 until processing. Once processed, the components are relatively stable, insensitive, and require special detonators to initiate an explosion.

The TLV-TWA value established by the ACGIH is not currently available for HMX; however, a maximum exposure level of 1.5 mg/m^3 (1.0 x 10^{-4} oz/ft^3) has been identified by Los Alamos

National Laboratory. The TLV-TWA is conservative in that it is intended as an 8-hr exposure day after day for most healthy workers, whereas the ERPG is a one-hour exposure limit for the general public in an emergency situation. The explosives analysis assumed instantaneous release, to a heights of 68 m (223 ft) for a 4.5 kg (10 lb) explosion and 89.6 m (294 ft) for a 13.6 kg (30 lb) explosion. The scenario modeled represented an explosive release of HMX in Building 4-66, which has an inventory limit of 25,549 kg (56,326 lb) of HMX. An explosion of 4.5 kg (10 lb) of HE would result in a release of 77 kg (170 lb) of respirable HMX at a height of 68 m (223 ft) and a release radius of 27 m (89 ft). The site boundary concentration was 0.22 mg/m^3 (2.0 x 10^{-7}oz/ft^3), less than the 1.5 mg/m^3 (1.0 x 10^{-4} oz/ft^3) TLV- TWA concentration. The detonation of 13.6 kg (30 lb) of HE caused by an act of sabotage would result in a release of 155 kg (342 lb) of respirable HMX at a height of 89.6 m (294 ft) and a release radius of 36 m (117 ft). The site boundary concentration was calculated to be 0.0045 mg/m^3 (4.0 x 10^{-9} oz/ft^3), less than the 1.5 mg/m^3 (1.0 x 10^{-4} oz/ft^3) TLV-TWA concentration. Fire releases for HMX were not analyzed in the "Chemical High Explosives Hazards Assessment" because the more conservative modeling of the TNT releases were sufficient to represent fire releases of HMX.

4.2.3.3 *Triaminotrinitrobenzene*

Triaminotrinitrobenzene (TATB) is a United Nations Class 1.3 explosive that is thermally stable and very insensitive to accidental initiation by shock or impact. TATB is generally coated with a thermoplastic polymer and pressed into the shape desired for its particular use. TATB is staged in Zone 4 East and Buildings 11-42, 12-65, and 12-83 until processing. Once processed, the components are relatively stable, insensitive, and require special detonators to initiate an explosion. The TLV-TWA value established by the ACGIH is not currently available for TATB; however, a maximum exposure level of 1.5 mg/m^3 (1.0 x 10^{-4} oz/ft^3) has been identified by Los Alamos National Laboratory. The TLV-TWA is conservative in that it is intended as an 8-hr exposure day after day for most healthy workers, whereas the ERPG is a one-hr exposure limit for the general public in an emergency situation.

The calculations for explosive release of TATB were modeled using two facilities, Building 4-75 and Building 12-65. Building 4-75 has an inventory limit of 27,734 kg (61,143 lb) of TATB. An explosion of 4.5 kg (10 lb) of HE would release 79.4 kg (175 lb) of respirable TATB at a release height of 68 m (223 ft) and a release radius of 27 m (89 ft). The resulting concentration at the site boundary was 0.23 mg/m^3 (2.0 x 10^{-7} oz/ft^3), which is below the 1.5 mg/m^3 (1.0 x 10^{-4} oz/ft^3) TLV-TWA concentration. An explosion of 13.6 kg (30 lb) of HE would release 160 kg (353 lb) of respirable TATB at a release height of 89.6 m (294 ft) and a release radius of 36 m (117 ft). The resulting concentration at the site boundary was 0.0047 mg/m^3 (5.0 x 10^{-9} oz/ft^3), which is below the 1.5 mg/m^3 (1.0 x 10^{-4} oz/ft^3) TLV-TWA concentration.

Building 12-65 has an inventory limit of 1,762 kg (3,885 lb) of TATB. An explosion of 4.5 kg (10 lb) of HE would release 29 kg (64 lb) of respirable TATB at a release height of 68 m (223 ft) and a release radius of 27 m (89 ft). The resulting concentration at the site boundary was 7.2 $\times$ 10^{-5} mg/m^3 (1.0 x 10^{-10} oz/ft^3), which is below the 1.5 mg/m^3 (1.0 x 10^{-4} oz/ft^3) TLV-TWA concentration. An explosion of 13.6 kg (30 lb) of HE would release 59 kg (130 lb) of respirable TATB at a release height of 89.6 m (294 ft), and a release radius of 36 m (117 ft). The resulting concentration at the site boundary was less than 1 $\times$ 10^{-5} mg/m^3 (1.0 x 10^{-11} oz/ft^3), which is below the 1.5 mg/m^3 (1.0 x 10^{-4} oz/ft^3) TLV-TWA concentration.

4.2.3.4 *Trinitrotoluene*

Trinitrotoluene (TNT) is a United Nations Class 1.1 explosive that is extremely powerful under appropriate conditions. TNT is the basis for comparison by which other explosives' blast output is calculated. TNT is used commonly as a constituent of HE components in bombs and grenades. TNT is staged in Zone 4 East and Buildings 11-42, 12-65, and 12-83 until processing. Once processed, the components are relatively stable, insensitive, and require special detonators to initiate an explosion.

A TLV-TWA value of 0.5 mg/m^3 (5.0 x 10^{-7} oz/ft^3) has been established by the ACGIH for TNT. The TLV-TWA is conservative in that it is intended as an 8-hr exposure day after day for most healthy workers, whereas the ERPG is a one-hr exposure limit for the general public in an emergency situation. Due to the low TLV-TWA of TNT as compared to RDX, HMX, and TATB, TNT was the primary chemical HE constituent modeled and provided a conservative estimate for addressing concerns for all chemical HE that may be present. Five fire release scenarios and twelve explosion release scenarios were modeled in the "Chemical High Explosives Hazards Assessment." The parameters used for modelling a fire release of TNT include a source term multiplied by the release fraction of 9 percent, the respirable fraction of 50 percent, and a 10-min release duration. Each analyses assumed meteorological conditions of Pasquill Stability Class E and a 4.25 m/sec (13.9 ft/sec) wind speed.

Building 12-59, with an inventory of 371 kg (818 lb), was modeled for 4.5 kg (10 lb) and 13.6 kg (30 lb) HE explosions. For a 4.5 kg (10 lb) explosion, the release height was 68 m (223 ft) with a release radius of 27 m (89 ft). The amount of respirable TNT was 16,8 kg (37 lb). The resulting concentration at the site boundary was 0.1 mg/m^3 (1.0 x 10^{-7} oz/ft^3), which is less than the 0.5 mg/m^3 (5.0 x 10^{-7} oz/ft^3) TLV-TWA concentration. For a 13.6 kg (30-lb) explosion, the release height was 89.6 m (294 ft); and the release radius was 36 m (117 ft), with 36 kg (80 lb) of respirable material released. The resulting concentration at the site boundary was 0.0049 mg/m^3 (5.0 x 10^{-9} oz/ft^3), which is less than the 0.5 mg/m^3 (5.0 x 10^{-7} oz/ft^3) TLV-TWA concentration.

Building 12-17, with an inventory of 5.4 kg (12 lb), was modeled for 4.5 kg (10 lb) and 13.6 kg (30 lb) HE explosions. For a 4.5 kg (10 lb) explosion, the release height was 68 m (223 ft) and a release radius of 27 m (89 ft). The amount of respirable TNT was 0.27 kg (0.6 lb). The resulting concentration at the site boundary was 0.1 mg/m^3 (1.0 x 10^{-7} oz/ft^3), which is less than the 0.5 mg/m^3 (5.0 x 10^{-7} oz/ft^3) TLV-TWA concentration. For a 13.6 kg (30 lb) explosion, the release height was 89.6 m (294 ft) and the release radius was 36 m (117 ft), with 1.8 kg (4 lb) of respirable material released. The resulting concentration at the site boundary was 0.0049 mg/m^3 (5.0 x 10^{-9} oz/ft^3), which is less than the 0.5 mg/m^3 (5.0 x 10^{-7} oz/ft^3) TLV-TWA concentration.

Building 12-21, with an inventory of 88 kg (193 lb), was modeled for 4.5 kg (10 lb) and 13.6 kg (30 lb) HE explosions. For a 4.5 kg (10 lb) explosion, the release height was 68 m (223 ft), with a release radius of 27 m (89 ft). The amount of respirable TNT was 10 kg (22 lb). The resulting concentration at the site boundary was 2.5 × 10^{-5} mg/m^3 (2.0 x 10^{-11} oz/ft^3), which is less than the 0.5 mg/m^3 (5.0 x 10^{-7} oz/ft^3) TLV-TWA concentration. For a 13.6 kg (30 lb) explosion, the release height was 89.6 m (294 ft) and the release radius was 36 m (117 ft), with 21 kg (46 lb) of respirable material released. The resulting concentration at the site boundary was less than 1 × 10^{-5} mg/m^3 (1.0 x 10^{-11} oz/ft^3), which is less than the 0.5 mg/m^3 (5.0 x 10^{-7} oz/ft^3) TLV-TWA concentration.

Building 12-64, with an inventory of 136 kg (300 lb), was modeled for 4.5 kg (10 lb) and 13.6 kg (30 lb) HE explosions. For a 4.5 kg (10 lb) explosion, the release height was 68 m (223 ft) with a release radius of 27 m (89 ft). The amount of respirable TNT was 11.8 kg (26 lb). The resulting concentration at the site boundary was 0.0038 mg/m^3 (4.0 x 10^{-9} oz/ft^3), which is less than the 0.5 mg/m^3 (5.0 x 10^{-7} oz/ft^3) TLV-TWA concentration. For a 13.6 kg (30 lb) explosion, the release height was 89.6 m (294 ft) and the release radius was 36 m (117 ft), with 24 kg (53 lb) of respirable material released. The resulting concentration at the site boundary was less than 1 × 10^{-5} mg/m^3 (1.0 x 10^{-11} oz/ft^3), which is less than the 0.5 mg/m^3 (5.0 x 10^{-7} oz/ft^3) TLV-TWA concentration.

Building 12-65, with an inventory of 1,762 kg (3,885 lb), was modeled for 4.5 kg (10 lb) and 13.6 kg (30 lb) HE explosions. For a 4.5 kg (10 lb) explosion, the release height was 68 m (223 ft) with a release radius of 27 m (89 ft). The amount of respirable TNT was 29 kg (64 lb). The resulting concentration at the site boundary was less than 1 × 10^{-4} mg/m^3 (1.0 x 10^{-10} oz/ft^3), which is less than the 0.5 mg/m^3 (5.0 x 10^{-7} oz/ft^3) TLV-TWA concentration. For a 13.6 kg (30 lb) explosion, the release height was 89.6 m (294 ft) and the release radius was 36 m (117 ft), with 59 kg (130 lb) of respirable material released. The resulting concentration at the site boundary was less than 1 × 10^{-5} mg/m^3 (1.0 x 10^{-11} oz/ft^3), which is less than the 0.5 mg/m^3 (5.0 x 10^{-7} oz/ft^3) TLV-TWA concentration.

A safe-secure trailer with an inventory of 313 kg (690 lb), was modeled for 4.5 kg (10 lb) and 13.6 kg (30 lb) HE explosions. For a 4.5 kg (10 lb) explosion, the release height was 68 m (223 ft) with a release radius of 27 m (89 ft). The amount of respirable TNT was 14.5 kg (32 lb). The resulting concentration at the site boundary was less than 0.044 mg/m^3 (4.0 x 10^{-8} oz/ft^3), which is less than the 0.5 mg/m^3 (5.0 x 10^{-7} oz/ft^3) TLV-TWA concenration. For a 13.6 kg (30 lb) explosion, the release height was 89.6 m (294 ft) and the release radius was 36 m (117 ft), with 32.2 kg (71 lb) of respirable material released. The resulting concentration at the site boundary was less than 0.001 mg/m^3 (1.0 x 10^{-9} oz/ft^3), which is less than the 0.5 mg/m^3 (5.0 x 10^{-7} oz/ft^3) TLV-TWA concentration. The consequences of this type of accident would be bounded by the resultant release of radioactive materials under these conditions, rather than the dispersal of respirable TNT.

4.3 Natural Phenomena and External Events

In the SARs, qualitative assessment was performed to eliminate from further consideration any of the initiators that pose little or no hazard to the facilities or their contents. Potential natural phenomena hazards and external events were identified by reviewing several prior risk and safety studies. The prior studies included environmental impact and safety analyses performed for the Pantex Plant site, current guidelines for performing DOE hazards assessments, recent risk and safety analyses of another DOE facility, and the recommended list of initiating events used to evaluate commercial nuclear power plant risks. In addition, an attempt was made to identify any other potential external initiating events unique to the Pantex Plant site that had not been considered in previous studies.

Table 4.3-1. presents the accident-initiating events that were considered for applicability for the bays. The status column in Table 4.3-1. indicates how each event was categorized in the screening process. The four criteria used in the screening process are

1. The event is impossible or improbable due to the size or location of the facility; the characteristics of the regional geology, topography, or hydrology; or the contents or the nature of the operations performed in the facility.

2. The event produces challenges that are similar to, or obviously less severe than, other events of higher likelihood already under consideration.

3. The event would not result in any potential for adverse consequences.

TABLE 4.3-1.—*Potential Natural Phenomena Hazards and External Events*

Event	Status	Event	Status
Aircraft Impacts	4	Lightning Strikes	4
Avalanches/Landslides	1	Loss of Off-site Power	3
Coastal Erosion	1	Low Lake or River Water Level	1
Drought	3	Meteor Strikes	1
Earthquakes	4	Pipeline Accidents	2,3
External Explosions	4	River Diversions	1
External Fires	5	Sandstorms/Duststorms	3
External Floods	4	Seiche	1
Fog	3	Snow	2
Forest/Grass Fires	3	Straight Winds	2
Frost	3	Structural Interactions	1
Hail	2	Temperature Extremes	3
Ice	2	Tornados	4
Industrial or Military Facility Accident	1,2	Transportation Accidents	2
Internal Explosion	5	Tsunami	1
Internal Fires	5	Volcanic Activity	1
Internal Floods	5		

Status Key
1 Not possible or plausible at this site or facility.
2 Less severe than other potential events.
3 No potential for adverse consequences.
4 Quantitative analysis required.
5 Facility-specific.

4. The event could not be eliminated from consideration. Quantitative analysis is required.

Many of the less credible events listed in Table 4.3-1. were eliminated from further consideration in this screening process. Four natural phenomena hazards and two external events were identified as requiring further analysis: earthquakes, floods, tornados, lightning strikes, aircraft impacts, and external explosions. Appendix F provides justification of the status ranking reported in this table. The likelihood and/or consequences of these events are analyzed quantitatively in this chapter. Other events have also been identified (i.e., criticality, fire) and are addressed in this chapter.

The following sections are based primarily on the hazards assessments, facility-specific information has been added where appropriate. Appendix E provides most of the additional information. It is important to note that currently new work is being conducted to determine bounding meteorological conditions at Pantex Plant. Recent data indicate that for analytical purposes, meteorology at Pantex Plant can be conservatively characterized by 1.5 m/s (3.4 mph) wind speeds and a Pasquill Stability of Class E. This is not consistent with many of the analyses presented. Once the new work is completed, new analyses will be conducted and the resulting site boundary doses will be included in this document as it is revised.

4.3.1 Explosion

The "Chemical High Explosives Hazards Assessment" provided relatively generic accident scenarios involving explosions in facilities and the estimated effects of the fragment and debris scatter and blast pressures. Seven facilities, intended to represent types or classes of facilities at Pantex Plant, were modeled for the internal detonation of the facility limit of HE. Table 4.3.1-1. lists the generically modeled facilities and the equivalent facilities. The hazards from building debris, primary fragments, secondary fragments, and blast pressures were analyzed to determine the likelihood that these hazards would produce a danger to individuals at or near the Plant. The analysis focused on the debris thrown from the roof and each wall for the worst case conditions to define dispersion in each direction.

The analysis in the "Chemical High Explosive Hazards Assessment" to determine blast, shock, and debris effects was conducted using several calculational models and computer softwares. The modeling included the use of the DISPRE Model, the Multiple Missile Debris Impact Simulation program (MUDEMIMP) code, or statistical simulation for building debris dispersion; the TRAJ computer program and statistical simulation for primary fragment density; the statistical simulation for secondary fragment debris density; and an explanation of the theory and test data used to predict external leakage pressures[40,41,42]. Each code is a general purpose explosives modeling code used by the Department of Defense. For debris dispersion, a hazard was considered to exist within a radius around a facility where at least one missile (e.g., primary fragments, secondary fragments, other debris) is predicted to fall within a range of a 557 m^2 (600-ft^2) area with an impact energy of greater than 1.52 kg-meters (11 ft-lb). For external leakage, a hazard was considered to exist in a radius around the facility within which a pressure of 2,109 kg/m^2 (3.0 psi) is produced.

Each representative facility was analyzed for the maximum bay limit; and for 13.6 kg (30 lb) of HE plus the maximum bay limit. All limits are based on TNT equivalent, which equates to 1.3 x HE weight. Lesser charge weights were also analyzed to quantify primary fragment hazards for more typical operational scenarios. Explosives distribution, typical wall and roof elements, and bay characteristics were selected to establish a maximized debris throw to provide an envelope dispersion for the facility category.

TABLE 4.3.1-1.—*Generically Modeled Facilities and Equivalent Facilities for HE Analysis*

Generically Modeled Facility	Equivalent Facility
4-71	4-19, 4-21, 4-25 through 4-27, 4-29 through 4-69, 4-71 through 4-75, 4-101 through 4-142, 12-58
12-17 (Bay 16)	FS-16, 11-5, 11-16 through 11-18, 11-20, 11-22, 11-36, 11-38,, 11-51, 12-8, 12-17, 12-19, 12-21 (Bays 1 through 5, West/East exposure Bays, and Analytical Bay), 12-21A, 12-24, 12-26, 12-31, 12-32, 12-41, 12-43, 12-59, 12-86
12-21	11-45, 12-17A, 12-17B, 12-21 (Bays 6, 7, 9, 11 & 14), 12-94, 12-121, BG-3, FS-2, FS-4, FS-5, FS-10, FS-21, FS-22
12-44	11-50, 12-44 (Cells 1 through 6), 12-85, 12-96, 12-98, FS-23, FS-24
12-64	Station A in Zone 12, 12-50, 12-55, 12-60, 12-62, 12-64, 12-84, 12-99, 12-104
12-65	11-23, 11-25, 11-37, 11-42, 12-56, 12-63, 12-65, 12-73, 12-83, 12-92, FS-11A
Safe-Secure Trailer (SST)	SST Pads, Safe-Secure Railcar

Primary fragments consist of casing material and fixtures, used in the explosives fabrication and weapons assembly process, that are in direct contact with the explosive charge. Eighteen generic primary fragment sources for the buildings analyzed included the steel casing surrounding an explosive sphere, a cased sphere inside a steel cylinder, ring fixtures, a plate from a readable trailer, a vacuum chuck, an Army/Navy container, a 5.1 cm × 5.1 cm × 7.6 cm (2 in. × 2 in. × 3 in.) block, and 1,136- and 75.6- liter (300- and 20-gal) chemical HE blending kettles.

Secondary fragments consist of support fixtures, used in various operations involving explosives, that are not in direct contact with the explosive charge. Typical secondary fragment sources for the buildings analyzed included support stands composed of structural tubes, and angles, as well as steel guard rings and lifting equipment. Items with separation distances from the detonation The effects of blast pressures on humans are significant. Calculations of blast pressures in the "Chemical High Explosives Hazards Assessment" were conducted to determine the hazards to people near the facility at the time of detonation. The blast pressure calculations were examined for different facility configurations, including three-walled cubicles, four-walled cubicles, and magazines that are representative of the six facilities examined. Threshold limits for blast pressure effects on critical target organs are shown in Table 4.3.1-2.

The "Chemical High Explosives Hazards Assessment" calculations show that building debris would be the greatest physical hazard from an explosion in Building 4-71. The detonation of this facility, with an HE limit of 36,288 kg (80,000 lb) of HE, could be expected to produce a hazard to individuals that are within approximately 3,048 m (10,000 ft) of the building. Primary fragments may have the potential to disperse at distances greater than the building debris, but the number of fragments are few and do not represent a significant hazard. Although the maximum debris range was significant for primary and secondary fragments, the impact was substantially less than the 1.52 kg-meter (11 ft-lb) limitation. The potential effects from explosions in the other representative facilities are provided in Table 4.3.1-3.

4.3.2 Criticality

The "Radiological Hazards Assessment Recalculation" document discusses eight scenarios by which an accidental criticality might be achieved. Overall, none of the scenarios were judged to be credible. Influencing factors in this judgement include (1) fissile-unit design features, geometry, and strength against deformation; (2) container ruggedness and generous spacing; (3) redundant safety practices (intended for criticality safety, and others intended for radiation or high-explosive safety; and (4) the improbability required to disrupt vaults, cells, bays, or magazines. More recent analyses show that, due to the numerous layers of controls in place, an inadvertent nuclear criticality incident would be an extremely unlikely event under all normal and credible abnormal conditions. Because of these factors, criticality scenarios are not considered further in this document.

4.3.3 Aircraft Crash

Pantex Plant is located about 27 km (17 mi) northeast of Amarillo, Texas, approximately 13.6 km (8.4 mi) from the NE-SW runway at the Amarillo International Airport. There is a prohibited airspace, approximately square, about 7.1 km (4.4 mi) on a side, and extending to an altitude of 1,463 m (800 ft) mean sea level above the site. Sandia National Laboratories performed an assessment of the probability of aircraft impact into Pantex Plant structures in the mid-1970s[43]. That study used the best-estimate model of K. Solomon[44] and included a thorough characterization of the air traffic in the area: i.e., the classes of aircraft (e.g., commercial, military, general aviation), the nature of the operations, the number of operations per year, and other

TABLE 4.3.1-2.—*Blast Pressure Effects on Humans**

Pressure Over Ambient, kg/m² (psi)	Effects on Humans/Threshold Limits
< 598 (0.85)	Severe injury or death unlikely to occur
3,516 (5.0)	90 percent probability of eardrum rupture
5,625 (8.0)	Threshold for possible thoracic injury
21,093 (30.0)	Threshold for possible lung damage
70,310 (100.0)	Lethality

*Originally derived from "Structures to Resist the Effects of Accidental Explosion," TM 5-1300, NAVFAC P-397, AFM 88-22, Departments of the Army, Navy, and Air Force, U.S. Government Printing Office, Washington, DC, November 1990 and "Ammunition and Explosives Safety Standards," DOD 5154.45, U.S. Department of Defense, June 1980.

TABLE 4.3.1-3.—*Effects of Explosive Limit Detonation for Representative Buildings*

Generically Modeled Facility	Effect	Debris Range (ft)/Lung Damage Range (ft)
4-71	Debris scattering/lung damage	3,048 m/107 m (10,000 ft/350 ft)
12-17 (Bay 16)	Debris scattering	213 m/9 m (700 ft/30 ft)
12-21	Debris scattering/lung damage	305 m/17 m (1,000 ft/55 ft)
12-44	Debris scattering	610 m (2,000 ft)*
12-64	Debris scattering/lung damage	1,006 m/15 m (3,300 ft/50 ft)
12-65	Debris scattering/lung damage	732 m/37 m (2,400 ft/120 ft)
SST	Debris scattering/lung damage	1,372 m/21 m (4,500 ft/70 ft)

* Building 12-44 is designed to collapse in upon itself in the event of an internal detonation. The 610 m (2,000 ft) debris scatter results from small fragments that escape through the steel door before the building collapses.

information that could affect the probability of an aircraft crash onto the Pantex site. This information is over 20 years old and will be updated to meet the needs of SWEIS. The DOE, together with other agencies, is developing a standard methodology for aircraft crash analysis and collecting data on the frequency and type of flights in the vicinity of Pantex Plant that will be used to update aircraft crash analysis when this methodology becomes available. Recently, DOE issued a draft document that presents a standardized approach to accident analyses for aircraft crashes into hazardous facilities. The results of the updated aircraft crash analysis will be provided in the next revision of this document. Data acquisition began in early 1995.

4.3.4 Earthquake

The "Natural Phenomena Hazards Assessment"[45] describes three major subsurface faults and one minor surface fault that exist in the Pantex Plant area. The largest subsurface fault is about 250-km (150-mi) long and lies about 40 km (25 mi) north of the Plant. The next largest subsurface fault is about 70-km (43-mi) long and is 8 km (5 mi) south of the Plant. The other subsurface fault is about 64 km (40 mi) long and 11 km (7 mi) north of the Plant. The surface fault is about 6-km (4-mi) long, 32 km (20 mi) northwest of the Plant, and may be an extension of the 64-km (40-mi) long subsurface fault. The largest recorded earthquake in the area occurred in 1931 and was centered about 402 km (250 mi) from the Plant. The event measured III (in the Amarillo area) on the Modified Mercalli Intensity Scale (Table 4.3.4-1).

Seismic events have the potential to occur in any geographic area, and the potential for highly destructive seismic events for certain areas is known (e.g., California). However, it is difficult to predict the magnitude of a seismic event before it occurs. Therefore, in accordance with Sections 5 and 6 of the DOE Hazards Assessment Guidance, a "beyond credible" event such as a large scale seismic event is identified as possible at Pantex Plant.

Figures 4.3.4-1. and 4.3.4-2. illustrate the relationship between earthquake acceleration magnitude, energy spectrum, and frequency for the Plant site[10]. Upper and lower uncertainty bounds are included in these hazard curves. Design basis earthquakes have been established for the various buildings at Pantex Plant using the concept of facility use categories. For comparison, a maximum credible earthquake for the Pantex Plant site has a lateral ground acceleration of ~ 333 cm/sec^2(0.33 g_0)[46]. Table 4.3.4-2. describes the performance categories and the corresponding nominal design basis earthquakes that each type of structure at Pantex Plant is required to withstand. The annual probability of exceedance in Table 4.3.4-2. refers to ground acceleration at the Plant from all possible design basis earthquakes, including those with epicenters far beyond the Amarillo area. The annual probability of exceedance for the maximum credible earthquake is lower than 1.0×10^{-5}.

The "Natural Phenomena Hazards Assessment" identified two event conditions used in modeling seismic events: an event producing ground accelerations of up to ~ 100 cm/sec^2 (0.10 g_0) and an event producing ground accelerations of up to ~ 333 cm/sec^2(0.33 g_0).

The "Natural Phenomena Hazards Assessment" considered seismic events as initiating events and assumed that releases would occur due to structural failure and the resulting damage (such as fire or explosions). Even without structural failure, seismic event conditions may also cause the release of hazardous materials by damaging containers. Since a seismic event is not related to meteorological phenomena, unfavorable dispersal conditions of wind speeds of 4.25 m/sec (9.5 mph) and Pasquill Stability Class E were used to represent worse case dispersion conditions. Median wind speeds of 6.75 m/sec (15 mph) were also considered. Hazard identification and

TABLE 4.3.4-1.—*Approximate Relationship Among Seismic Event Intensity, Acceleration, and Magnitude*

Modified Mercalli Intensity Scale	Description of Effects*	Maximum Acceleration (gravity)	Richter Magnitude
I	Not felt; marginal and long-period effects of large earthquakes evident.	< 0.003	M2
II	Felt by persons at rest, on upper floors, or favorably placed.	< 0.003	M3
III	Felt indoors; hanging objects swing; vibration similar to the passing of light trucks occurs; duration is estimated; might not be recognized as earthquake.	0.003 to 0.007	
IV	Hanging objects swing; vibration occurs similar to the passing of heavy trucks, or there is a sensation of a jolt like a heavy ball striking the walls; standing autos rock; windows, dishes, and doors rattle; in the upper range of IV, wooden frames creak.	0.007 to 0.0015	M4
V	Felt outdoors; duration is estimated; sleepers waken; liquids become disturbed and some spill; small unstable objects are displaced or upset; doors swing closed and open; shutters and pictures move; pendulum clocks stop, start, and change rate.	0.0015 to 0.03	
VI	Felt by all; many are frightened and run outdoors; persons walk unsteadily; windows, dishes, glassware breaks; things fall off shelves; pictures fall from walls; furniture moves or overturns; weak plaster and masonry D crack; small bells ring (church, school); trees/bushes shake.	0.03 to 0.09	M5
VII	Difficult to stand; noticed by auto drivers; hanging objects quiver; furniture breaks; cracks and other damage occurs to masonry D; weak chimneys break at roof line; plaster, loose bricks, stones, tiles, cornices fall; some cracks appear in masonry C; waves appear on ponds, water turbid with mud; small slides and cave-ins occur along sand and gravel banks; large hanging bells ring.	0.09 to 0.22	M6
VIII	Steering of autos affected; damage to masonry C, with partial collapse; some damage occurs to masonry B, but none to masonry A; stucco and some masonry walls fall; twisting and fall of chimneys, factory stacks, monuments, towers, and elevated tanks occur; frame houses move on foundations if not bolted down; loose panel walls are thrown out; changes occur in flow or temperature of springs and wells; cracks appear in wet ground and on steep slopes.	0.15 to 0.3	M6

TABLE 4.3.4-1.—*Approximate Relationship Among Seismic Event Intensity, Acceleration, and Magnitude (Cont.)*

Modified Mercalli Intensity Scale	Description of Effects*	Maximum Acceleration (gravity)	Richter Magnitude
IX	General panic; masonry D destroyed; masonry C is heavily damaged, sometimes with complete collapse; general damage occurs to foundations; frame structures shift off foundations, if not bolted; frames crack; serious damage occurs to reservoirs; underground pipes break; conspicuous cracks appear in ground; sand and mud ejected in alleviated areas; earthquake fountains and sand craters occur.	0.3 to 0.7	M7
X	Most masonry and frame structures are destroyed, with their foundations; some well-built wooden structures and bridges are destroyed; serious damage occurs to dams, dikes, and embankments; large landslides occur; water is thrown on banks of canals, rivers, lakes, pools, etc.; sand and mud shift horizontally on beaches and flat land; rails are bent slightly.	0.45 to 1.5	
XI	Rails are bent greatly; underground pipelines are completely out of service.	0.5 to 3.0	M8
XII	Damage nearly total; large rock masses are displaced; lines of sight and level are distorted; objects are thrown into the air.	0.5 to 7	M9

*Masonry A: Reinforced, especially laterally, and bound together by using steel, concrete, etc. Designed to resist lateral forces.
Masonry B: Not designed to resist lateral forces.
Masonry C: Ordinary work.
Masonry D: Weak materials, etc.

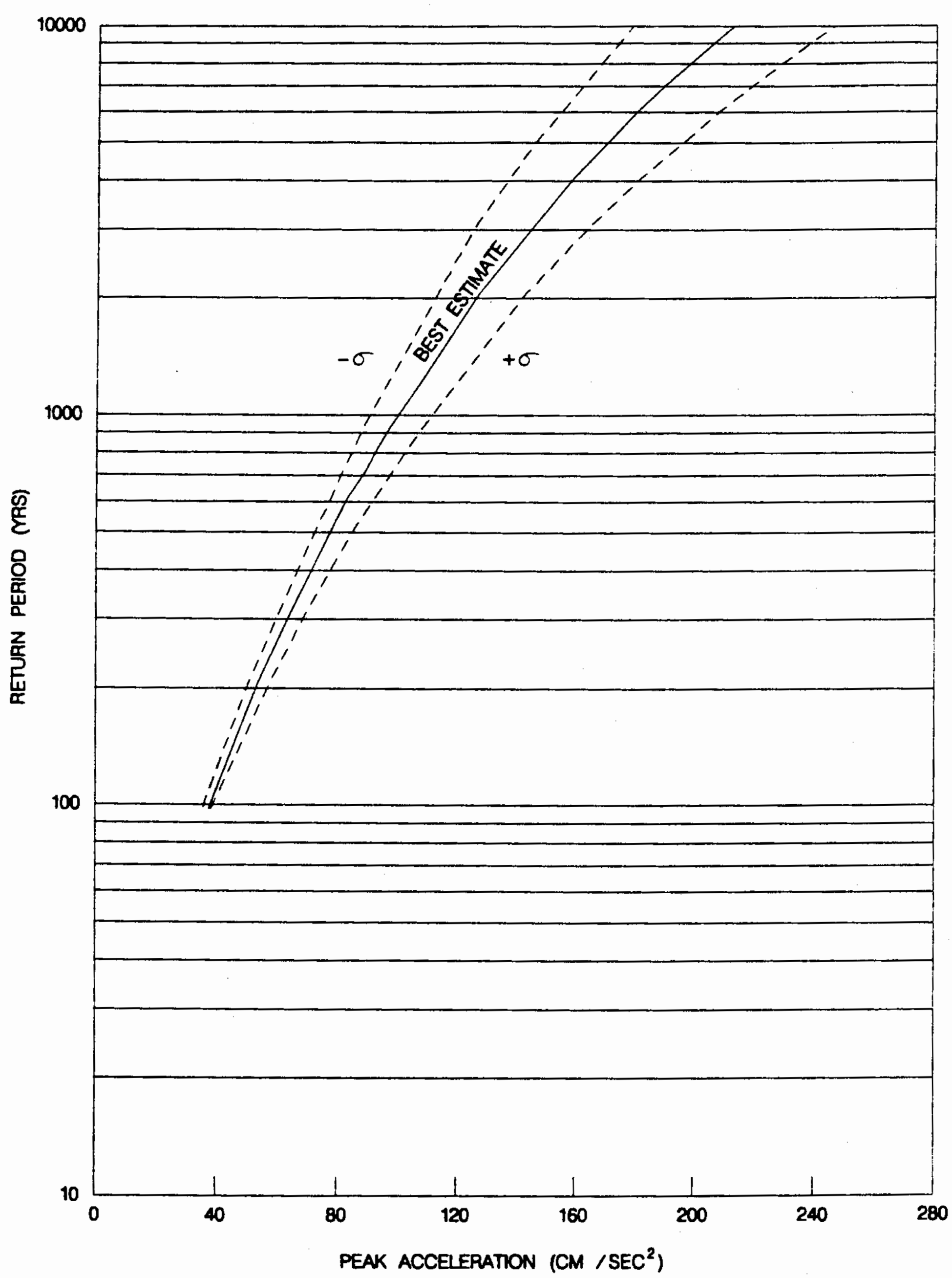

FIGURE 4.3.4-1.—*Earthquake Hazard at Pantex Plant.*

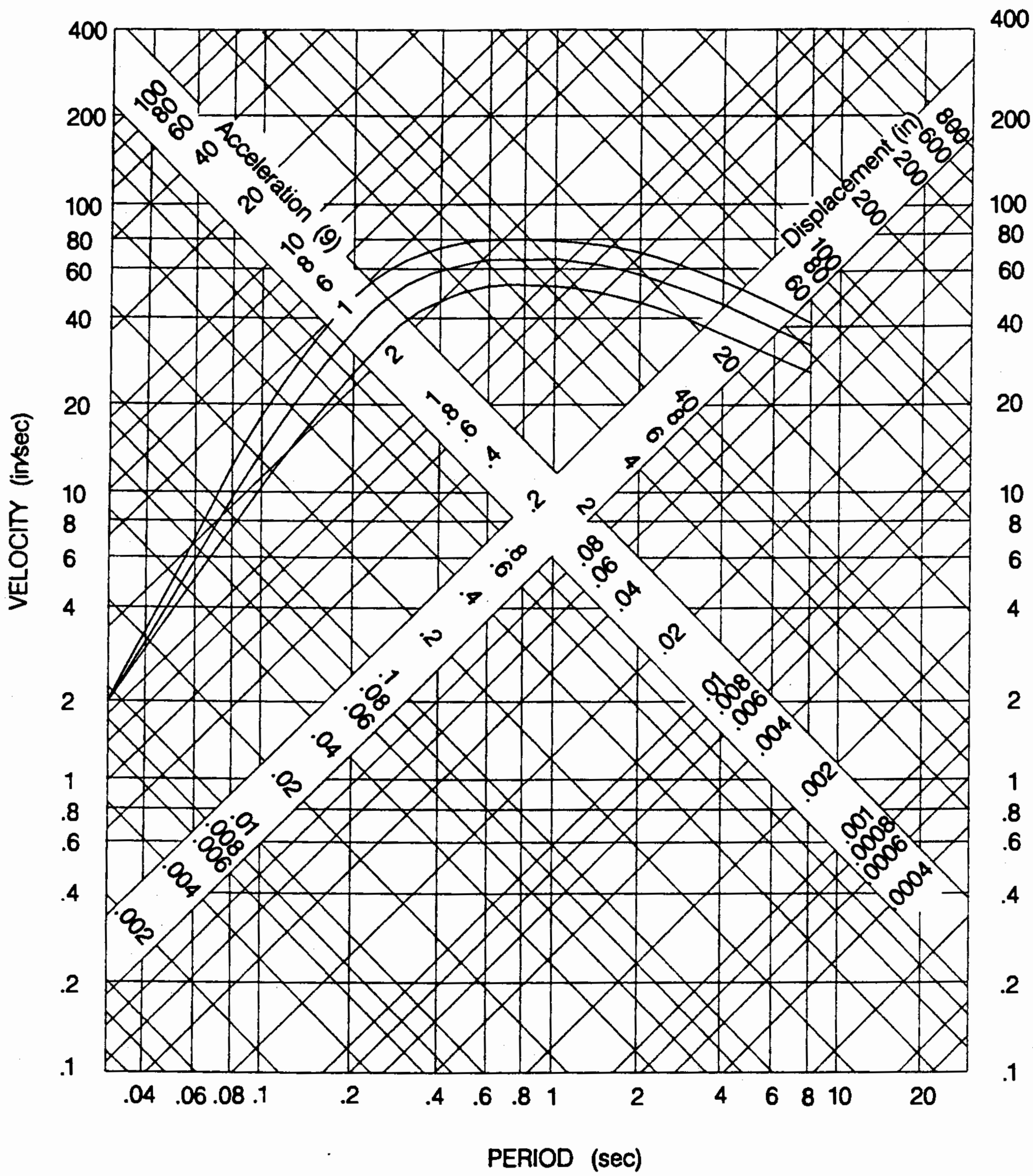

FIGURE 4.3.4-2.—*Design Response Spectrum, Pantex Plant.*

TABLE 4.3.4-2.—*Facility Use Categories and Design Basis Earthquakes*

	Description	Design Basis Earthquake Magnitude (Peak Acceleration)	Annual Probability of Exceedance
PC-1	No mission-dependent purposes (i.e., administrative buildings, cafeterias, storage, and plant- or ground-oriented maintenance and repair facilities).	($0.08\ g_0$) ~80 cm/sec^2	2×10^{-3}
PC-2	Mission-dependent purposes (i.e., laboratories, production facilities, computer centers, and emergency handling or hazard recovery facilities).	($0.10\ g_0$) ~100 cm/sec^2	1×10^{-3}
PC-3	Confinement of the contents is necessary for public or employee protection (i.e., uranium enrichment plants and facilities that handle or store significant quantities of radioactive or toxic materials).	($0.13\ g_0$) ~130 cm/sec^2	1×10^{-3}
PC-4	Confinement of the contents and the protection of the public and the environment are of paramount importance (i.e., facilities handling substantial quantities of in-process plutonium or fuel reprocessing facilities). Represent hazards with potential long-term and widespread effects.	($0.17\ g_0$) ~170 cm/sec^2	2×10^{-4}

dispersal analyses were conducted similar to those described in Section 4.2.

Structural modeling for various conditions was performed to demonstrate survivability of selected structures during a seismic event. The Pantex Plant SARs also provide detailed structural analyses of both design basis earthquakes (~100 cm/sec² or 0.13 g_0) and maximum credible earthquakes (~333 cm/sec² or 0.33 g_0).

Four buildings were analyzed for the ~100 cm/sec² (0.10 g_0) seismic event in the "Natural Phenomena Hazards Assessment." The buildings were selected to represent four of five categories of structures at Pantex Plant. A fifth building construction type (simple frame construction with metal siding, stucco, or brick covering) wasconsidered and discounted because it would be completely destroyed during any natural phenomena event. Table 4.3.4-3. provides category, representative facility, and results of a ~100 cm/sec² (0.10 g_0) seismic event model.

Results of analyses for the ~333 cm/sec² (0.33 g_0) seismic event showed similar results to a ~100 cm/sec² (0.10 g_0) seismic event.

Analysis was conducted for earthquake-initiated chlorine releases with instantaneous, 3-min, 5-hr, and 12-hr release times. With an instantaneous release of 816 kg (1,800 lb) from Building 13-47, the ERPG-2 concentration (9 mg/m³ or 1.0 x 10^{-6} oz/ft³) would be exceeded to a distance of 7.35 mi. The calculation assumes meteorological conditions of Pasquill Stability Class E and 4.25 m/sec (9.5 mph) wind speed. Chlorine gas has been reduced below the threshold values as shown in Appendix B. Therefore, the analysis conducted in the "Hazardous Materials Hazards Assessment Recalculation" document is more conservative than anticipated in the existing conditions.

Analyses of the longer release times (3-min, 5-hr, and 12-hr), showed that concentration levels aresignificantly reduced with increased release times. A release caused by a puncture or fracture of a chlorine cylinder in Building 13-47 with a release time of 3-min would result in 25 mg/m (2.5 x 10^{-5} oz/ft³) at the site boundary, greater than the ERPG-2 concentration. An identical release of chlorine from Building 15-29 with a release time of 3-min would result in 16 mg/m³ (1.6 x 10^{-5} oz/ft³) at the site boundary, also greater than the ERPG-2 concentration. All other chlorine release scenarios resulted in releases that would not exceed the ERPG-2 at the site boundary.

Modeling for release of nitric acid used a worse case scenario of all 91 kg (200 lb) stored in Building 11-17 spilling in the 18.6 m² (200 ft²) area at a temperature of 38°C (100°F) following a seismic event. The resulting site boundary concentration would be 0.51 mg/m³ (5.1 x 10^{-7} oz/ft³), which is well below the ERPG-2 concentration of 39 mg/m³ (3.9 x 10^{-5} oz/ft³). Modeling for release of phosphoric acid used a worse case scenario of all 30 kg (66 lb) stored in Building 12-68 spilling in the 18.6 m² (200 ft²) area at a temperature of 38°C (100°F) following a seismic event. The resulting site boundary concentration would be 0.01 mg/m³ (1.0 x 10^{-8} oz/ft³), which is well below the TLV-TWA concentration of 1.0 mg/m³ (1.0 x 10^{-6} oz/ft³).

Modeling for release of sulfuric acid used a worse case scenario of all 1,134 kg (2,500 lb) stored in Building 11-17 spilling in the 18.6 m² (200 ft²) area at a temperature of 38°C (100°F) following a seismic event. The resulting site boundary concentration would be 4.3 × 10^{-8} mg/m³ (4.3 x 10^{-6} oz/ft³), which is well below the ERPG-2 concentration of 10.0 mg/m³ (1.0 x 10^{-5} oz/ft³). Earthquake-initiated releases of TDI, Pu-239, Pu-238, Tritium, and Co-60 were not modeled in the Natural Phenomena Hazards Assessment." Uranium releases were modeled, but only for an earthquake-initiated fire event, which is discussed in Section 4.3.6.

TABLE 4.3.4-3.—*Typical Building Categories, Representative Facility, and Results of a 0.10 g_0 Seismic Event*

Building Category	Representative Facility	Results
Older buildings (simple 1940s construction)	Building 11-14	The tile walls, the interior 30.5 cm (12-in) thick concrete walls, and parapets could fail; and the roof with support pillars would be expected to remain intact.
HE storage magazines	Building 4-71	The "garage-type" doors could fail, and the wooden truss roof would remain intact. The walls of the structure supported by earthen backfill also would not be affected.
Assembly/ disassembly buildings with bays	Building 12-64	No effect
Assembly/ disassembly buildings with cells	Building 12-44	No effect
Simple frame construction	Not analyzed	Assumed to be completely destroyed

4.3.5 Tornado

The National Severe Storms Forecast Center (NSSFC), operated by the National Weather Service in Kansas City, Missouri, maintains a data "base of the tornados that have been reported in the United States since 1950. It shows that 786 tornadoes were recorded in the top 26 counties of the Texas Panhandle between 1950 and 1993. The top 26 counties in the Texas Panhandle contain about 2,300 km^2 (900 mi^2). In 1995 alone, sixty-five tornados were recorded in the Texas Panhandle[47]. This is more than in any other year, and made 1995 a record year for tornados in the Texas Panhandle. Tornados are classified by use of the Fujita-scale (F-scale) which typically estimates wind speed indirectly based on the resultant damage at the high end (F4 and F5) of the scale. The low frequency of occurrence and the small area of the Pantex Plant in relation to the entire Panhandle result in a low (1×10^{-6}) probability of occurrence of an F5 event. Table 4.3.5-1. provides the Fujita F-scale classification of tornados based on damage[13]. Section 6.4 provides historical information on tornado and high wind events at Pantex Plant. More specific information about tornados in Carson County and the eight counties surrounding Carson County can be found in Chapter 6.0 of the Environmental Information Document.

Damage from tornados is generally caused by high winds and tornado-borne missiles. The two standard missiles used for analysis of potential effects on moderate hazard facilities are a 6.8 kg (15 lb), 5.1 cm × 10.2 cm (2 in. × 4 in.) plank and a 34 kg (75 lb), 7.6-cm (3-in.) diameter steel pipe as defined in DOE-STD-1020-94. The damage caused by these wind-borne missiles could potentially initiate release of unprotected hazardous or radiological materials. As a general rule, the winds that precede and follow a tornado will be blowing at about 32 km/hr to 48 km/hr (20 to containing chemical HE and/or hazardous construction types shows that heavily reinforced structures are not vulnerable to damage from a large-scale tornado. However, several structures materials are vulnerable to tornado events and release of material is possible.

The entire Panhandle is located in a relatively high tornado frequency area. Figure 4.3.5-1. describes the relationship between tornado frequencies and straight wind magnitudes at Pantex Plant. The hinged point of the curve is called the transition wind speed. For winds less severe than the transition wind speed (about 185 km/hr or 115 mph), straight winds are the dominant hazard. Conversely, for wind speeds above 185 km/hr (115 mph), tornados present the more significant threat. Design basis winds have been established for various buildings at Pantex Plant depending on the type of operations performed. For instance, facilities that handle large quantities of radioactive material are required to be capable of withstanding much more severe design basis winds than facilities that handle nonhazardous material. Four facility use categories have been developed by the DOE to focus the analysis of design basis accidents[13]. The use of UCRL-15910, "Design and Evaluation Guidelines for Department of Energy Facilities Subject to Natural Phenomena Hazards," in defining natural phenomena design basis accidents is required by DOE Order 6430.1A "General Design Criteria"[48]. Table 4.3.5-2. presents the performance categories and the corresponding design basis winds that each type of structure is nominally required to withstand.

The "Natural Phenomena Hazards Assessment" considered tornados as an initiating event with releases occurring after the tornado passed, using a wind speed of 40 km/hr (25 mph) and Pasquill Stability Class D to represent worse case dispersion conditions. Hazard identification and dispersal analyses were conducted similar to those described in Section 4.2 with the exception of the more severe meteorological conditions.

TABLE 4.3.5-1.—*Fujita F-Scale Classification of Tornados Based on Damage*

Scale	Damage	Wind Speed km/hr (mph)	Description of Tornado
F0	Light	64-116 (40-72)	Some damage to chimneys, TV antennae, sign boards; tree branches broken; shallow-rooted trees pushed over; old, hollow trees break or fall.
F1	Moderate	117-180 (73-112)	The beginning of hurricane wind speed is 117 km/hr (73 mph). Surfaces peeled off roofs; windows broken; trailer houses moved or overturned; trees on soft ground uprooted; some trees snapped; moving autos pushed off roads.
F2	Considerable	181-253 (113-157)	Roofs torn off frame houses, leaving strong upright walls; weak structured outbuildings and trailer houses demolished; railroad boxcars pushed over; large trees snapped or uprooted; light-object missiles generated; cars blown off highways; block structures damaged badly.
F3	Severe	254-331 (158-206)	Roofs and some walls torn off well-constructed frame houses; some rural buildings demolished completely; trains overturned; steel-framed warehouse structures torn; cars lifted off ground are rolled some distance; most trees uprooted, snapped, or leveled; block structures often leveled.
F4	Devastating	332-418 (207-260)	Well-constructed frame houses leveled, leaving debris; structures with weak foundations lifted, torn, and blown some distance; trees debarked by small flying objects; sandy soil eroded and gravel flies; cars thrown or rolled some distance, finally disintegrating; large missiles generated.
F5	Incredible	419-512 (261-318)	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; steel-reinforced concrete badly damaged; auto-sized missiles fly distances of 91 m (100 yds) or more; trees debarked completely; incredible phenomena can occur.

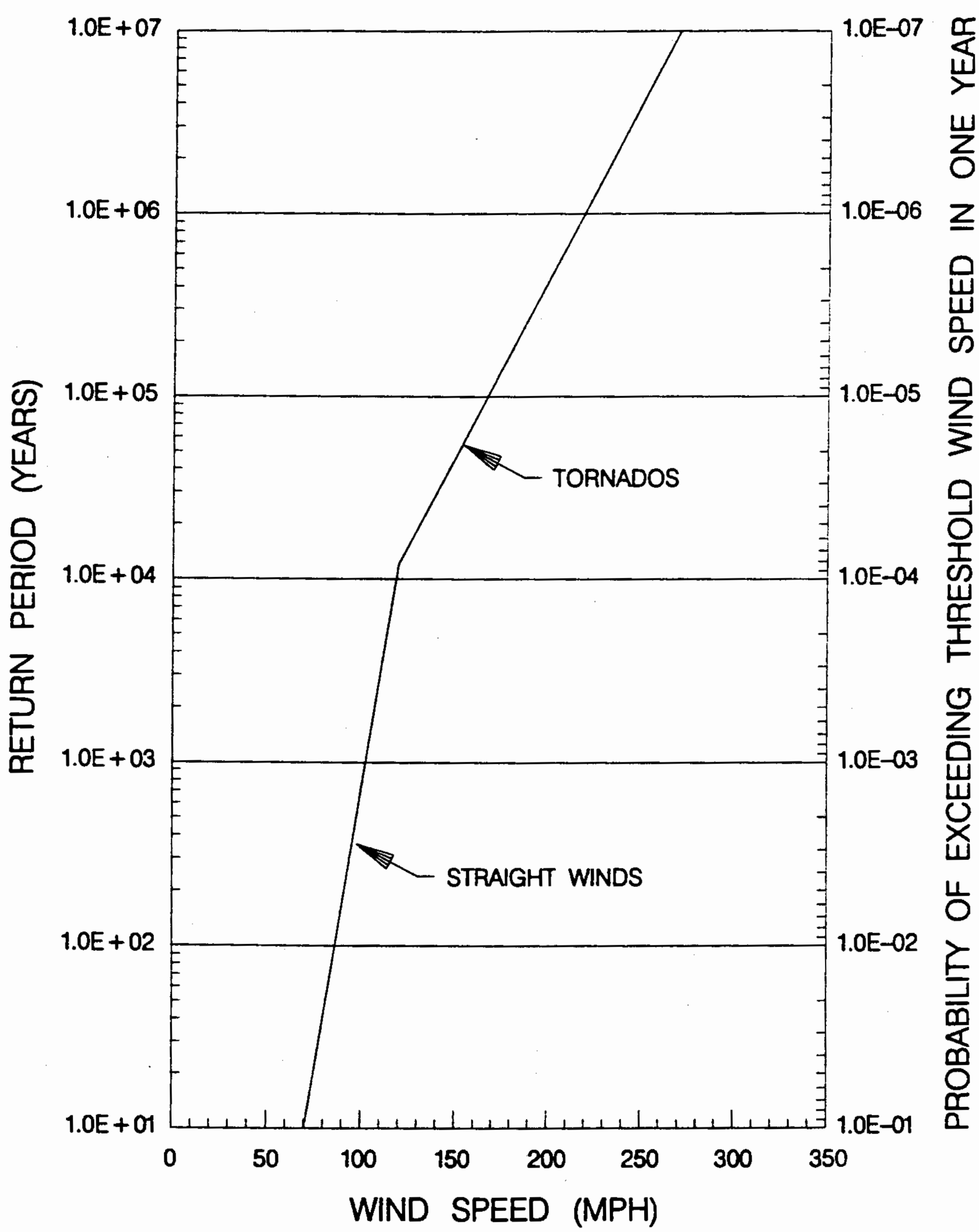

FIGURE 4.3.5-1.—*Wind Hazard at Pantex Plant.*

TABLE 4.3.5-2.—*Facility Use Categories and Design Basis Winds*

Performance Category	Description	Design Basis Wind Speed	Annual Exceedance Probability
PC-1	No mission-dependent purposes (i.e., administrative buildings, cafeterias, storage, and plant- or grounds-oriented maintenance and repair facilities).	126 km/hr (78 mph) straight winds	2×10^{-2}
PC-2	Mission-dependent purposes (i.e., laboratories, production facilities, computer centers, and emergency handling or hazard recovery facilities).	126 km/hr (78 mph) straight winds	2×10^{-2}
PC-3	Confinement of the contents is necessary for public or employee protection (i.e., uranium enrichment plants and facilities that handle or store significant quantities of radioactive or toxic materials).	212 km/hr (132 mph) tornado winds	2×10^{-5} (Tornado) 1×10^{-3} (Wind)
PC-4	Confinement of the contents and the protection of the public and the environment are of paramount importance (i.e., facilities handling substantial quantities of in-process plutonium or fuel reprocessing facilities). Represent hazards with potential long-term and widespread effects.	293 km/hr (182 mph) tornado winds	2×10^{-6} (Tornado) 1×10^{-4} (Wind)

Structural modeling for various conditions was performed to demonstrate survivability of a selected structure during a tornado event. Two wind conditions were selected for modeling structural effects: (1) the lower wind speed of a 241 km/hr (150 mph) tornado (212 km/hr or 132 mph fastest wind speed), assumed to be an F3 event; and (2) the upper wind speed of 418 km/hr (260 mph) tornado (388 km/hr or 241 mph fastest wind speed), assumed to be the upper limit of an F4 event. Results of analysis for the 418 km/hr (260 mph) tornado are similar to those for a 241 km/hr (150 mph) tornado event.

Table 4.3.5-3. provides categories, representative facilities, and results of a 241 km/hr (150 mph) tornado model. The facilities modeled for tornado-generated missiles in the "Natural Phenomena Hazards Analysis" are the same used in the seismic analysis described in Section 4.3.4. Buildings 11-14 and Building 4-71 are not constructed to resist tornado-generated missiles. These building types could be penetrated by the missiles, and the contents of the building could be damaged as the missiles travel through the building. Buildings similar to Building 12-64 and 12-44 are expected to resist penetration by tornado-generated missiles.

A Pu-239 release scenario initiated by a tornado or seismic event was analyzed in the "Natural Phenomena Hazards Assessment." Only a worse-case event would initiate a release of Pu-239. This event would need to cause an explosion or fire in the facility. Explosion release scenarios are discussed in Section 4.2.1.1 and fire release scenarios are presented in Section 4.3.6.

Limited quantities of chlorine are located at two locations within the Plant: the water treatment facility (Building 15-29) and the sewage treatment plant (Building 13-47). A bottle rack is anchored inside each facility and may hold up to six cylinders of chlorine. The range of releases includes a more probable event in which the valve stem or system piping is damaged or misaligned and the chlorine gradually leaks from a single cylinder (68 kg or 150 lb), and a less probable event in which a tornado fractures or punctures multiple cylinders, resulting in a release of up to 816 kg (1,800 lb) from Buildings 15-29 or 13-47. Chlorine gas has been reduced below the threshold values as shown in Appendix B. Therefore, the analysis conducted in the "Hazardous Materials Hazards Assessment Recalculation" document is more conservative than anticipated in the existing conditions.

Analysis was conducted for instantaneous, 3-min, 5-hr, and 12-hr tornado-initiated chlorine releases. With an instantaneous release of 816 kg (1,800 lb) from Building 13-47, the ERPG-2 concentration (9 mg/m^3 or 9.0×10^{-6} oz/ft^3) would be exceeded out to a distance of 12.63 km (7.85 mi). The calculation assumes meteorological conditions of D stability and 11.2 m/s (25 mph) wind speed.

Modeling for release of nitric acid used a worse-case scenario of all 91 kg (200 lb) stored in Building 11-17 spilling in the 18.6 m^2 (200 ft^2) area at a temperature of 38°C (100 °F) during a tornado event. The resulting site boundary concentration would be 0.20 mg/m^3 (2.0×10^{-7} oz/ft^3), which is well below the ERPG-2 concentration of 39 mg/m^3 (3.9×10^{-5} oz/ft^3).

Modeling for release of phosphoric acid used a worse-case scenario of all 66 lb stored in Building 12-68 spilling in the 18.6 m (200 ft^2) area at a temperature of 38°C (100°F) during a tornado event. The resulting site boundary concentration would be 0.003 mg/m^3 (3.0×10^{-9} oz/ft^3), which is well below the TLV-TWA concentration of 1.0 mg/m^3 (1.0×10^{-6} oz/ft^3).

Tornado-initiated releases of sulfuric acid, TATB, TDI, Pu-239, Pu-238, tritium, and Co-60 were not modeled in the "Natural Phenomena Hazards Assessment." Uranium releases were modeled, but only for a tornado-initiated fire event, which is discussed in Section 4.3.6.

TABLE 4.3.5-3.—*Typical Building Categories, Representative Facility, and Results of a 150-mph Tornado*

Building Category	Representative Facility	Results
Older buildings (simple 1940s construction)	Building 11-14	The tile walls, the exterior tile walls, and the roof would be expected to fail completely. The interior 30.5 cm-thick (12-in.-thick) concrete walls and parapets would be expected to survive with some spalling and cracking.
HE storage magazines	Building 4-71	Both the "garage-type" doors and wooden truss roof could fail.
Assembly/disassembly buildings with bays	Building 12-64	The only portions that could sustain damage are the bay exterior blast doors and the exterior air handling units.
Assembly/disassembly buildings with cells	Building 12-44	The 5.8 m (19 ft) of gravel on the round room could be disturbed if the Gunite (or functional equivalent) covering was removed and the gravel needed to be replaced. Building integrity would remain unchanged.
Simple frame construction	Not applicable	Assumed to be destroyed

4.3.6 Fire

External fires at Pantex Plant may have several initiators (e.g., lightning strikes, earthquakes, tornados, etc.); however, most facilities and external transport routes are paved, with little combustible material available for spreading to other facilities. Pantex Plant facilities are located in an area with little significant wildfire hazard based on the calculated Wildland/Urban Interface Hazard Rating[49]. Internal fires may be caused in numerous ways, including operational accidents or natural phenomena.

The accident analyses conducted for fire-initiated releases are the same as described in the various hazards assessments. Operational accident-initiated fires were analyzed separately from natural phenomena-initiated fires because natural phenomena has the potential to negatively affect other mitigating support systems such as sprinklers, fire alarms, transportation routes etc.

Fire release was identified in the "Chemical High Explosives Hazards Assessment" as a possible release scenario for chemical HE, especially if the chemical HE is in direct contact with heat or flame. This release could range from none to 9 percent of the facility limit in particulate form. A fire limited to the interior of the facility by the fire suppression system or human fire fighters would only cause internal releases in the room of the fire.

4.3.6.1 *Operational Accident-Initiated Fire Releases*

Fires Involving Radiological Materials. The metal plutonium pits are designed to maintain their integrity at least to 410°C (770°F) indefinitely or to higher temperatures for short periods of time. Plutonium metal melts at 640°C (1,184°F). The facilities that contain radiological materials typically have limited ignition sources.

A bounding scenario for plutonium dispersal caused by fire releases is presented in the "Radiological Hazards Assessment Recalculation" document. This scenario is calculated assuming the material in one or two pits is dispersed by fire with no containment. Plutonium dispersal with no containment caused by fire would be extremely unlikely with catastrophic consequences. The CEDEs in the immediate area were calculated to exceed 0.06 rem and 0.13 rem, respectively, with maximum doses of 0.2 rem and 0.4 rem at 0.55 km (0.34 mi), and the corresponding one-rem PAG dose not exceeded outside of the facility. The facilities that would have plutonium pits outside of their containers would not likely be breached due to a fire not associated with an explosion. If the HVAC system failed to shutdown in a fire, the HEPA filtration system would substantially reduce the amount of material released, and the dose would not exceed the one-rem PAG. The operational accident analysis also included consideration of fires. While the occurrence of a fire in the cells was found to be extremely unlikely, a fire leading to plutonium dispersal outside the cell of occurrence was found to be incredible. Based upon the scenario presented in the "Radiological Hazards Assessment Recalculation," a fire scenario could provide a 0.063 rem dose at 100 m (328 ft) and 0.15 rem at the site boundary from 6.5 kg (14.3 lb) of Pu-239, and a 0.13 rem dose up to 100 m (328 ft) and a 0.30 rem dose at 100 m (328 ft) to the site boundary from 13 kg of Pu-239. In this scenario, the Pu-239 is released in a heat plume, which settles to the receptor height upon cooling.

Tests of triple encapsulation of the RTGs have demonstrated that the integrity of the units is maintained to high temperatures, so RTG resistance to fire is extremely good. Hypothetically, an extreme event (e.g., fire) could violate the RTG encapsulation and lead to melting of the plutonium oxide with a limited amount of material converted to aerosol in the respirable range. The results from the FMEA for a Pu-238 release caused by melting are shown to be incredible with marginal consequences.

Calculations using HOTSPOT analysis for a scenario in which a fire causes a release of plutonium from one RTG concluded that the CEDE in the immediate area would exceed 37 rem, with the corresponding one-rem PAG dose exceeded as far away as 0.57 km (0.37 mi).

A tritium release may occur at temperatures at or above 200°C (392°F) due to increased internal pressure or reservoir material failure. A fire could cause reservoir failure, with a release containing a high content of tritium oxide because of the combustion of the tritium. This scenario is considered extremely unlikely with negligible consequences.

The release of uranium in a fire or an explosion with a subsequent fire was calculated in the "Radiological Hazards Assessment Recalculation." The CEDE in the immediate area would exceed 40 rem, with the corresponding one-rem PAG dose exceeded as far as 0.70 km (0.43 mi). The arrival time at the Plant site boundary would be 4.8 min. This scenario is considered to be incredible with marginal consequences.

Release of Co-60 would require a fire of such intensity that the lead container would be breached and the steel rod melted. Only an extreme event such as an aircraft crash with an ensuing fuel fire is likely to cause such a release.

Fires Involving Hazardous Materials. Overpressurization of a chlorine cylinder is considered extremely unlikely due to the construction and relative resistance to fire of the structure in question. However, sabotage could result in such a scenario, which would then resemble an explosive release of gas. This scenario and consequences are analyzed in Section 4.2.2.1.

Release of phosphoric acid from a 208-liter (55-gal) drum due to fire would have exceeded the TLV-TWA threshold out to 10 km (6.2 mi), with a site boundary concentration of 340 mg/m^3 (3.4 x 10^{-4} oz/ft^3) and a facility boundary of 74,000 mg/m^3 (7.4 x 10^{-2} oz/ft^3). Release from a 416-liter (110-gal) drum due to fire would have exceeded the TLV-TWA threshold out to 13 km (8.1 mi), with a site boundary concentration of 670 mg/m^3 (6.7 x 10^{-4} oz/ft^3) and a facility boundary concentration of 150,000 mg/m^3 (1.5 x 10^{-1} oz/ft^3). Releases from a fire were assumed in the assessment to be the same as from an explosion.

Fires or explosions may present rapid releases of sulfuric acid. The high ambient temperatures in a fire scenario, however, would result in near instantaneous evaporation of the material. Analyses for fire releases were conducted using 3.8 liter (1 gal), 18.9 liter (5 gal), and 132.5 liter (35 gal) of sulfuric acid and the assumption that the acid would not decompose during the fire. Three and eight-tenths liters (1 gal) of sulfuric acid could produce concentrations of 26,000 mg/m^3 (2.6 x 10^{-2} oz/ft^3) in the immediate area during a fire. The ERPG-2 concentration could be exceeded to a distance of 2.3 km (1.4 mi), with a site boundary concentration of 10 mg/m^3 (1.0 x 10^{-5} oz/ft^3). A fire involving 18.9 liters (5 gal) of sulfuric acid could produce concentrations of 130,000 mg/m^3 (1.3 x 10^{-1} oz/ft^3) in the immediate area and concentrations of 50 mg/m^3 (5.0 x 10^{-5} oz/ft^3) at the site boundary, which would exceed the ERPG-2 concentration at a distance of up to 4.8 km (3 mi). A fire involving 132.5 liters (35 gal) of sulfuric acid could produce concentrations of greater than 500,000 mg/m^3 (5.0 x 10^{-1} oz/ft^3) in the immediate area, could produce concentrations of 350 mg/m^3 (3.5 x 10^{-4} oz/ft^3) at the site boundary, and would exceed the ERPG-2 concentration at a distance of up to 11 km (6.8 mi).

Fire involving one gal of nitric acid would result in concentrations of 8,200 ppm in the immediate area of the facility, a site boundary concentration of 37 ppm, and an ERPG-2 (15 ppm) concentration exceeded up to 1.4 km (0.9 mi). A similar fire involving 37.9 liters (10 gal) of nitric acid would result in concentrations of 82,000 ppm in the immediate area, and the ERPG-2 concentration could be exceeded at a distance up to 3.5 km (2.2 mi).

Rapid release of TDI into the atmosphere could be caused by a fire or explosion resulting from an accident or sabotage. Analysis of a fire involving one gal of TDI concluded that a concentration level in the immediate area would reach 2,400 ppm and levels of 0.4 ppm at the site boundary. The TLV-TWA would be exceeded to a distance of 14 km (8.7 mi).

The "Hazardous Materials Hazards Assessment" conservatively modeled accident releases subject to fire conditions. Conservative consequence calculations used an effective release height of 2 m (6.6 ft) because it produced the highest concentrations at the site boundary. Meteorological conditions and internal fire calculations were not conducted due to the numerous conditions and dynamics involved. Fires were modeled for outside releases directly to the outside of a facility with an instantaneous release time. Fire releases for uranium were calculated using two scenarios, one for facilities with HEPA filters and the other for facilities without HEPA filters.

Fire involving 2,150 kg (4,741 lb) of uranium in a facility with operational HEPA filters would result in concentrations of 39 ppm in the immediate area of the facility, a site boundary concentration of 0.018 mg/m^3 (1.8 x 10^{-8} oz/ft^3), and an ERPG-2 (0.2 mg/m^3 or 2.0 x 10^{-7} oz/ft^3) concentration exceeded up to 0.81 km (0.5 mi). Fire involving 2,150 kg (4,741 lb) of uranium in a facility without operational HEPA filters would result in concentrations of 3,900 ppm in the immediate area of the facility, a site boundary concentration of 1.8 mg/m^3 (1.8 x 10^{-6} oz/ft^3), and an ERPG-2 (0.2 mg/m^3 or 2.0 x 10 $^{-7}$oz/ft^3) concentration exceeded up to 5 km (3.1 mi).

Fire involving 4,300 kg (9,482 lb) of uranium in a facility with operational HEPA filters would result in concentrations of 78 ppm in the immediate area of the facility, a site boundary concentration of 0.03 mg/m^3 (3.0 x 10^{-8} oz/ft^3), and an ERPG-2 (0.2 mg/m^3 or 2.0 x 10^{-7} oz/ft^3) concentration exceeded up to 1.05 km (0.7 mi). Fire involving 4,300 kg (9,482 lb) of uranium in a facility without operational HEPA filters would result in concentrations of 7,800 ppm in the immediate area of the facility, a site boundary concentration of 3.6 mg/m^3 (3.6 x 10^{-6} oz/ft^3), and an ERPG-2 (0.2 mg/m^3 or 2.0 x 10^{-7} oz/ft^3) concentration exceeded up to 7 km (4.4 mi).

Fires Involving Chemical HE. Fire releases for RDX or HMX were not analyzed in the "Chemical High Explosives Hazards Assessment" because the more conservative modeling of the TNT releases were sufficient to represent fire releases of RDX or HMX. However, TATB was modeled for a fire release scenario.

One fire scenario was modeled for TATB, representing a fire in Building 12-65, which has a facility limit of 1,762 kg (3,885 lb). The results of this analysis show a release of 79.4 kg (175 lb) of respirable TATB at a release height of 2.1 m (7 ft). A concentration of 41 mg/m^3 (4.1 x 10^{-5} oz/ft^3) was calculated to a distance of 97 m (317 ft). The site boundary concentration was 5.3 mg/m^3 (5.3 x 10^{-6} oz/ft^3) with a maximum exceedance distance of 2.3 km (1.42 mi).

Building 12-17 has an inventory limit of 5.4 kg (12 lb) of TNT. The calculated fire release of TNT would be 0.2 kg (0.5 lb) of respirable TNT at a release height of 2.1 m (7 ft). The resulting concentration at the site boundary would be 0.015 mg/m^3 (1.5 x 10^{-8} oz/ft^3), with a maximum exceedance distance of 0.1 mi, which is below the 0.5 mg/m^3 (5.0 x 10 $^{-7}$oz/ft^3) TLV-TWA concentration.

Building 12-21 has an inventory limit of 87.5 kg (193 lb) of TNT. The calculated fire release of TNT would be 4.1 kg (9 lb) of respirable TNT at a release height of 2.1 m (7 ft). The resulting concentration at the site boundary would be 0.27 mg/m^3 (2.7 x 10^{-9} oz/ft^3), with a maximum exceedance distance of 0.48 mi, which is below the 0.5 mg/m^3 (5.0 x 10^{-7} oz/ft^3) TLV-TWA concentration.

Building 12-64 has an inventory limit of 300 lb of TNT. The calculated fire release of TNT would be 6.4 kg (14 lb) of respirable TNT at a release height of 2.1 m (7 ft). The resulting concentration at the site boundary would be 0.23 mg/m^3 (2.3 x 10^{-7} oz/ft^3), with a maximum exceedance distance of 0.61 mi, which is below the 0.5 mg/m^3 (5.0 x 10^{-7} oz/ft^3) TLV-TWA concentration.

Building 12-65 has an inventory limit of 1,762 kg (3,885 lb) of TNT. The calculated fire release of TNT would be 79.4 kg (175 lb) of respirable TNT at a release height of 2.1 m (7 ft). The resulting concentration at the site boundary would be 5.3 mg/m^3 (5.3 x 10^{-6} oz/ft^3), with a maximum exceedance distance of 4.7 km (2.92 mi), which exceeds the 0.5 mg/m^3 (5.0 x 10^{-7} oz/ft^3) TLV-TWA concentration.

4.3.6.2 *Natural Phenomena-Initiated Fire Releases*

Chemical HE releases was not analyzed for natural phenomena-initiated fires in the "Natural Phenomena Hazards Assessment."

Fires Involving Radiological Materials. The "Natural Phenomena Hazards Assessment" provided consequence analysis for tornado or seismic event-initiated fire releases of radiological materials. Three radiological materials release scenarios were modeled for a fire following a tornado or seismic event: Pu-239, Pu-238, and Tritium.

A release of Co-60 due to an explosion would require an extreme fire event, resulting in temperatures well above the range predicted for normal fire events. This scenario was not modeled in the "Natural Phenomena Hazards Assessment."

The release of Pu-239 for a seismic event followed by fire was calculated in the "Natural Phenomena Hazards Assessment." A source term of 13 g (0.5 oz) was used, assuming a 4.25-m/sec (9.5-mph) wind speed and Pasquill Stability Class E. The HEPA filters were assumed to be failed or bypassed. The CEDE in the immediate area would be 4.6 $\times$ 10^{-2} rem, with a site boundary CEDE of 2.2 $\times$ 10^{-1} rem, below the corresponding one-rem protective action guidelines (PAG).

Release of Pu-238 in RTGs could occur if multiple RTGs in storage areas were exposed to fires exceeding design limits, such as might be produced by seismic events. A release of 174 Ci was used, assuming a 4.25-m/sec (9.5-mph) wind speed and Pasquill Stability Class E. The CEDE in the immediate area would be 1.1 $\times$ 10^{-2} rem, with a site boundary CEDE of 5.2 $\times$ 10^{-2} rem, below the corresponding one-rem PAG.

Release of tritium is limited to the worst case seismic event that would result in a fire. A large percentage of release would be in the form of tritiated water as a result of the combustion process. A release of 300,000 Ci of tritium in a seismic event followed by a fire, assuming a 4.25-m/sec (9.5-mph) wind speed and Pasquill Stability Class E, would result in a CEDE in the immediate area of 7.6 $\times$ 10^{-3} rem and a site boundary CEDE of 4.0 $\times$ 10^{-2} rem, below the corresponding one-rem PAG.

Fires Involving Hazardous Materials. Four hazardous material release scenarios were modeled for a fire following a tornado or seismic event:

- A vapor release of nitric acid from Building 11-17
- A vapor release of phosphoric acid from Building 12-68
- A vapor release of sulfuric acid from Building 11-17, Building 12-68, Building 12-5-G1
- A vapor release of TDI from Building 12-59.

A release of 91 kg (200 lb) of nitric acid from Building 11-17 (assuming a 6-min release duration, a 4.25 m/sec (9.5 mph) wind speed, and Pasquill Stability Class E) results in a 1,300 mg/m^3 (1.3 x 10^{-3} oz/ft^3) facility boundary concentration and a site boundary concentration of 7.4 mg/m^3 (7.4 x 10^{-6} oz/ft^3), below the corresponding ERPG-2 concentration of 39 mg/m^3 (3.9 x 10^{-5} oz/ft^3).

A release of 30 kg (66 lb) of phosphoric acid in a seismic event followed by fire in Building 12-68 assumed a 6-min release duration, a 4.25-m/sec (9.5-mph) wind speed, and Pasquill Stability Class E. The facility boundary concentration in such an event would be 420 mg/m^3 (4.2 x 10^{-4} oz/ft^3), and the site boundary concentration would be 11 mg/m^3 (1.1 x 10 $^{-5}$oz/ft^3), exceeding the corresponding TLV-TWA concentration of 1 mg/m^3 (1.0 x 10^{-6} oz/ft^3) to a distance of 2 km (1.21 mi).

Six calculations for release of sulfuric acid in the "Natural Phenomena Hazards Assessment" using a seismic event followed by fire were conducted: a release of 1,134 kg (2,500 lb) from Building 11-17 or Building 12-68, a release of 95 kg (210 lb) from Building 11-17, a release of 472 kg (1,040 lb) from Building 12-5-G1, a release of 13.6 kg (30 lb) from Building 11-17 or Building 12-5-G1. Each calculation assumed a 6-min release duration, a 4.25 m/sec (9.5 mph) wind speed, and Pasquill Stability Class E.

- For the release of 1,134 kg (2,500 lb) of sulfuric acid from Building 11-17, the facility boundary concentration was 9.1 × 10^{-6} mg/m^3 (9.1 x 10^{-9} oz/ft^3) and the site boundary concentration was 4.3 × 10^{-8} mg/m^3 (4.3 x 10^{-11} oz/ft^3), well below the corresponding ERPG-2 concentration of 10 mg/m^3 (1.0 x 10^{-5} oz/ft^3).

- For the release of 1,134 kg (2,500 lb) from Building 12-68, the facility boundary concentration was 160,000 mg/m^3 (1.6 x 10^{-1} oz/ft^3) and the site boundary concentration was 400 mg/m^3 (4.0 x 10^{-4} oz/ft^3), exceeding the corresponding ERPG-2 concentration of 10 mg/m^3 (1.0 x 10^{-5} oz/ft^3) to a distance of 12 km (7.43 mi).

- For the release of 95 kg (210 lb) from Building 11-17, the facility boundary concentration was 1,300 mg/m^3 (1.3 x 10^{-3} oz/ft^3) and the site boundary concentration was 7.8 mg/m^3 (7.8 x 10^{-6} oz/ft^3), below the corresponding ERPG concentration of 10 mg/m^3 (1.0 x 10^{-5} oz/ft^3) to a distance of 1.9 km (1.2 mi).

- For the release of 472 kg (1,040 lb) from Building 12-5-G1, the facility boundary concentration was 6,600 mg/m^3 (6.6 x 10^{-3} oz/ft^3) and the site boundary concentration was 170 mg/m^3 (1.7 x 10^{-4} oz/ft^3), exceeding the corresponding ERPG-2 concentration of 10 mg/m^3 (1.0 x 10^{-5} oz/ft^3) to a distance of 6.1 km (3.76 mi).

- For the release of 13.6 kg (30 lb) from Building 11-17, the facility boundary concentration was 120 mg/m^3 (1.2 x 10^{-4} oz/ft^3) and the site boundary concentration was 0.71 mg/m^3 (7.1 x 10^{-7} oz/ft^3), below the corresponding ERPG-2 concentration of 10 mg/m^3 (1.0 x 10^{-5} oz/ft^3) to a distance of 0.5 km (0.29 mi).

- For the release of 13.6 kg (30 lb) from Building 12-5-G1, the facility boundary concentration was 120 mg/m^3 (1.2 x 10^{-4} oz/ft^3) and the site boundary concentration was 3.1 mg/m^3 (3.1 x 10^{-6} oz/ft^3), below the corresponding ERPG-2 concentration of

10 mg/m^3 (1.0 x 10^{-5} oz/ft^3) to a distance of 0.5 km (0.29 mi).

The release of TDI in a seismic event followed by fire was calculated in the "Natural Phenomena Hazards Assessment."

A release of 4.5 kg (10 lb) from Building 11-7N or 12-59 was used, assuming a 6-min release duration, a 4.25-m/sec (9.5-mph) wind speed, and Pasquill Stability Class E. The facility boundary concentration from this calculation was 63 mg/m^3 (6.3 x 10^{-5} oz/ft^3) and the site boundary concentration was 0.37 mg/m^3 (3.7 x 10^{-7} oz/ft^3), exceeding the corresponding TLV-TWA concentration of 0.036 mg/m^3 (3.6 x 10^{-8} oz/ft^3) to a distance of 13.2 km (8.21 mi). Calculations were also conducted using a 24 km/hr (15 mph) wind and Pasquill Stability Class E. The site boundary concentration was 0.24 mg/m^3 (2.4 x 10^{-7} oz/ft^3) for Building 11-7N, and 1.0 mg/m^3 (1.0 x 10^{-6} oz/ft^3) for Building 12-59, both exceeding the corresponding TLV-TWA concentration of 0.036 mg/m^3 (3.6 x 10^{-8} oz/ft^3) to a distance of 10 km (6.2 mi).

The release of uranium (with and without HEPA filter) using a seismic event followed by fire was also calculated. A release of 4,291 kg (9,460 lb) was used, assuming a 6-min release duration, a 4.25 m/sec (9.5 mph) wind speed, and Pasquill Stability Class E. The facility boundary concentration from this calculation without the HEPA filter intact, was 29 mg/m^3 (2.9 x 10^{-5} oz/ft^3) and the site boundary concentration was 0.65 mg/m^3 (6.5 x 10^{-7} oz/ft^3), exceeding the corresponding TLV-TWA concentration of 0.20 mg/m^3 (2.0 x 10^{-7} oz/ft^3) to a distance of 1.9 km (1.15 mi). The facility boundary concentration with the HEPA filter intact was 0.29 mg/m^3 (2.9 x 10^{-7} oz/ft^3) and the site boundary concentration was 0.0065 mg/m^3 (6.5 x 10^{-9} oz/ft^3), below the corresponding TLV-TWA concentration of 0.20 mg/m^3 (2.0 x 10^{-7} oz/ft^3). A calculation using a release of 2,146 kg (4,730 lb) of uranium without the HEPA filter intact results in a facility boundary concentration of 6.7 mg/m^3 (6.7 x 10^{-6} oz/ft^3) and a site boundary concentration of 0.13 mg/m^3 (1.3 x 10^{-7} oz/ft^3), below the TLV-TWA concentration of 0.20 mg/m^3 (2.0 x 10^{-7} oz/ft^3).

4.3.7 Lightning Strikes

Pantex Plant is equipped with a lightning location and protection system and a static potential monitoring system to provide warning of lightning and potential static discharge near the Plant. Electrical storm and static potential warnings are disseminated via the PA system and the rapid notification system to the groups and buildings that could be affected. All outdoor operations involving explosives and nuclear explosives cease or continue to a point at which the operation is secure whenever lightning warning conditions are in effect. Additionally, all structures that contain significant quantities of radiological or chemical hazardous materials are equipped with engineered systems to protect them from lightning damage.

The impact of lightning strikes on Pantex Plant operations is minimal; however some unprotected areas are vulnerable to damage caused by lightning strikes.

4.3.8 Flooding

River or stream flooding, tidal surges, tsunamis, dam failures, ice jams, and so forth are not possible or are highly unlikely for the Plant site. Playas 1 and 2 are nearest the production and staging areas at the Plant and are the primary focus of the discussion of flooding probability. General flooding of some low-lying portions of Pantex Plant could occur due to the runoff associated with precipitation and the subsequent ponding in the playas, although, historically, there has been no flooding on the site. A flooding hazard analysis based on meteorological data and site topography determined that the probability of flooding at Pantex Plant is low[11]. Figures 4.3.8-1. and 4.3.8-2. show the set of flood hazard probability curves from this analysis, including the mean hazard probability, for Playas 1 and 2,

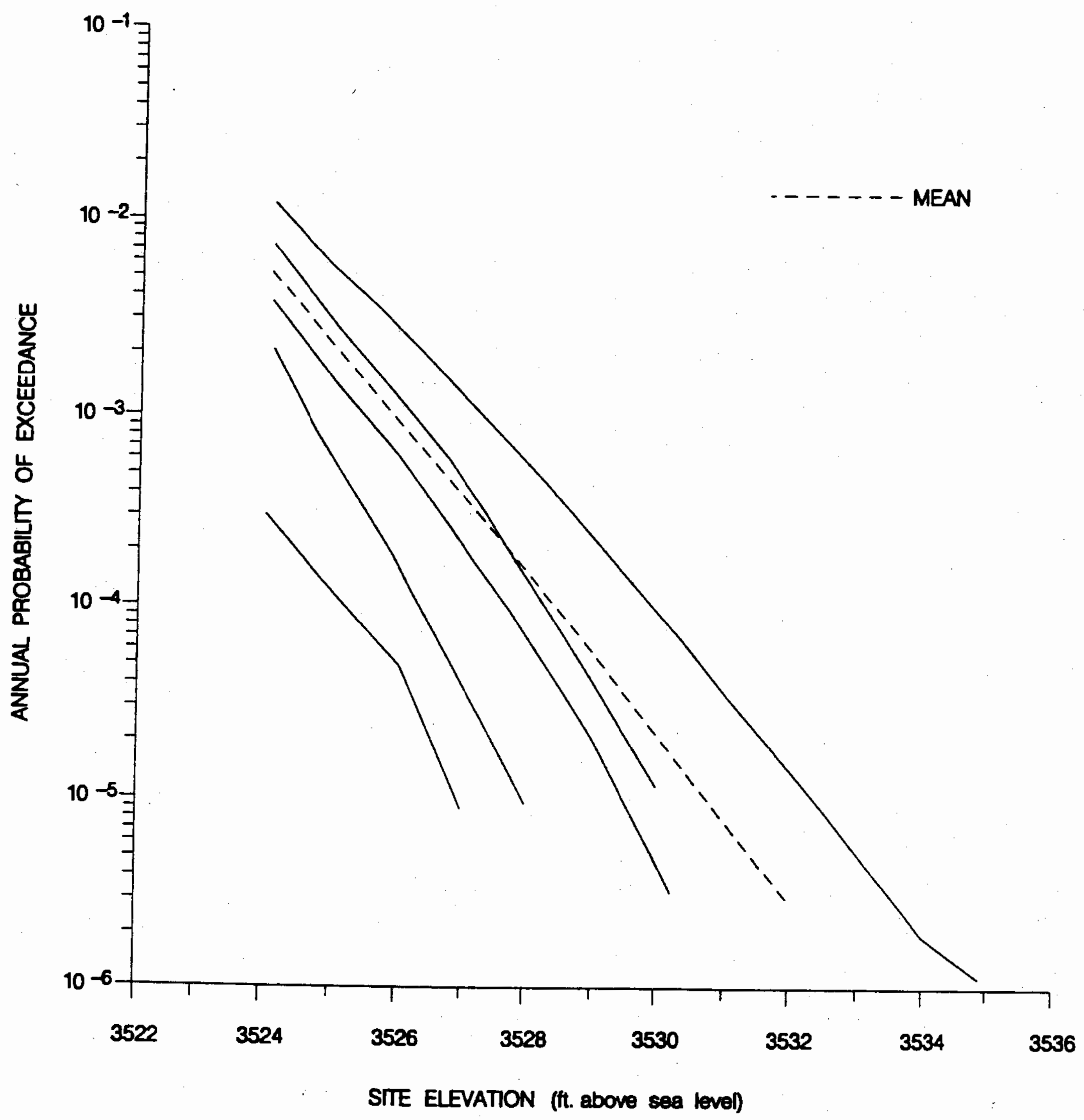

FIGURE 4.3.8-1.—*Flood Hazard at Pantex Plant (Playa 1).*

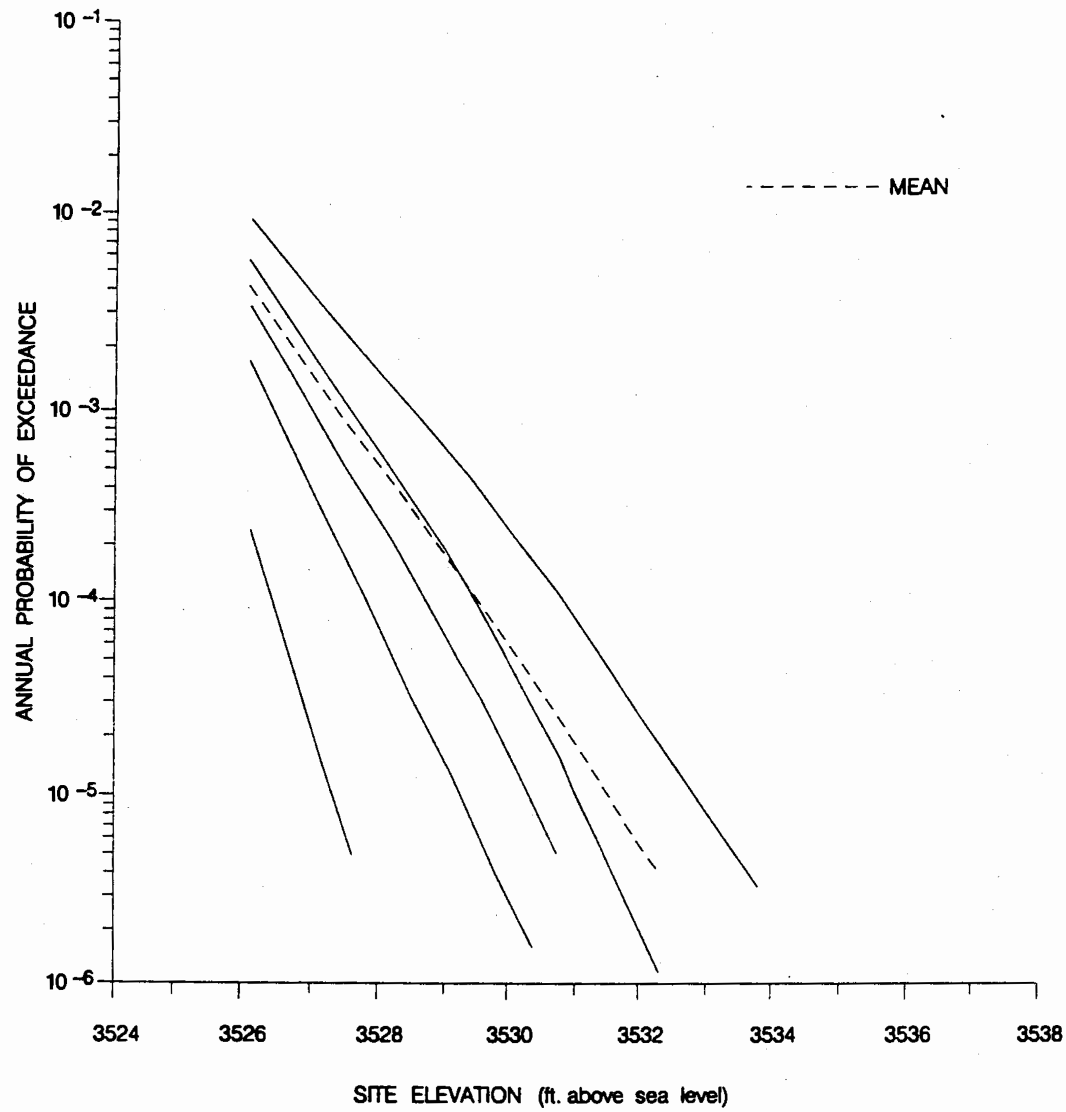

FIGURE 4.3.8-2.—*Flood Hazard at Pantex Plant (Playa 2).*

TABLE 4.3.8-1.—*Rainfall Required to Produce Flood Stage Elevation for Playas 1 and 2*

Flood Stage Elevation (m,ft)	Rainfall (cm, in.)	
	Playa 1	Playa 2
1,071 (3515)	4.17 (1.64)	--
1,073 (3520)	13.74 (5.41)	5.21 (2.05)
1,074 (3525)	28.17 (11.09)	18.8 (7.40)
1,076 (3530)	48.49 (19.09)	37.19 (14.64)
1,077 (3535)	78.97 (31.09)	60.66 (23.88)
1,079 (3540)	--	96.32 (37.92)

TABLE 4.3.8-2.—*Facility Use Categories and Minimum Design Basis Flood Level*

Facility Use Category	Design Basis Flood Level m above sea level (ft above sea level)	Annual Probability of Exceedance
General Use Buildings - Facilities that do not have a mission-dependent purpose (i.e., administrative buildings, cafeterias, storage, and maintenance and repair facilities), and are plant- or grounds-oriented. (Performance Category 1)	1074.0 (3525.0) (Playa 1) 1075.0 (3527.0) (Playa 2)	2×10^{-3}
Important or Low Hazard Buildings - Facilities that have a mission-dependent purpose (e.g., laboratories, production facilities, and computer centers) and emergency handling or hazard recovery facilities (e.g., hospitals, fire stations). (Performance Category 2)	1075.0 (3527.0) (Playa 1) 1075.6 (3529.0) (Playa 2)	5×10^{-4}
Moderate Hazard Buildings - Facilities where confinement of the contents is necessary for public or employee protection (e.g., uranium enrichment plants, or other facilities involving the handling or storage of significant quantities of radioactive or toxic materials). (Performance Category 3)	1075.5 (3528.5) (Playa 1) 1076.3 (3531.0) (Playa 2)	1×10^{-4}
High Hazard Buildings - Facilities where confinement of the contents and the protection of the public and environment are of paramount importance (e.g., facilities handling substantial quantities of in-process plutonium or fuel reprocessing facilities). Facilities in this category represent hazards with potential long-term and widespread effects. (Performance Category 4)	1076.3 (3531.0) (Playa 1) 1076.9 (3533.0) (Playa 2)	1×10^{-5}

respectively. (Five separate models were used to estimate the mean flood hazard probabilities.) Table 4.3.8-1. also summarizes the rainfall amounts correlated with flood stage elevations for both Playas 1 and 2. These data represent the amount of continuous rainfall required to produce various flood stage elevations. Design basis flood levels have been established for the Plant site with respect to Playas 1 and 2 using the concept of facility use categories. Table 4.3.8-2. describes the facility use categories and the corresponding nominal design basis flood levels against which each type of structure at Pantex Plant is to be protected.

The "Natural Phenomena Hazards Assessment" concludes that the potential destructive capabilities of a flooding event are restricted by the topography of the Pantex Plant site to a gradual rising of flood waters in the playa lake areas and in the interior of any facility with sections constructed below ground level. Additionally, liquid spills of hazardous materials could actually be mitigated by flood conditions, since the liquids would be diluted in the flood. The release hazard presented by a flooding event at Pantex Plant is limited to the possibility of an inadvertent critical excursion caused by flooding of staging areas for radiological materials. Even an inadvertent criticality excursion is unlikely without deliberate malevolent action. The "Radiological Hazards Assessment Recalculation" information on criticality event scenarios are described in this document in Section 4.3.2.

4.3.9 External Events

Because of the large restricted area around the Material Access Area and the remote location of Pantex Plant, no industrial or military facility accidents are credible threats. Furthermore, the hazards associated with aircraft crashing into the facility are considered explicitly in Section 4.3.3. A railroad is located 2 km (1.2 mi) from the southern part of Zone 12. Various chemicals (e.g., chlorine, hydrogen fluoride, and ammonia) could be shipped in sufficient quantity (e.g., 45,360 kg or 100,000 lbs) that could, in an accident, result in concentrations that are IDLH at the Pantex Plant. Under these conditions, operating personnel would have to shut down operations in all facilities. Pantex personnel would then use the initial protective action of sheltering in place, followed by evacuation as appropriate.

The probability of a railroad accident on a section of track is estimated to be 6.0 x 10^{-8}/car mile for Class 5/6 track, trackage similar to that used by the Burlington Northern Santa Fe Railroad in the vicinity of Pantex Plant. Based on an average train length of 81 cars, the accident rate per train mile is therefore 4.9 x 10^{-6}/train mile. Assuming that the length of track is 3.2 km (2 mi) long and that about 45 trains per day traverse the section, the frequency of a train accident in that 3.2-km (2-mi) segment is 0.16 accidents/year, or about one accident every 6 years. Based on a Federal Railroad Administration Study, hazardous materials are involved in 11.6 percent of the accidents, and just over 20 percent of these accidents result in some release of hazardous materials. Most hazardous materials would not result in a release that would pose any threat to a facility several miles away. The report lists the 125 most-shipped hazardous chemicals in 1986, along with the number of tank car shipments for each. Based on these values, there are two chemicals widely shipped that, if released, would produce a significant toxic gas plume. These are chlorine (the second most-likely hazardous material shipped by rail) and ammonia (fourth in the list). Together, they represent about 13 percent of the hazardous materials shipped. Adding in releases of hydrogen fluoride, hydrogen chloride, and sulfur dioxide (much less-commonly shipped materials) increases this probability to 13.8 percent. Considering the above three factors (the probability that hazardous materials will be involved in an accident, the probability of a release given the involvement in the accident, and the probability that the release will be a toxic gas), the frequency of a release that could potentially reach the plant is 5 x 10^{-4}/year. This means a toxic gas plume might reach the plant about once every 2,000 years, an unlikely accident.

Chlorine has a lower IDLH concentration than ammonia, 30 versus 500 ppm. Both have almost identical vapor pressure curves, and when released, both will immediately volatize about 20 percent of the liquid. Because other release characteristics are similar and ammonia has the higher IDLH, a chlorine release is certainly a more limiting accident. Taken together, these two materials represent more than 90 percent of the toxic gases being transported. Thus it appears reasonable to use chlorine as the representative chemical when estimating release effects. The effect of a release from a rail car loaded with 91,440 kg (90 tons) of chlorine has been estimated by a nomograph produced by the Chlorine Institute, which shows that under typical atmospheric conditions, the IDLH concentration is exceeded for distances out to 2,000 m (1.2 mi) from the release point. This distance increases to just over 4,000 m (2.5 mi) for unfavorable conditions. Both estimates were based on a 2.24 m/sec (5 mph) wind speed.

The Burlington Northern Santa Fe Railroad borders the Pantex Plant on the south side. Its closest point of approach to Zones 11 and 12 is about 2,000 m (1.2 mi). Using a line parallel to the rail line at an offset distance of 4,000 m (2.5 mi) would include all of Zones 11 and 12. Using the most common direction for winds at the Pantex Plant, south-southwest, the offset line drawn 4,000 m (2.5 mi) from a release point on the rail line would include the southern half of Zone 12 and a very small part of Zone 11.

The conclusion is that a toxic gas release from an accident on the rail line is unlikely and that if a release of hazardous material occurred, the concentration of the toxic gas would not be above the IDLH value onsite for typical atmospheric conditions. However, for unfavorable conditions, typical of those in the early morning hours around sunrise, the IDLH values could be exceeded.

Security personnel are stationed in towers for security purposes at all times at the southern perimeter of Zone 12 (and at many other locations throughout the site). The security personnel are trained to notice a train derailment and notify the Emergency Operations Center (EOC) whenever one occurs. If any chemical cloud is reported to the EOC, then the PA system is used to issue an immediate site shutdown of all operations. The PA system covers all operating areas where hazardous material is handled, but does not cover some of the outlying area where only administrative work is performed (e.g., the Killgore building). This shutdown is similar to and more extensive than the routine shutdown that is announced for lightning strikes within a 16.1-km (10-mi) radius. A significant difference is that in some of the protected areas (e.g., bays and cells), operations are allowed to continue during a lightning strike warning whereas for a site shutdown, all operations would cease.

A train derailment did occur within the past ten years near the Plant. The security personnel noticed the derailment and appropriate personnel were notified. The material that was released during the derailment turned out to be inert material (tennis shoes and dry cereal), therefore no site shutdown was necessary. The EOC has within the last two years enacted a similar scenario and determined no additional measures were needed.

Another possible external event is a pipeline accident. The only pipelines on or near the Plant are 1) low-pressure steam lines and chilled water lines for heating and cooling on the Plant, and 2) natural gas lines located outside the Material Access Area on the Plant and adjacent to Plant property. Rupture of the steam or chilled water lines is not considered a significant threat unless other failures occur simultaneously. Natural gas pipeline failures leading to explosions are considered less severe than other external explosion events within the Material Access Area due to the distance between the gas lines and the operating facilities. Therefore, the effects of such explosions are subsumed in the consideration of explosions in adjacent facilities.

4.4 Calculational Methods

Toxicological hazards were modelled in the hazards assessments using the Emergency Prediction Information (EPI) code, Version 5.0, from Homman Associates, 1988. This particular software package was selected for several reasons. First, the EPIcode uses the Gaussian dispersion model, a widely accepted algorithm, as the basic algorithm to calculate downwind concentrations. The Gaussian equation provides flexibility for adjustment to wind speeds and release heights. Second, the EPIcode is capable of receiving input that will allow modeling of chemicals that are not part of the 600 chemicals incorporated into the EPIcode database. Third, the developer of EPIcode also wrote the Lawrence Livermore software package HOTSPOT, which was used for the radiological hazards. Both programs provide sufficiently accurate estimations of release consequences. Fourth, the EPIcode is the only one listed in the 75 other risk assessments that include ERPGs. Finally, the EPIcode was discussed and recommended in the DOE Headquarters hazardous assessment course and was one of two chemical programs demonstrated.

HOTSPOT was chosen as the most flexible, simple to use, and accurate program of its type for the hazards assessments. The dispersion conditions modeled in HOTSPOT represent conservative, unfavorable atmospheric conditions that might be expected in the event of a release of materials from the Pantex Plant and provide emergency planners with a baseline of information for use in the allocation of emergency preparedness resources and actions. Other meteorological conditions can be used to work with various accident scenarios.

The HOTSPOT codes were created to provide health physics personnel with a fast, field-portable tool for calculating and evaluating accidents involving radioactive materials. The HOTSPOT codes provide a first-order approximation of the radiation effects associated with the atmospheric release of radioactive material and provide a reasonable level of accuracy for a timely initial assessment. More importantly, the HOTSPOT codes produce a consistent output for the same input assumptions, and minimize the probability of errors associated with reading a graph incorrectly or scaling a universal nomogram during an emergency situation. (Note that HOTSPOT PC codes have not been approved by DOE for use in accident analyses in SARs.)

Four general HOTSPOT modules (Plume, Explosion, Fire, and Resuspension) allow for downwind assessment following the release of radioactive material as a result of a continuous or puff release, explosive release, fuel fire, or an area contamination event. Other specific modules deal with the release of plutonium, uranium, and tritium to expedite the initial assessment of accidents involving nuclear weapons. Additional programs estimate the CEDE from inhalation for any of the radionuclides listed and calibrate a radiation survey instrument for ground survey measurements.

The XREFRAC code was used for calculating respirable fractions of radiological material in explosive release situations where the mass of explosive is less than the mass of radiological material (a regime where HOTSPOT is not applicable). The model was also used to establish that equal masses of material and HE maximize the radiation dose received at the relevant distances for emergency planning purposes (i.e., facility boundary, the site boundary, and the 16.1 km (10 mi) Emergency Planning Zone boundary).

The KENO Monte Carlo code is used for criticality calculations[50]. The primary statistical computer code used for nuclear criticality calculations is MCNP, a general Monte Carlo code for neutron and photon transport[51].

Modeling explosion events in the hazards assessments inside the facilities included addressing the physical hazards that result from building debris, primary fragments, secondary fragments, and external leakage pressures. Building debris is defined as components of the facility. Primary fragments consist of casing material and fixtures, used in the explosives fabrication and weapons assembly process, that are in direct contact with the explosive charge. Secondary fragments consist of support fixtures, used in various operations involving explosives, that are not in direct contact with the explosive charge. External leakage pressure is produced when structures fail during a detonation. This failure allows blast waves to escape from the structure and produce hazards to adjacent buildings and unprotected personnel. External leakage pressures were considered only in respect to their effect on unprotected personnel.

Shock and gas impulse loads for building components with line-of-sight to the high-explosive charge were calculated in the hazards assessments using the SHOCK and FRANG software codes, respectively[52,53]. The SHOCK program is approved by the U.S. Department of Defense Explosives Safety Board (DDESB) for calculating shock phase loading on structures, including the shock reflections off nearby surfaces. The FRANG code includes the effects of venting. For building components that did not have line-of-sight with the charge, such as ramp or corridor components, leakage pressure curves from TM 5-1300 were extrapolated to determine the impulse loads[54].

Building debris dispersion was modeled in the hazards assessments using the DISPRE model. The DISPRE model is an analytical procedure that can be used to predict the hazardous building debris density resulting from an accidental explosion. The model was developed for the DOE and has been accepted by the DOD Explosives Safety Board. Hazardous debris distances can be predicted for buildings constructed of reinforced concrete, masonry (clay-tile or standard concrete masonry units), and other lightweight components such as corrugated metal panels. The model was validated using an extensive testing program.

A modified version of the computer code MUDEMIMP is used in the DISPRE development program to estimate the hazardous debris throw based on the input comprised of the debris characteristics. It uses input probability distributions to simulate the building break-up and predict the debris dispersion. MUDEMIMP is based on probabilistic methods including variations and uncertainties of the launch and flight parameters of individual missiles created from an explosion. The code reports maximum hazardous debris distance, reports maximum distance of all debris, and builds histogram data for the number of hazardous missiles that land in or pass through a square foot area. The 55.7 m^2 (600 ft^2) area is a DOD specified value for calculating debris density. The kinetic energy of a hazardous fragment is defined by the user in the input parameters (e.g., 1.52 kg-m or 11 ft-lb). Five thousand simulations were executed to obtain a statistical range of data using Monte Carlo random sampling techniques to select the parameters of each missile.

A statistical analysis using the TRAJ computer model was performed to estimate building debris distribution for those cases where input parameters exceeded the limitations of the DISPRE model. The TRAJ computer program used to predict debris throw is a two-dimensional trajectory program for personal computers. The program was originally developed by the Naval Surface Warfare Center as part of the Naval Explosives Safety Improvement Program. The code allows the input of fragment mass, shape, density, cross-sectional area, initial velocity, initial trajectory, and possible terrain barriers as initial conditions. The code then calculates the trajectory path, the projected throw distance, and the impact energy. Since its inception, the program has been updated and modified. The latest version released by Naval Surface Warfare Center includes barricades, sloping terrain, and a ricochet model from the computer program FRAGHAZ[55].

Other modeling programs have been used in the SARs. The ERAD computer code is used to analyze the dispersion of a plume of airborne plutonium aerosol and the exposure of personnel, and the GENII code is used for analysis of tritium releases.

MELCOR analyses were used to provide a realistic assessment of the plutonium releases in some SARs. MELCOR is a nuclear power reactor severe accident analysis code developed under the sponsorship of the Nuclear Regulatory Commission (NRC).

4.5 REFERENCES

1. Jacobs Engineering Group, Inc., *Chemical High Explosives Hazards Assessment for the Pantex Plant, Amarillo, Texas*, Prepared in conjunction with Ogden Environmental and Energy Services Co., October 1993.

2. Jacobs Engineering Group, Inc., *Hazardous Materials Hazards Assessment for the Pantex Plant, Amarillo, Texas*, Prepared in conjunction with Ogden Environmental and Energy Services Co., November 1992.

3. Jacobs Engineering Group, Inc., *Recalculation of Potential Deposition Levels and Dose Exposure Levels for the Pantex Radiological Hazards Assessment for the Pantex Plant*, Prepared in conjunction with Ogden Environmental and Energy Services Co., October 1993.

4. Jacobs Engineering Group, Inc., *Natural Phenomena Assessment for the Pantex Plant, Amarillo, Texas*, Prepared in conjunction with Ogden Environmental and Energy Services Co., October 1993.

5. DOE Order 5480.23, *Nuclear Safety Analysis Reports*, U.S. Department of Energy, April 10, 1992.

6. Battelle Pantex, *DOE Order 5480.22/5480.23 Implementation Plan Volume 1 Revision C for the Pantex Plant, Amarillo, Texas*, Risk Management Department, Amarillo, Texas, January 1994.

7. DOE Order 5481.1B, "Safety Analysis and Review System," Change 1. U.S. Department of Energy, May 19, 1987.

8. DOE/AL Order 5481.1B, "Safety Analysis and Review System." U.S. Department of Energy, Albuquerque Operations Office, January 27, 1988.

9. DOE, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports*, DOE-STD-3009-94, U.S. Department of Energy, July 1994.

10. Lawrence Livermore National Laboratory, *Design and Evaluation Guidelines for Department of Energy Facilities Subject to Natural Phenomena Hazards*, UCRL-15910, June 1990.

11. Lawrence Livermore National Laboratory, *Natural Phenomena Hazards Modeling Project: Flood Hazards Models for Department of Energy Sites*, UCRL-53851, May 1988.

12. DOE, *Emergency Management Guide, Guidance For Hazards Assessment*, U.S. Department of Energy, June 26, 1992.

13. DOE, *Final Environmental Impact Statement - Pantex Plant Site - Amarillo, Texas*, DOE/EIS-0098, U.S. Department of Energy, October 1983.

14. Lawrence Livermore National Laboratory, *Natural Phenomena Hazards Modeling Project: Extreme Wind/Tornado Hazard Models for Department of Energy Sites*, UCRL-53526, August 1985.

15. Lawrence Livermore National Laboratory, *Natural Phenomena Hazards Modeling Project: Seismic Hazard Models for Department of Energy Sites*, UCRL-53582, Rev. 1, November 1984.

16. "Database of Unusual Occurrence Reports for Pantex Plant, TriLab Risk Study." In preparation.

17. Mason & Hanger - Silas Mason Co., Inc., *Nuclear Explosive Abnormal Environments at the U.S. DOE Pantex Plant*, Pantex Plant, Amarillo, Texas, February 1993.

18. DOE, *Plutonium ES&H Vulnerability Assessment,* Pantex Site Assessment Team Report, July 29, 1994.

19. Lawrence Livermore National Laboratory, *HOTSPOT PC Health Physics Codes*, Hazards Control Department, Version 6.5.

20. Alexander, R.E. et al., *An Assessment of the Onsite Lung Dose Commitments Resulting from a Postulated HE/Pu Gravel Gertie Accident*, Pantex Plant Report, 1989.

21. U.S. Code of Federal Regulations, Title 10, Energy. Part 100, "Reactor Site Criteria." October 1988.

22. Sandia National Laboratories, *MELCOR 1.8.0: A Computer Code for Nuclear Reactor Severe Accident Source Term and Risk Assessment Analyses*, NUREG/CR-5531 (SAND90-0364), January 1991.

23. Atomic Weapons Research Establishment Report No. 0-20/65, *The Determination of the Particle Size Distribution of the Particulate Matter Collected during the Double Tracks and Clean Slate 1 Events of Operation Roller Coaster*.

24. Sandia National Laboratories, *Gravel Gertie Confinement Verification Program - Summary Report*, SAND83-0840, August 1984.

25. Boughton, B. A. and J. M. DeLaurentis, *Description and Validation of ERAD: An Atmospheric Dispersion Model for High Explosive Detonations*, SAND92-2069, Sandia National Laboratories, October 1992.

26. SARA 90-29, *Analysis of the W79 Alt 325 Design Basis Accident*, Lawrence Livermore National Laboratories, July 31, 1990.

27. U.S. Nuclear Regulatory Commission, *Nuclear Fuel Cycle Facility Accident Analysis Handbook*, NUREG-1230, Washington, D.C., May 1988.

28. Mason & Hanger - Silas Mason Co., Inc., *12-44 Cell 8, Safety Analysis Report*, Pantex Plant, Amarillo, Texas, February, 1995.

29. Mason & Hanger - Silas Mason Co., Inc. *Final Safety Analysis Report, Zone 4 Magazines (Staging or Interim Storage of Nuclear Weapons and Components)*, UCNI, Pantex Plant, December 1992.

30. DOE, *Environmental Assessment for Interim Storage of Plutonium Components at Pantex and Department of Energy Response to Comments on the Pre-Approval Environmental Assessment and Public Meeting*, Volumes 1 and 2, DOE/EA-0812, January 1994.

31. DOE, *Internal Dose Conversion Factors for Calculation of Dose to the Public*, DOE/EH-0071, U.S. Department of Energy, July 1988.

32. Oak Ridge National Laboratory, *RSIC Computer Code Collection: GENII Environmental Radiation Dosimetry Software*, CCC-601, Radiation Shielding Information Center, April 1992.

33. Jacobs Engineering Group, Inc., *Radiological Hazards Assessment for the Pantex Plant*, In conjunction with Ogden Environmental and Energy Services Co., Inc., August 1991,

34. Mason & Hanger - Silas Mason Co., Inc. *Basis for Interim Operation for the Pantex Plant, Amarillo, Texas*, revision 3, errata b, March 1996.

35. U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 355, "Emergency Planning and Notification."

36. U.S. Code of Federal Regulations, Title 29, Labor. Part 1910.119, "Process Safety Management of Highly Hazardous Chemicals, Explosives, and Blasting Agents."

37. DOE Order 5500.3A, *Planning and Preparedness for Operational Emergencies*, (Chg. 1), U.S. Department of Energy, February 27, 1992.

38. EPI (Emergency Prediction Information) Code, produced by Homman and Associates, Version 5.0.

39. *XREFRAC*, written by Ogden Environmental and Energy Services Co., contained in Appendix C of *Chemical High Explosives Hazards Assessment for the Pantex Plant, Amarillo, Texas*, October 1993.

40. *DISPRE*, "Prediction of Building Debris for Quantity-Distance Siting," Technical Paper No. 13, Department of Defense Explosives Safety Board, Alexandria, Virginia.

41. Montanaro, P. E., *MUDEMINP Computer Code Update, Version 1.2*, Naval Surface Warfare Center, Silver Spring, Maryland, October 1992.

42. Montanaro, P. E., *TRAJ - A Two Dimensional Trajectory Program for Personal Computers*, Naval Surface Warfare Center, Silver Spring, Maryland.

43. Sandia National Laboratories, *An Assessment of the Probability of Aircraft Impact with Pantex Structures*, SAND76-0120, June 1976.

44. Solomon, K.A., *Estimate of the Probability that an Aircraft will Impact the PVNGS*, Revision 1, NUS-1416, Arizona Nuclear Power Project, July 25, 1975.

45. Jacobs Engineering Group, Inc. and Ogden Environmental and Energy Services Co., October 1993. *Natural Phenomena Hazards Assessment for the Pantex Plant Amarillo, Texas*, prepared for the U.S. Dept. of Energy.

46. ERDA, *Seismic Hazard and Building Structure Behavior at the Pantex Facility*, URS/John A. Blume & Associates, Engineers, prepared for U.S. Energy Research and Development Administration, Amarillo Area Office, April 1976.

47. Telephone conversation with Mr. Douglas Crowley, U.S. National Weather Service, 1900 English Road, Amarillo, Tx 79107.

48. DOE Order 6430.1A, *General Design Criteria*, U.S. Department of Energy, April 6, 1989.

49. National Fire Protection Association, Inc., *Standard for Protection of Life and Property from Wildfire*, NFPA 229, Batterymarch Park, Quincy, Massachusetts, 1991.

50. *KENO 5a - An Improved Monte Carlo Criticality Program with Supergrouping*. Oak Ridge National Laboratory, 1984.

51. *MCNP - A General Monte Carlo Code for Neutron and Photon Transport*, LA-7396-M, Revision 2.

52. Wagner, P., and J. Connett, *SHOCK User's Manual*, Version 1.0, Naval Civil Engineering Laboratory, Port Hueneme, California, January 1988.

53. Wagner, P., and J. Connett, *FRANG User's Manual*, Version 1.0, Naval Civil Engineering Laboratory, Port Hueneme, California, January 1989.

54. Departments of the Army, the Navy and the Air Force, *Structures to Resist the Effects of Accidental Explosions*, Department of the Army Technical Manual TM 5-1300, Department of the Navy Publication NAVFAC P-397, Department of the Air Force Manual AFM 88-22, November 1990.

55. *TRAJ - A Two Dimensional Trajectory Program for Personal Computers*, code modified to include barricades, sloping terrain, and ricochet models, Naval Surface Warfare Center, Silver Spring, Maryland.

5.0 TRANSPORTATION

This chapter describes the transportation of hazardous materials and hazardous waste at Pantex Plant. A Transportation Safety Analysis Report, which will present this information in greater detail, is currently being reviewed by the DOE for approval. The Transportation Safety Analysis Report contains detailed information about onsite transportation, including facility and operations descriptions, accident analysis, and other information required by DOE Order 5480.23[1]. The information will be useful in the SWEIS for defining accident and consequence information during onsite transportation operations.

5.1 OVERVIEW

Many different hazardous materials are transported onsite and offsite at Pantex Plant, including nuclear explosives, nuclear components, high explosive (HE) components and materials, tritium, and a variety of chemicals. Pantex Plant uses over 8,500 different chemicals and produces approximately 50 different types of hazardous waste streams. However, of the many thousands of chemicals used, only five are present in quantities large enough to merit concern.

Threshold planning quantities (TPQ) of hazardous chemicals are specified in 40 CFR 355 and 29 CFR 1910.119[2,3]. Only two chemicals, chlorine gas and sulfuric acid, were present in quantities greater than their respective TPQs and have since been reduced below their TPQ values. Other chemicals exist in sufficient quantities for possible concern. A value of 10 percent of the TPQ was chosen as the screening criterion. Only three other chemicals, nitric acid, toluene diisocyanate, and phosphoric acid, are present in quantities above the screening criterion. These chemicals are more fully described in the Hazardous Materials Hazards Assessment[4].

It should be noted that HE and special nuclear material (SNM) pose a threat to the facilities and public, unlike that of other hazardous chemicals and materials. Consequently, this chapter stresses HE and SNM transportation more thoroughly than transportation of hazardous chemicals and materials, although the threat from these materials is not necessarily greater.

Typical vehicles used to transport hazardous materials include forklifts, safe secure trailers (SSTs), flatbed trailers, hardened trailers, vans, trucks, pallet jacks, and tow motors. Intrazone transportation is frequently carried out via enclosed ramps and corridors, while interzone transportation is carried out on paved roads.

It has been determined from transfer records that there are approximately 30,000 transfers per year of radiological and explosive materials at Pantex Plant. To ensure the safety of operations, transportation controls are imposed. The Nuclear Material Control Center monitors all transfers of SNM. Truck drivers are trained, certified, and have commercial drivers licenses and meet the rigorous Federal Highway Administration requirements as to physical fitness and random drug and alcohol testing. Signs and corridor mirrors help to alert the intrabuilding driver of hazardous situations for transfers within the ramps, and speed limits and the walker-spotter system help ensure a safe traveling speed (see Section 5.3).

Because many of the materials transported are hazardous, special containers are used to transport these materials. Typical containers include Army/Navy (AN) cans, Kennedy kits, AL-R8 containers, DT containers, and gas cylinders.

5.2 TRANSPORTATION ORGANIZATION

To transport materials at Pantex Plant safely and effectively, a number of interdependent organizations must interact with one another. These organizations include the Traffic Section in the Packaging and Shipping Department, the Transportation and Staging Operations Department, Explosives Storage Operations Department of the Applied Technology Division, the Inventory Control Section of the Production Stores Department, the Applications Support Department, the Safeguards and Security Division, and the Operations Center. Other organizations involved in transportation are the Transportation Safeguards Division (TSD) Coordination Section, the Waste Management Department, the Waste Operations Department, the Vehicle Maintenance Facility, and the Explosive Tracking Center. Information about each organizational department, their responsibilities, and DOE couriers are provided in Chapter 5.0 of the Programmatic Information Document.[5]

5.3 ADMINISTRATIVE CONTROLS

Administrative controls are in place at Pantex Plant to protect the worker, the Plant, and the public from transportation accidents involving hazardous materials. Transportation procedures and standards are in place to guide the worker in the packaging, handling, and transporting hazardous materials both onsite and offsite.

Packaging of hazardous material for transportation offsite is accomplished in accordance with applicable DOE, EPA, NRC, Department of Transportation (DOT), and State of Texas regulations.

Mason & Hanger-Silas Mason Co., Inc. is registered with the DOT as a private carrier as required by Federal Highway Administration, Motor Carrier Safety Regulations. Therefore, commercial vehicles and drivers meet the rigorous requirements of the DOT for qualification and operation. Mason & Hanger is also registered with the DOT as a shipper and transporter of hazardous materials as required by the Hazardous Materials Regulations Management directives require packaging of hazardous materials for transportation onsite be in accordance with DOT requirements or include administrative controls that provide equivalent safeguards.

The DOE Explosives Safety Manual[6] requires vehicles and drivers to be in compliance with Title 49 CFR parts 382 and 390 through 397 for both onsite and offsite transportation of explosives[7,8,9,10,11,12,13,14,15]. Since the vehicles and drivers used for transporting explosives are the same vehicles and drivers used to transport other hazardous material, Motor Carrier Safety Regulations are met both onsite and offsite.

The following paragraphs discuss some of the more important administrative controls currently in place at Pantex Plant.

Training. Personnel who operate vehicles that transport nuclear materials are required to attend a training course that includes classroom and hands-on training. Demonstration of proficiency is performed before a certified vehicle instructor. Each vehicle operator is required to attend refresher training and demonstrate proficiency every two years. Personnel are permitted to transport nuclear material only after they have been observed by the vehicle supervisor moving non-nuclear material for a minimum of two weeks. Only properly trained, DOE Personnel Assurance Program (PAP) certified personnel are allowed to handle or transport nuclear explosives. In addition, all transportation supervisors, technicians, and assembly and evaluation engineers are trained in the performance of the nuclear explosives immediate action procedures associated with their assignments.

Traffic Safety. All tractor drivers must have a Texas commercial driver's license and a good driving record verified by the Texas Department of Public Safety. Truck drivers are trained, qualified, given physical exams and randomly screened for drugs and alcohol according to the Department of Transportation requirements.

The DOE sets conservative speed limits to maintain vehicle safety. The speed limit for vehicles transporting nuclear explosives or nuclear components on roads at Pantex Plant is 32.2 km/hr (20 mph). The speed limit for forklifts traveling in ramps is 8.1 km/hr (5 mph).

Waste Management. The Waste Management Department sets guidelines for the safe handling of hazardous waste.

Hazardous Material Labeling. All containers containing hazardous chemicals are labeled according to a system developed by the Hazard Communication Group of the Industrial Hygiene Department. This system meets the requirements of 29 CFR Section 1910.1200[16]. This labeling does not supersede DOT labeling and does not apply to HE and SNM materials. Chemicals are bar coded and labeled upon receipt at Pantex Plant (except for Account 35 materials - material used to build weapons) and entered into a database. They are categorized on a scale of 0 to 4 (0=None, 4=Very High) in the following three categories: health, flammability, and reactivity. The form of the substance (solid, liquid, gas) is also noted. Hazardous substances are categorized according to the most hazardous substance in the mixture. For example, the product "Lock-Ease" would be a Health Hazard 4 material because of the presence of aluminum tristearate, although present in small amounts. When a container is empty, the owner of the container notifies Hazard Communication and the container is removed from the database.

Additionally, each package of hazardous material is labeled per 49 CFR, Part 172.101, "Hazardous Material Table," and 40 CFR, Part 262.31 (if waste material)[17,18]. All containers of explosives, explosive assemblies, or explosive articles not required to be labeled (per 49 CFR, Part 172.101) are labeled as "EXPLOSIVES."

Plutonium Limits on SSTs/Hardened Trailers. The maximum number of plutonium-bearing nuclear explosives that may be transported in a single group in an SST or hardened trailer is limited by the total plutonium content. The amount of plutonium transported is limited by the DOT Transport Index Requirements in 49 CFR. For an SST, limits for weaponized plutonium follow the 40 kg (88.2 lb) rule. For a hardened trailer, limits for weaponized plutonium follow the 15 kg (33.1 lb) rule[19].

Two-Person Concept. Operations involving the handling and transportation of nuclear explosives require adherence to the two-person concept. This concept requires that a minimum of two authorized persons be present during handling and transportation of nuclear explosives. These two people must be in the DOE PAP and must possess technical knowledge appropriate to the task. They must be in a position to detect incorrect or unauthorized operations with respect to the task to be performed, and must be familiar with pertinent safety and security requirements.

Walker-Spotter Program. A walker-spotter program is in effect when moving SNM, nuclear explosives, or nuclear explosive-like assemblies (NELA) through the ramps of Zone 12. The program was created to enhance the safety of forklift operations involving nuclear materials. A walker-spotter walks in front of the forklift and directs all traffic, including foot traffic, to stop until the vehicle carrying the nuclear material passes. No traffic is permitted to pass a forklift transporting such material unless directed by the walker-spotter.

Adherence to the forklift speed limit is ensured by the walker-spotter program since a walker-spotter must walk at a reasonable pace in front of the vehicle. In addition to providing the vehicle operator with a "second set of eyes," the program also fulfills the two-person concept requirements.

5.4 LOADING DOCKS

At Pantex Plant, numerous loading docks are used for loading and unloading hazardous materials. As most hazardous materials must pass through a loading dock, the commonly used docks are described in Section 3.4.2.

5.5 HAZARDOUS MATERIAL TRANSPORTATION PROCESS

The Production Stores Department is responsible for handling and moving packaged nuclear explosives and weapon components between operating areas and staging areas within Zone 12 MAA. Figure 5.5-1., the Master Flow Diagram, illustrates the hazardous material flow paths for both onsite and offsite transfers.

Transfers of HE, nuclear explosives, and nuclear components are scheduled and prepared in response to material transfer requests via a material move order. Preparation includes scheduling the use of loading docks, forklifts, transport vehicles, escorts, pallets, and tie-down chains and straps. Material limits are checked automatically by computer and stored in the CRADS (Control Room Automated Data System) computer system and verified by physical inspection.

For each phase of the transfer, a material custodian is assigned to oversee the operations. A shipping custodian is responsible for transportation away from the point of origin. A receiving custodian takes control of the material at the destination.

Forklifts, cranes, pallet jacks, tow motors, hardened trailers, flatbed trailers, truck tractors, special tooling, and highly trained and certified personnel are used in nuclear explosives operations. The equipment and functions are common to all nuclear explosive operations at Pantex Plant. Forklifts and flatbed trailers are generally used to transfer nuclear explosives and weapon components to and from hardened trailers and SSTs. Transportation between various facilities in Zone 12 is inferred. All nuclear explosives are handled as specified in Plant Standards for transfer within Zone 4 MAA and between Zone 4 MAA and Zone 12 MAA consistent with plant procedures. Cranes, hoists, tow motors, and pallet jacks of various capacities are used for operations in different facilities. Operations and program-specific special tooling for particular nuclear explosives are reviewed in the program-specific nuclear explosives safety study (NESS).

All movements of nuclear explosives, Joint Test Assemblies, Joint Interface Tests, and components are reported to and coordinated with the Nuclear Materials Control Center. Each location that handles nuclear explosives, NELAs, or components notifies the Nuclear Materials Control Center prior to the transfer and after the receipt of a shipment. Each shipment of nuclear explosives, NELAs, or components moved between facilities is documented with the Nuclear Materials Control Center via a secure telephone located inside or near the loading dock, and the serial number of each individual container or nuclear explosive is verified using a computer terminal, also located inside or near the facility. The Manufacturing Resources Planning II software system is used for inventory location and tracking. The TSD Coordination Section enters these units into the MRP system upon receipt from offsite.

Tamper indicating devices (TIDs) are placed on containers containing nuclear components to deter/detect unauthorized opening. The TIDs are closely examined at transfer points during a move operation. When a container arrives at a staging facility with a broken TID, the TID custodian is notified. The TID custodian will contact Safeguards and Security, who then isolates the container. Without opening the container, it is monitored with a gamma detector to determine if the SNM is still present. A swipe of the container

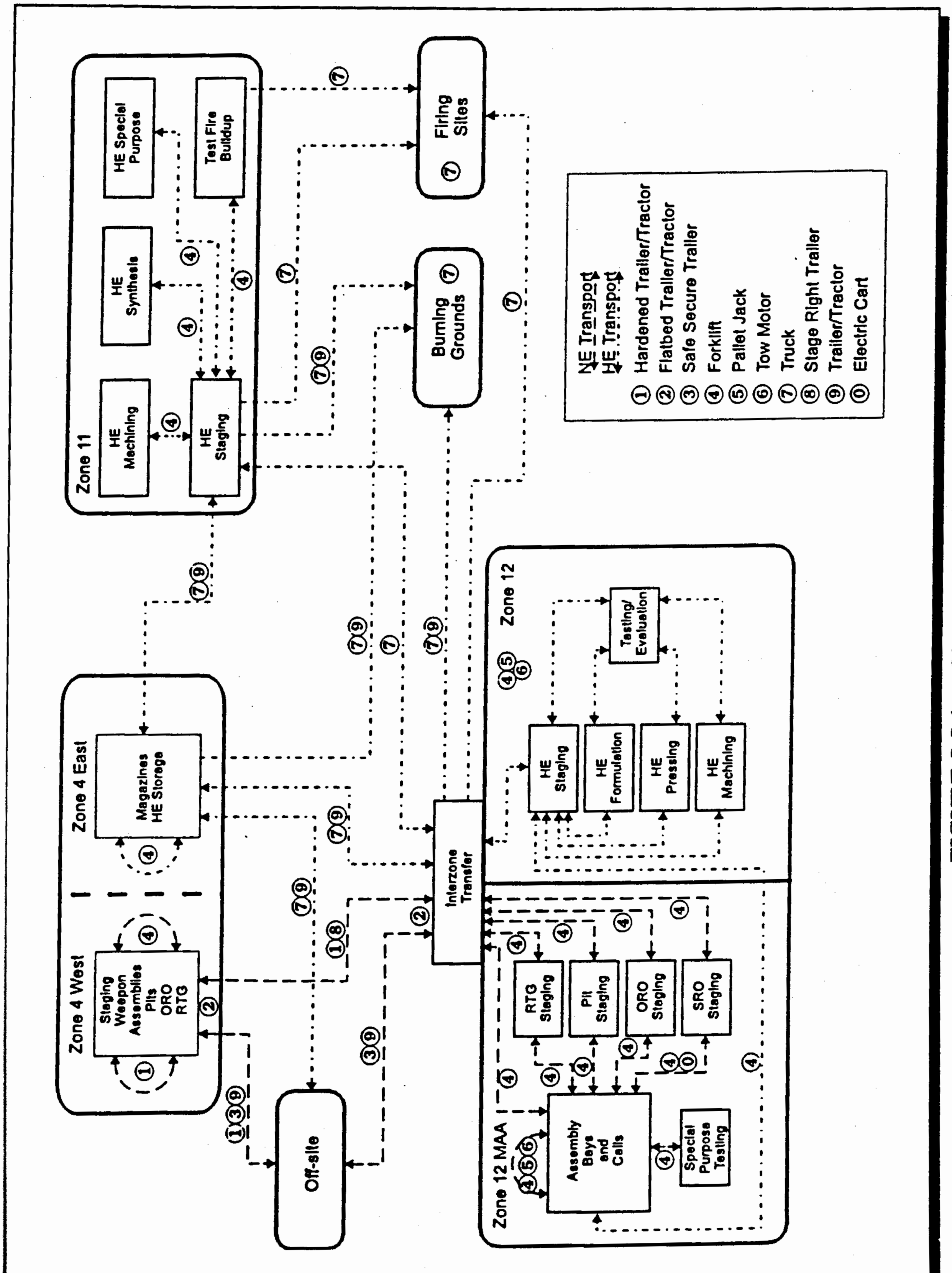

FIGURE 5.5-1.— *Master Flow Diagram.*

is also performed to determine if there has been any contamination.

The container is then opened to verify the serial number of the contents with the Nuclear Materials Control Center. Personnel will not accept any container until compliance is ensured for all administrative procedures associated with the TIDs.

5.5.1 Transfer to and from Offsite

All shipments, except nuclear explosives, nuclear components, and special assemblies, in and out of Pantex Plant go through the Traffic Section of the Packaging and Shipping Department. The Traffic Section is responsible for the receipt of commercial materials, both hazardous and non-hazardous, from offsite and for handling materials to be transported out of Pantex Plant. The shipment and receipt of nuclear explosives, nuclear components, and special assemblies is the responsibility of the TSD Coordination Section. With the exception of nuclear explosives, nuclear components, high explosives, and some hazardous materials, all other materials shipped to Pantex Plant are first unloaded at one of seven high docks located at Building 16-19. This building is located outside of the fence surrounding the Plant so that uncleared drivers may deliver their cargo with a minimum of security risks. While many hazardous substances are unloaded at Building 16-19, such as sulfuric acid, many of the operations in this building deal with non-hazardous material.

Materials coming into Building 16-19 may be either temporarily staged or immediately shipped to their final destination within the Plant. The majority of the supplies are moved directly to the chemical laboratories. If an item does not need to be shipped immediately, Building 16-19 has several chemical storage areas, which are kept locked. Different areas hold different classes of chemicals. Chemicals are stored until needed by the Plant, at which time the Transportation and Staging Operations Department transports the materials.

All hazardous materials (with the exception of HE and SNM) at Pantex Plant receive a bar coded tag containing information about the degree of hazard of the substance. Most hazardous materials are labeled when they are unloaded and unpacked at Building 16-19. The exception is Account 35 materials, which are materials used to build weapons. Account 35 materials, which may or may not be hazardous, are sent from Building 16-19 to Building 12-5B for unpacking and labeling.

The TSD Coordination Section coordinates all nuclear explosives and nuclear component movements in and out of Pantex Plant. They perform a similar function for nuclear explosives that Traffic performs for commercial items. Nuclear explosives and nuclear components are transported to and from Pantex Plant on SSTs. SST shipments are normally brought onsite at Pantex Plant through the west gate.

Nuclear explosives are shipped in containers known as H-gear or in roadables which are metal frames on casters.

Nuclear explosives are received from offsite on SSTs into the Zone 4 MAA for staging in the magazines before being transferred to Zone 12 for further processing. The act of receiving the nuclear explosive into the Zone 4 MAA from the TSD Coordination Section is called "buying the load." Several types of nuclear components are transported from Zone 4 MAA and Zone 12 MAA to offsite facilities for recycling. The act of giving the nuclear explosive to the TSD Coordination Section for transfer offsite is known as "selling the load." Occasionally Joint Test Assemblies, and NELAs are shipped from Amarillo by air. When they are taken to the airport, they are usually loaded from magazines in Zone 4 MAA. However, they may also be taken directly to the airport from Zone 12.

Explosive materials shipped to Pantex Plant from offsite are brought onsite at the east gate. Northwest of the east gate is an area called the "Inspection and Transfer Station", where some HE loading and unloading operations take place. This area is located at the north end of 15th Street, where 15th Street terminates in a T-shaped intersection with Pantex Drive. There is no loading dock in this area. This area is used to transfer arriving HE shipments from incoming vehicles to Pantex Plant vehicles, and to transfer outgoing shipments of HE from Pantex Plant vehicles to commercial vehicles. When loading or unloading of trailers is not required, the swapping of trailers is sometimes performed at this point. For safety reasons, it is remote from any buildings or other facilities. During operations in which explosives are loaded or unloaded, the street is blocked off and no traffic is allowed on the street beyond the blockades. HE may also be shipped from offsite directly to the 11-R-22 ramp loading dock (near Building 11-42) or Zone 4 East, where it can be staged before being moved to other buildings for further processing.

Type B containers, which meet the design requirements set forth in 10 CFR 71.43 and 10 CFR 71.71, are used in most offsite transfers of radioactive material[20]. Type A and Strong Tight containers are also used for certain offsite transfers. Tritium reservoirs, explosives, explosive components, other hazardous and non-hazardous materials shipped from Pantex Plant by air are loaded onto a trailer and driven to the DOE area of the Amarillo Airport. The DOE area is located on the east side of the airport on the Strategic Air Command alert strip away from all occupied buildings and the main terminal. The trailer is driven to within about 30.5 m (100 ft) of the airplane and unloaded onto the tarmac. The drums are transferred from the trailer to the aircraft by forklift, or by hand, if they are light enough. The drums are removed from pallets on the forklift into the aircraft and secured. In addition to the fire extinguishers carried by the transport truck and the airplane, another fire extinguisher is brought to the vicinity of the plane for the duration of the transfer.

Table 5.5.1-1. provides data on the amount of material transported through the Amarillo International Airport by Ross Aviation. Transports by air dropped off sharply in mid-1995 as it became less cost-effective for the site to utilize the company's services. Ross Aviation will continue to transport shipments but only on an as-needed basis rather than the weekly scheduled freight runs in the past.

Offsite transportation is conducted by two separate organizations. All SNM, nuclear weapons, nuclear explosives, and some special assemblies are moved by the DOE/TSD Couriers and Pantex Plant Transportation and Staging Operation Department. Material, hazardous and non-hazardous, not transported by one of these two activities is delivered or picked up by common carriers through arrangement with the Traffic Section of the Packaging and Shipping Department. For all movements of hazardous materials offsite by commercial vehicles, there have been no records of accidents meeting the DOT reporting criteria during the last twenty years. Information on offsite transportation accidents is provided in Section 6.3.1. DOE ships explosives by Ross Aviation. Tables 5.5.1-2. thru 5.5.1-5. contain lists of the date for each inbound and outbound shipment, the type of explosives, and the amount of explosives in the items (not the total weight of the items) for 1994 and 1995. During the 1994 time period there were two shipments where substantial amounts of explosives (tens of pounds versus grams) occurred. The first was an outbound shipment on January 14 when 61,744 g (136 lb) was shipped and the other was an outbound shipment on April 22 when 110,776 g (244 lb) was shipped. In both cases these shipments were classified as Explosive Hazard Class 1.1. The tables for 1995 show how shipments have dropped off dramatically.

TABLE 5.5.1-1.—*Quantity of Material Transported by Ross Aviation*

Fiscal Year	Non-Classified		Classified	
	Pieces	Kg (lb)	Pieces	Kg (lb)
1992	361	7,539 (16,621)	718	16,785 (37,004)
1993	188	2,781 (6,132)	434	15,791 (34,813)
1994	146	8,525 (18,795)	79	6,941 (15,301)
1995	140	7,190 (15,851)	65	4,273 (9,421)

TABLE 5.5.1-2.—*Inbound Shipments of Explosives by Ross Aviation in 1994*

Date	Amount of Explosives, grams (pounds)	Explosive Hazard Class
01/12/94	23.0 (0.05)	1.4
02/04/94	20.0 (0.04)	1.4
03/31/94	0.8 (0.002)	1.4
04/06/94	5.36 (0.01)	1.4
04/15/94	96.0 (0.21)	1.4
04/29/94	2.185 (0.005)	1.4
05/13/94	41.0 (0.09)	1.4
05/25/94	16.0 (0.04)	1.4
05/27/94	12.415 (0.03)	1.4
06/17/94	10.0 (0.02)	1.4
06/27/94	15,255.0 (33.56)	1.4
06/29/94	14.5 (0.03)	1.4
07/08/94	0.2 (0.0004)	1.4
07/27/94	14,982.0 (32.96)	1.4
08/10/94	0.04 (0.0001)	1.4
08/19/94	0.168 (0.004)	1.4
09/30/94	3.22 (0.01)	1.4
10/05/94	10.0 (0.02)	1.4
11/02/94	150.364 (0.33)	1.4

TABLE 5.5.1-3.—*Inbound Shipments of Explosives by Ross Aviation in 1995*

Date	Amount of Explosives, grams (pounds)	Explosive Hazard Class
1-26-95	< 10 (< 0.02)	1.4
2-23-95	19 (0.04) 20 (0.04)	1.4
3-1-95	0.2 (0.0004)	1.4
3-8-95	2.5 (0.006)	1.4
5-31-95	1.35 (0.003)	1.4
7-27-95	1.0 (0.002)	1.4
11-28-95	< 10 (< 0.02)	1.4

TABLE 5.5.1-4.—*Outbound Shipments of Explosives by Ross Aviation in 1994*

Date	Amount of Explosives, grams (pounds)	Explosives Hazard Class
01/05/94	0.71 (0.002)	1.4
01/07/94	2,951.0 (6.49)	1.1
01/14/94	61,744.0 (136)	1.1
02/04/94	0.38 (0.001) 15.3 (0.03)	1.1 1.4
03/11/94	6.2 (0.01)	1.4
03/16/94	1.37 (0.003)	1.4
04/08/94	48.0 (0.11)	1.1
04/22/94	110,776.0 (244)	1.1
05/06/94	10.0 (0.02)	1.4
05/20/94	18.715 (0.04)	1.4
05/25/94	4.86 (0.01)	1.4
05/27/94	0.66 (0.001)	1.4
06/10/94	2.5 (0.01)	1.4
06/24/94	20.0 (0.04)	1.4
07/20/94	5,902.0 (12.98)	1.4
07/22/94	3,600.0 (7.92)	1.3
08/05/94	11,350.0 (24.97)	1.4
09/02/94	13,661.0 (30.05)	1.4
09/30/94	22.0 (0.04)	1.4
10/27/94	107.0 (0.24) 0.21 (0.0005)	1.3 1.4
11/03/94	39.1 (0.09)	1.4
11/17/94	0.66 (0.001)	1.4

TABLE 5.5.1-5.—*Outbound Shipments of Explosives by Ross Aviation in 1995*

Date	Amount of Explosives, grams (pounds)	Explosive Hazard Class
1-26-95	17.77 (0.04) 17.63 (0.04) 10.0 (0.002)	1.4
6-7-95	5,900 (13)	1.3
7-27-95	1.5 (0.003) 1.75 (0.004) <300 (<0.7) 200 (0.4)	1.4

The current waiver granted by the DOT allows the DOE to ship explosives by air and that shipments of Explosive Class 1.1 must be reviewed on a case by case basis. While it is possible that Explosive Class 1.1 may be sent by air carrier, they are generally sent by truck. Shipments of Explosive Class 1.4 are usually small quantities (grams) and shipped in containers to mitigate an accident and pose no threat to Pantex Plant, the public, or the environment.

There are no special rules for the flight paths for aircraft carrying explosives. Ross Air aircraft fly with the same Visible Flight Rules or Instrument Flight Rules patterns as any other aircraft. Under Visible Flight Rules conditions, the inbound flight would not go over Pantex Plant whereas during Instrument Flight Rules conditions, the inbound flight would essentially go over the Plant within one mile of Zone 4. For outbound flights the current path does not take them over Pantex Plant.

5.5.2 Interzone Transfers

Interzone transportation (transportation between zones) is carried out using asphalt roads. Asphalt roads are used within Zone 4 and connect Zone 4 with Zones 11 and 12. While Zones 4, 11, and 12 are the primary working areas at Pantex Plant, asphalt roads connect other areas as well, such as the Firing Sites, Burning Ground, and the Central Shipping and Receiving Facility, Building 16-19. Figure 5.5.2-1. shows the interzone transfer routes at Pantex. Roadbeds are designed to handle heavy vehicles and are maintained by DOE-owned equipment onsite or by outside contractors.

Interzone transportation is the responsibility of the Transportation and Staging Operations Department. During an interzone transfer of a nuclear explosive, progress is tracked through control center site communications and compared with the planned schedule. There is a 90-minute time limit for completing an interzone transfer of nuclear explosives or nuclear components.

Transfer operations between zones include the transfer of nuclear explosives and nuclear components between the Zone 4 MAA and Zone 12 MAA. Other hazardous materials are unloaded at Building 16-19 and then shipped to various locations within the Plant.

Many different interzone transfers can be made. One example of a process requiring interzone transportation is the explosive machining process. Items staged in Building 12-83 are transferred to Building 11-42 for short-term staging before being delivered to Building 11-50 for machining. Scrap is typically disposed of at the burning ground through Building 11-42. Machined items are returned to Building 12-83 before being transferred to Building 12-65 for short-term staging. They are shipped from Building 12-65 to the Zone 12 MAA for assembly.

5.5.3 Intrazone Transfers

Intrazone transportation (transportation within a zone) in Zone 11 and Zone 12 is usually carried out through ramp connections between buildings, although all other zones do not have ramps. A ramp is a smooth, level, enclosed concrete path that provides shelter from inclement weather. In Zone 11, ramps typically have wood framing, with walls and roofs constructed out of either corrugated metal or plastic. In Zone 12, newer ramp walls are constructed out of corrugated metal or plastic, mounted on steel beams. However, some older ramp walls are constructed out of cemesto. Reinforced windows and metal personnel doors on both sides of the ramp are located at regular intervals. Overhead doors are located at exterior roadbed intersections for vehicle access. Personnel may travel within the ramps on foot, bicycle, pedacycle, forklift, or in small electric personnel carts.

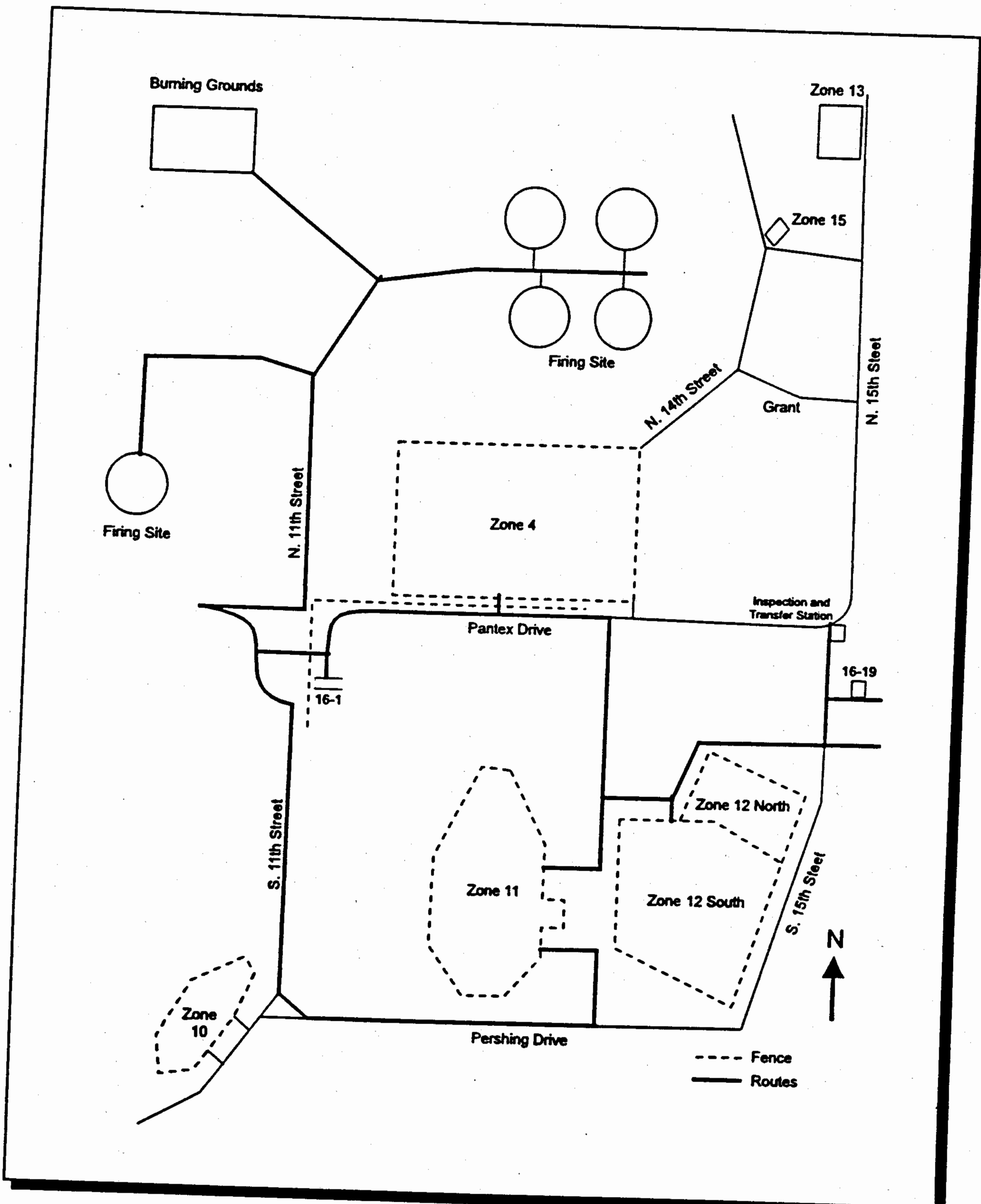

FIGURE 5.5.2-1.—*Interzone Transfer Routes at Pantex.*

Fully assembled nuclear explosives are sometimes transferred from building to building within Zone 12. Interbuilding moves of HE are typically handled by the Explosives Storage Operations Department of the Applied Technology Division, but in some situations by the Production Stores Department.

During an intrazone transfer of nuclear explosives, progress is tracked through control center site communications and compared with the planned schedule. There is a 30-minute time limit for completing an intrazone transfer.

Nuclear explosives and nuclear components are also moved from bay to bay within the same building. The Inventory Control Section of the Production Stores Department typically handles these moves. Bay-to-bay transfers are carried out with the use of transportation carts. Components are attached to the carts using appropriate tooling. Each nuclear explosive system has its own specific, custom-designed tooling.

Sometimes, hazardous chemicals are stored in outdoor sheds. Bottles of chemicals are carried into the building as needed. Glass and plastic bottles are placed in rubber baskets for ease in handling when transporting chemicals from outside storage into the building. The rubber baskets reduce the likelihood of dropping the container and help prevent a glass container from breaking if it is accidentally dropped.

One example of a process involving intrazone transfers is explosives powder pressing in Zone 12. Explosives powder to be pressed is removed from storage in Building 12-83 (magazine storage) and transported to either Building 12-17 (if IHE) or Building 12-63 (if HE) for pressing and testing. The pressed shapes are than transported to Building 12-21 for x-ray inspection.

5.5.4 Transportation of Hazardous Waste

Transportation of hazardous waste is the responsibility of Waste Operations Department. Waste Operations Department handles Class I non-radioactive and mixed waste. The waste can be in either solid or liquid form.

Many organizations at Pantex Plant generate hazardous waste. The waste generators first request a container from Waste Operations Department. Containers typically used are 208-liter (55-gallon) drums. A PX-1071 form is generated when a container is issued. The container and its intended use is entered into a database for tracking.

Once a container is full, the generator calls Waste Operations Department, which then transports the waste to a storage site. Waste Operations Department collects approximately 30 containers of waste per month.

There are approximately 11 RCRA-permitted sites at Pantex consisting of Building 11-9, Building 11-7 North Pad, and magazine 4-50 for the storage of hazardous waste. Some wastes are also stored in large 12.2-m (40-ft) long sheds called conexes.

Waste is shipped offsite by an outside vendor. The vendor accepts 92 containers of waste per shipment. As waste shipped offsite for disposal in the same shipment must be of a similar type, similar wastes from the various waste storage sites are transported to one location prior to shipment. Consequently, the waste vendor makes only one stop.

5.6 TRANSPORTATION EQUIPMENT

Equipment used in transportation includes forklifts, hardened trailers, SSTs, flatbed trailers, trucks, vans, battery-powered carts, pallet jacks, tow motors, pallet trailers, double-axle tractors, and transportation carts.

Electric forklifts are used for transporting nuclear explosives, nuclear components, high explosives, and explosive components within Zone 4, Zone 11, and Zone 12. Electric forklifts are used for handling nuclear explosives outside of the magazines in Zone 4 MAA. They are also used to handle pallets loaded with hazardous chemicals. Some forklifts are fitted with a pair of special mechanical arms used to move individual 208-liter (55-gallon) drums filled with hazardous material. Electric forklifts are used both indoors and outdoors. Nuclear explosives equipped with casters for towing may be moved between locations by forklift, using a program-specific tow bar. Nuclear explosives that are not equipped with casters are lifted and moved by inserting the forklift tines into tine locations in the H-gear.

Diesel forklifts may be used to move empty pallets, pits, OROs, JTAs, trainers, or chemical explosives within Zones 4, 11, and 12. Diesel forklifts must remain at least 7.6 m (25 ft) from a magazine when the door is open. The speed limit for forklifts is 8.1 km/hr (5 mph), and the distance between forklifts must be at least 7.6 m (25 ft). If the load on the tines of a forklift obstructs the forward view, traveling with the load trailing (i.e., backwards) is required so that the operator's view will not be obstructed. Diesel forklifts are only used outdoors. The use of forklifts equipped with gasoline engines is prohibited in transportation operations at Pantex Plant.

Hardened trailers start as basic, dry-freight, 12.2 m (40 ft) commercial trailers that are armor plated with steel tread plating over a wooden floor. Landing gear consists of metal posts mounted on the front of the trailer that are lowered to the ground to support it when parked. They are also commonly referred to as Utility trailers (Utility is the name of the trailer company). The sides of the trailers consist of a stainless steel alloy, lined with exterior grade plywood and armor plating. The empty weight of the trailer is approximately 16,330 Kg (36,000 lb). The trailers have three tie-down tracks (right, left, and center). Tie-down chain assemblies with adapters are used to secure cargo in these trailers. Hardened trailers are used for the onsite transportation of both nuclear explosives and weapon components between Zone 12 MAA and Zone 4 MAA. They are also used to transport H1616 containers and NELAs from Pantex to the Amarillo Airport.

Safe secure trailers (SSTs) are similar to hardened trailers. They have landing gears, five tie-down tracks, and standard aluminum budd wheels with special brake systems. SSTs are designed for offsite transportation and therefore contain safety and security features not found on hardened trailers. SSTs are normally used only for offsite shipments of nuclear explosives, SNM, and special assemblies. SSTs can be used for onsite transportation as well.

Flatbed trailers are basic 12.2 m (40 ft) commercial trailers with the same bed height as the hardened trailers and SSTs. They are used as fixed loading platforms during hardened trailer or SST loading and unloading operations. Flatbed trailers are pulled by safety-approved tractors. During loading and unloading operations, a personnel ladder is used to climb to and from the trailer. Side boards are installed to prevent the load from sliding off the trailer bed.

Trucks and vans are used to transport shipments, such as explosive powders and explosive components, to the various operating areas of the Plant. These vehicles are equipped with tie-down provisions to prevent load shifting during transit. They are also equipped with fire extinguishers, spark arresters, warning placards, and lights.

Battery-powered transport carts equipped with wire baskets are used for transporting inert material, reservoirs in Kennedy kits, and RTGs. Battery-powered carts are often used for personnel transportation.

Pallet jacks are hand-operated, unpowered devices used to move materials for short distances or in spaces where forklifts cannot be employed. They are used in Zones 4, 11, and 12 as required for processing in bay and cell operations and for staging in magazines. The wheeled forks of a pallet jack will fit between the top and bottom boards of a double-faced pallet. The wheels lower into spaces between the bottom boards to raise the pallet off the floor for transporting. The physical design of a pallet jack limits it to lifting its load only a few inches off the floor.

Tow motors are motorized devices used for towing equipment such as carts and trailers. A tow motor has no provisions for lifting or loading material or for personnel transport. Tow motors are used to improve control of nuclear explosives during short distance moves, thereby eliminating hand movements. Movement is under two-person control at slow speed. Tow motors are EE-rated and use batteries requiring periodic charging.

Pallet trailers are used to transport pits between Zone 12 MAA and Zone 4 MAA. The pallet trailers are nonhardened and double-axled. The frame of the trailer is the load-bearing structure so that the outer skin and rivets are not subjected to any load other than their own weight. The pallet trailers are capable of transporting a 2,722 kg (6,000 lb) load and are towed by trucks. They are specifically built to hold staging pallets used in the Stage Right Project, which are capable of accommodating either four or six containers.

Double-axle tractors are used for pulling hardened trailers and SSTs. These tractors are equipped with two-way radios, allowing communication with the Guard Headquarters and Transportation and Staging Operations Department dispatcher. Tractor braking switches are easily actuated by either the driver or passenger.

Transportation carts are used to transport fully-assembled weapons on H-gear without casters. Carts are also used for moving nuclear explosives in various stages of assembly or disassembly between locations. Nuclear explosives and subassemblies are loaded on to or removed from carts using the appropriate lifting fixtures, slings, or the bay hoist/crane. Carts with nuclear explosives may be designed for movement by forklift towbar, forklifting, or by hand-pushing.

5.7 Description of Typical Transfers

The following paragraphs describe transfer procedures for different objects, including fully assembled nuclear explosives, pits, ORO components, HE, tritium reservoirs, RTGs, chlorine, and other items of interest.

5.7.1 Transportation of Fully Assembled Nuclear Explosives

Transportation of fully assembled nuclear explosives on transportation carts or in special containers is carried out by using forklifts, SSTs, or hardened trailers.

Fully assembled nuclear explosives arrive at Pantex Plant in an SST. The nuclear explosives are staged in Zone 4 MAA before being sent to Zone 12 MAA for disassembly. Since nuclear explosives typically are removed from the SST in front of the magazine in which they are to be staged, a flatbed trailer may be used. The flatbed trailer is backed up to the SST, the tractor ignition is turned off, the wheels are chocked, and a hinged bridge plate on the flatbed trailer is lowered to cover the gap between the trailers. The bridge plate is not secured to the SST, but only supported by it. A forklift on the back of the flatbed drives into the SST, removes the nuclear explosive, and places it on the flatbed. Nuclear explosives on H-gear equipped with casters are lifted down to the ground by an electric forklift and rolled into the magazine by hand. Two flatbed trailers are equipped with a turntable mounted flush in the deck. Nuclear explosives without casters are positioned on the turntable. The nuclear explosive is then turned to the proper position for pickup by a forklift. The forklift on the ground then removes the nuclear explosive from the flatbed trailer and transports it into the magazine. The nuclear explosive is then staged in the magazine.

Although most nuclear explosives are removed in front of the Zone 4 MAA magazine in which they are to be staged, as described in the preceding paragraph, some weapon systems cannot be unloaded using this procedure because of their weight. The loading dock at Building 4-26 is used instead. The operations start with backing the transportation vehicle to the lift platform. The rear vehicle doors are opened prior to approaching the platform. The truck driver obtains the services of a spotter to guide the backing of the vehicle. The vehicle is backed into position, the dock plate is positioned, and the wheels are chocked. Removable safety rails are installed. With the lift platform in place, the unit is off-loaded from the SST by attaching a chain from the tongue of the unit to a forklift. The forklift then pulls the unit out of the SST. The wheels of the transportation dolly are chocked while on the lift platform. After the unit is removed from the truck, the lift and unit are lowered to floor level and then towed to the storage location. The reverse occurs when the unit is being loaded onto the transportation vehicle.

When a nuclear explosive is ready to be transported to Zone 12 MAA, it is loaded onto a hardened trailer using a flatbed trailer, the reverse of the unloading process. The hardened trailer then takes the nuclear explosive to Zone 12 MAA.

Nuclear explosives and weapon components are unloaded in Zone 12 MAA through low docks. The hardened trailer is backed up to the flatbed trailer in front of the roll-up door with the rear vehicle doors opened. The truck driver obtains the services of a spotter to guide the approach of flatbed trailer. The material is then moved either manually or by a lifter on the trailer. A forklift is then used to move the material off the flatbed trailer and down the ramps to its destination. As this procedure is cumbersome, new loading docks have been constructed that will allow the hardened trailer or SST to back up to the dock so that forklifts can drive directly onto the hardened trailer or SST.

A protective blanket may be put on some nuclear explosives when they are loaded in Zone 4 MAA, before the nuclear explosive is removed from the magazine to be positioned on the trailer. These blankets are bullet- and fragment-proof. Once the nuclear explosive is placed inside the trailer, the blanket is removed to allow for proper tiedown of each unit. On delivery of nuclear explosives to Zone 12 MAA, a protective blanket may be installed on each nuclear explosive, after removing tie-down equipment and before removing the nuclear explosive from the trailer. Similar procedures are followed when transporting nuclear explosives from Zone 12 MAA to Zone 4 MAA. SSTs loaded with weapons (both ingoing and outgoing) are frequently staged in the Zone 4 MAA temporarily pending shipment offsite, movement to Zone 12 MAA, or off-loading. Weapons are never stored in hardened trailers except in the event of inclement weather. If lightning warnings or severe thunderstorm warnings go into affect during a transport in a hardened trailer, the move will continue to its destination where the weapons will be staged until the storm warnings are lifted and then the off-loading of weapons will immediately commence.

5.7.2 Transportation of SNM

Special nuclear material, commonly referred to as SNM, includes plutonium, uranium-233, or uranium enriched in U-233 or U-235. Typical SNM items transported at Pantex Plant include pits, ORO components, and RTGs.

Pits are transported in pit containers (e.g., AL-R8 drums). The drums are secured and transported on an SNM tie-down pallet or on the staging pallets used in the Stage Right Project. There are two types of stage right pallets. The first is capable of accommodating four containers and the second can hold six containers. The capacity of a the stage right pallet trailer is twenty-four containers.

ORO components are typically transported in DT containers. If the ORO components are not in unit shipping containers, the containers are secured and transported on an SNM tie-down pallet.

Within the Zone 12 MAA, tritium reservoirs can be transported in Kennedy kits or suitcases. The kit is transported in a wire basket secured either to a forklift or to the bed of an electric cart. A wire basket must be secured with a CGU-1/B nylon strap. Reservoirs are transferred from Kennedy kits or suitcases to AL-S1 (H1616) containers for shipment offsite. The H1616 container can be used for both onsite and offsite transportation.

RTGs typically are transported in 6M drums. When transported in drums, the drum is secured on the SNM tie-down pallet.

5.7.3 Transportation of HE Components

HE of all hazard classes is generally transported in AN cans, although other kinds of containers may be used for certain types of components (for example, explosive powders may be moved in fiberboard drums or boxes, or in wooden boxes). The AN cans are tied down on pallets, which are picked up and moved to the loading dock to be loaded onto a transport vehicle for road movement.

DOT Hazard Class/Division 1.1 is the greatest hazard class of components. Typical Class/Division 1.1 items include pressed HE pieces and shaped HE components. These components are usually transported in AN cans on special pallets.

DOT Hazard Class/Division 1.2 includes non-mass detonating, fragment-producing explosives such as shells, mines, and grenades. Such materials generally are not found at Pantex Plant.

DOT Hazard Class/Division 1.3 includes IHE components and some spin rockets. They may be transported in a wire basket secured to the tines of a forklift.

DOT Hazard Class/Division 1.4 includes detonators, igniters, timers, and switches. They may be transported in a wire basket secured to the tines of a forklift (as with DOT Hazard Class/Division 1.3 components) or in a box having forklift locators.

For bay-to-bay transfers within buildings, scrap pieces of explosives produced by machining are packaged in AN containers. AN containers may be used for both HE and IHE. The containers are transported either in a transport cart or in a special intrabuilding transfer cart. When transported between buildings or zones, scrap HE is handled like any other piece of HE.

5.7.4 Transportation of Materials to and within the Burning Ground

The Transportation and Staging Operations Department is responsible for moves to the burning ground. Moves within the burning ground are the responsibility of the Applied Technology Division. Most HE moves to the burning ground are made from Buildings 12-83 and 11-42. However, movements can be made from other buildings in Zone 12 as well. Typically, AN type containers are used to transport HE to the burning ground. Containers loaded with HE typically are placed on special pallets which would hold 4 AN cans or transfer carts with wheels which can transport a single AN can. The special pallets or transfer cart can be moved to the loading dock where the pallet with AN cans or AN cans only are loaded on the transport vehicle. The cans are placed side by side and strapped to the truck bed. The pallet itself may also be loaded directly onto a truck with the aid of a forklift. The pallet is tied to the floor of the truck with chains or straps. The truck is then driven to the burning ground.

Once at the burning ground, the HE may be either burned immediately or staged. The HE to be burned immediately is off-loaded from the truck by diesel forklift on the road and then transported by forklift to the burning tray. The HE to be staged is offloaded and staged at BG-3. When a burning tray becomes available for the staged HE, an empty four-position pallet is loaded onto a diesel forklift. One container is hand-loaded onto the pallet in the front position (near end of tines). The forklift is then driven to a burning tray. The forklift places the pallet near the tray and backs away. The container is opened, and the HE is removed and placed onto the tray for burning. After the HE is burned, the forklift returns, picks up the pallet and empty container, and returns to the staging area near the control bunker.

5.7.5 Transportation of Materials to and within the Firing Sites

The Transportation and Staging Operations Department is responsible for moving test fire assemblies and HE between the firing sites and other buildings at Pantex Plant. Transportation within the firing site area is the responsibility of firing site personnel. All shipments to the firing site are received at the FS-11 receiving dock, except those received directly at FS-2, FS-10, and FS-21. Shipments arrive from Zones 11 and 12, and possibly Zone 4 East, although the usual procedure would be for shipments from Zone 4 East to go to Zone 12 before being sent to the firing site.

Materials are usually transported to the firing site in vans that have been fitted for transporting explosives, with safety devices such as fire extinguishers, tie-down straps, spark arresters, warning lights, and placards. Transportation at the firing site is provided by either van or pickup truck driven by firing site personnel. Most packages received at the firing site are light enough to be hand-carried. However, the pickup truck is fitted with a lifting fixture for loading and unloading heavy packages.

5.7.6 Transportation of Chlorine Bottles

Chlorine is the most hazardous non-explosive, non-radioactive material at Pantex Plant. It is used for water treatment primarily at two locations, Building 15-29 (water treatment) and Building 13-47 (sewage treatment).

Chlorine is delivered in 68-kg (150-lb) metal cylinders to the site. The cylinders are transported on racks and unloaded by forklift. The racks accommodate up to six cylinders. Cylinder valves are protected with robust cylinder valve caps during movement and storage. As chlorine is a high health hazard, the racks are not stored at Building 16-19. The Transportation and Staging Operations Department transports the cylinders to the water treatment centers soon after arrival.

5.8 SAFETY-RELATED SUPPORT SYSTEMS

The following section discusses the various safety-related support systems used in the transportation operations at Pantex Plant: tie-down equipment, bullet- and fragment-proof blankets, fire protection, lightning protection, and radiation monitoring.

5.8.1 Tie-Down Equipment

Tie-down equipment ensures that containers with hazardous materials do not shift or slide during transport. This equipment includes type MB-1 chain assemblies, nylon straps, tensioners, vehicle and trailer floor lugs, mechanical ratchets, chain and cable pullers, slings, rails, plates, and other necessary hand tools. Not all types of tie-down equipment are used in every vehicle.

5.8.2 Bullet and Fragment Protective Blankets

Protective blankets are provided for nuclear explosives, carts used to transport high explosives, high explosives subassemblies, physics packages, and other units or components that are susceptible to damage or degradation and to meet nuclear explosive safety and security requirements. Carts (roadable, H-gear, dollies, etc.) transporting nuclear explosives or physics package configurations with conventional HE components have protective covers that afford ballistic protection or have provisions to accept protective blankets. The protective blankets used for different nuclear explosive programs are specified in Pantex Plant standards. The blankets are made of Kevlar™[21].

5.8.3 Fire and Lightning Protection

Fire detection and suppression systems with sprinkler heads are installed in most of the ramps and loading docks. There are two water supply systems at Pantex Plant. One is a combined system supplying both domestic and fire protection needs. The second is the high-pressure fire loop dedicated for fire protection only. Where detection and suppression systems are available, the systems meet applicable code requirements for emergency operations, including backup power.

No fire suppression systems are available in Zone 4. However, each magazine in Zone 4 is equipped with two portable fire extinguishers. Fire extinguishers are spaced at intervals along both sides of ramps in Zone 11 and Zone 12, and are placed in buildings in these zones.

All gasoline-powered vehicles are equipped with at least a 1.1-kg (2.5-lb) ABC portable fire extinguisher. Larger trucks used to carry HE are equipped with a 4.5-kg or 9.1-kg (10-lb or 20-lb) ABC-type fire extinguisher in addition to the 1.1-kg (2.5-lb) extinguisher.

The lightning protection for buildings, ramps, and magazines is typically an integrally mounted system with a maximum resistance of 10 ohms. The lightning protection system serves to limit and localize damage to facilities, and to ensure that effects to personnel and materials being transferred are negligible.

5.8.4 Radiation Monitoring

Radiation monitoring is performed on nuclear explosives and containers of radioactive material received at Pantex Plant. The monitoring is performed to ensure that nuclear explosives and containers have not sustained damage or radioactive leakage during shipment. Vehicles that carry radioactive materials are also monitored. This monitoring is usually done by taking swipes of the SNM containers and making radiation measurements with ion chambers. Radiation monitoring is also done before items are shipped offsite.

5.9 Preventive Maintenance and Inspection

Upon receipt of new equipment at Pantex Plant, the Maintenance Reliability Section is notified by Property Management or the Maintenance Planning Section. Equipment, warranties, and maintenance procedures are the responsibility of the Maintenance Reliability Section.

Each item to be inspected is entered into a computerized database that includes the property number, description, location, property location custodian, base month and year, craft to perform the inspection, frequency, schedule hours, and tasks to be performed. Each month, a fraction of the vehicles at Pantex Plant receive a preventive maintenance (PM) inspection. A monthly PM schedule is generated from the computerized database. This monthly schedule is divided into weekly schedules that are sent to the applicable craft shops to be worked.

Completed PM work orders are returned to the Maintenance Reliability Section where they are reviewed. Evaluation of this maintenance craft feedback provides for the continuous review, update, and validation of PM work instructions. The PM completion date, repairs if noted, hours required, and craft personnel performing the inspection are entered into the computer for historical maintenance record. Completed PM work orders are kept on file at the Vehicle Maintenance Facility or in the Maintenance Reliability Section.

Safety-related equipment and systems that are subjected to periodic maintenance and inspection include containers, forklifts, utility trucks, tow motors, SSTs, hardened trailers, flatbed trailers, protective blankets, portable fire extinguishers, and tie-down equipment. Offsite vehicles, such as SSTs, are maintained to vigorous DOT regulatory requirements.

5.10 Incident Procedures

As defined in DOE Orders, an incident is any deviation from normal operations or activities that has the potential to result in an emergency. The following paragraphs describe the transportation procedures for movement of explosives under special circumstances, such as inclement weather, fire, or mechanical breakdown of the vehicle. These procedures apply to both nuclear and non-nuclear explosives. They apply to both interzone transfers and intrazone transfers, whether they take place outdoors or within ramps.

If an emergency condition is found to exist, the Pantex Emergency Management Plan is activated and the Operations Center (OC) transitions into the Emergency Operations Center (EOC). Mitigation of the emergency is managed from the EOC by the Emergency Management Team in accordance with the Plant's series of Emergency Preparedness Procedures.

During inclement weather, operations at Pantex Plant may be suspended if the weather conditions introduce unacceptable risks. The on-duty Facility Manager (or alternate) responsible for the transportation of explosives between Zones 4 and 12, and the loading, unloading, and handling of explosives in the staging area, shall evaluate on a case-by-case basis the transport of nuclear explosives and/or HE during inclement weather and approve and disapprove such requests. Typical inclement weather situations include icy roads, snow-packed roads, blizzard conditions, fog, dust storms, and electrical storms.

If nuclear explosives are to be moved on roads covered with ice or snow, the vehicle must be equipped with tire chains. The speed limits must be reasonable and prudent for prevailing road conditions and shall not exceed 32.2 km/hr (20 mph). The speed is reduced in bad weather below 32.2 km/hr (20 mph) consistent with road conditions and other safety considerations.

Vehicles en route with nuclear explosives or HE when inclement weather strikes may continue to their destination before ceasing operations. Loading and unloading operations are to cease immediately upon notification from the Operations Center that an electrical storm warning is in effect. Materials that have been loaded onto the dock may be moved into the building. Operations may resume when the electrical storm has passed and the "all clear" has been given.

In case of an incident involving a vehicle fire, the load should be inspected for evidence of fire, and the Pantex Fire Department and the plant security force should be notified. Local police should be notified if the incident has offsite consequences. In the meantime, the transportation crew should fight the fire with available fire extinguishers. However, if the explosives load is threatened by the fire, all persons should be evacuated to a staging point at a pre-established safe distance.

If a mechanical breakdown occurs during transportation of non-nuclear explosives, the vehicle should be removed from the road as far as is practical. For traffic safety, emergency reflectors, signals, etc. should be posted. The vehicle trouble should be reported to Plant Security and Safety Departments. In the meantime, the crew should maintain surveillance of the vehicle and remove the vehicle load, if necessary, for vehicle repair.

5.11 CONTAINERS

Several types of containers are used as packages for nuclear explosive components, explosives, material movement, and nuclear explosives at Pantex Plant (Table 5.11-1.). These containers provide protection of their contents from accidents during transportation, contribute to criticality safety, provide extra protection from fires and flooding during staging, and provide additional confinement features for their contents. The design requirements and degree of protection provided by the container depends on the purpose and use of the container, and some containers are provided separate safety analysis reports. For example, constraints for containers used for offsite transportation of radioactive materials are given in 10 CFR 71 Subpart H. The use of containers in the bays is administratively controlled by the building safety standards. Table 5.11-1. summarizes the major features of several of these containers.

Many of the nuclear explosive components listed in the first column of Table 5.11-1. are cased or encapsulated. For instance, plutonium pits are cased, and HE is required to be encapsulated when plutonium is present. Encapsulated components therefore have two levels of protection or confinement: the encapsulation is the first level and the transportation container is the second level.

All warheads, re-entry vehicles, artillery shells, and some types of bombs are contained within metal shipping packages. Other types of bombs, NELAs, and some ORO components are not packaged, but rather are fastened into metal frames on casters (called roadables or H-gear). H-gear is designed by Sandia National Laboratories and constructed under contract to DOE. All pits and RTGs and some ORO components are packaged in sealed steel containers. Other types of ORO components are staged in plywood-and-steel boxes.

Pits containing plutonium are staged only in AL-R8 containers and shipped in FL containers. AL-R8 containers are categorized by the DOT as specification 17H steel drums and are modified by fitting a 2.5-cm (1-in.) plastic vent plug in the top lid. There are four sizes of AL-R8 containers: Models 2030, 2040, 2050, and 2060. The model number refers to the 50.8-cm (20-in.) diameter of the drum and its 76.2-, 101.6-, 127.0-, or 152.4-m (30-, 40-, 50-, or 60-in.) height. All AL-R8 containers are constructed of 18-gauge 0.12-cm thick (0.0475-in) carbon steel and weighs approximately 45 kg (100 lb). Within an AL-R8 container, a pit is secured on a metal frame and is surrounded by Celotex (high-density cane-fiber pressboard) insulation.

The AL-R8 will be phased out in favor of the new AT-400A pit storage container. The AT-400A was introduced at Pantex Plant in 1995 and should be fully implemented by the end of 1997. The AT-400A is approximately 50.8 cm (20 in.) in diameter and 71.1 cm (28 in.) high. It will be constructed out of 304C stainless steel. Prototype containers are currently undergoing testing at Sandia National Laboratories. The AT-400A will be much more durable and robust than the AL-R8 and has been designed to fit current Stage Right equipment and technology. The new container is designed for both transportation and storage functions. A fully loaded AT-400A will weigh approximately 136 to 159 kg (300 to 350 lb), compared with 45.4 kg (100 lb) for an AL-R8. The AL-R8 container does not pose any

TABLE 5.11-1.—*Specifications for Containers Used at Pantex Plant*

	Type of Container	Dimensions and Structural Characteristics (General)
Pits (plutonium)	AL-R8	• 18-gauge carbon steel drum; 50.8 cm diameter; 76.2, 101.6, 127.0, or 152.4 cm height (20-in. diameter; 30-in., 40-in., 50-in., or 60-in. height) • 2.5 cm (1-in.) vent plug in top • Celotex™ insulation
	AT-400A	• Will replace the AL-R8 • 304C stainless steel; 50.8 cm diameter; 71.1 cm height (20-in. diameter; 28-in. height) • Fire resistant foam liner
	FL	• 16-gauge stainless steel outer containment drum; 57 cm diameter; 127.0 cm height (22½-in. diameter, 50-in. height) • 12-gauge stainless steel inner containment drum; 35.1 cm diameter; 96.5 cm height (13 4/5-in. diameter, 38-in. height) • Celotex insulation • Meets Type B package constraints (10 CFR 71)
Pits (uranium)	DT-9	• 18-gauge carbon steel drum; 33.6 cm diameter; 88.9 cm height (24-in. diameter, 35-in. height) • Celotex insulation
	DT-23	• 16-gauge stainless steel outer containment drum; 84.3 cm diameter; 103.9 cm height (33 1/5-in. diameter, 40.9-in. height) • 0.42 cm (0.165-in.) stainless steel inner containment drum; 52.8 cm diameter; 68.6 cm height (20 4/5-in. diameter, 27-in. height) • Celotex insulation • Meets Type B package constraints (10 CFR 71)
ORO Components	Metal Drums	• Various wall thickness ranging from 18- to 14-gauge • Carbon or stainless steel • Various sizes ranging from 114 to 416 liters (30 to 110 gal)
	DT-18	• Outer confinement is 208 liter (55-gal) drum with 18-gauge stainless or low carbon steel wall and 16-gauge lid • Inner containment constructed of 35.6 cm (14-in.) schedule 10S stainless steel pipe; O-ring sealed heads; construction meets ASME Pressure Vessel Code; contoured polyurethane supports/centers components • 7.1 cm (2-13\16 in.) thick Celotex and plywood insulation between inner pipe and outer drum • Meets Type B package constraints (10 CFR 71)
	4000 Series Boxes	• Wooden box measuring 58.4 cm high, 61 cm deep, 96.5 cm long (23 in. high, 24 in. deep, 38 in. long) • Plywood plank sides • Steel base; 7.6 cm (3-in.) steel band around width of device

TABLE 5.11-1.—*Specifications for Containers Used at Pantex Plant (Continued)*

Component	Type of Container	Dimensions and Structural Characteristics (General)
	7000/8000 Series Boxes	• Wooden box measuring 99.1 cm high, 86.4 cm deep, 198.1 cm long (39 in. high, 34 in. deep, 78 in. long) • Plywood plank sides • Steel base; 7.6 cm (3-in.) steel band around width of device
RTGs	DT-6M	• 20-gauge, 37.9 liter (10-gal) carbon steel drum; 33 cm diameter, 61 cm height (13 in. diameter, 24 in. height) • Four, 1.27 cm (½-in.) vent holes near top
Explosives	Various	Various (including "AN Cans," "detonator cases," wooden boxes, and cardboard boxes)
Tritium Reservoirs	Kennedy Kits	Light sheet metal, briefcase style containers measuring 30.5 cm x 25.4 cm x 20.3 cm (12 in. × 10 in. × 8 in.), with urethane foam liner
	H1616	• Outer drum is manufactured from 18 gauge 304 stainless steel; 41.7 cm diameter, 54.1 cm height (16.4 in. diameter, 21.3 in. height) • High performance alumina silica ceramic fiber insulation • Fire retardant polyurethane foam encapsulates the thermal barrier • Stainless steel liner • Containment vessel made of 304 austenitic stainless steel; 30.76 diameter, 36.3 cm height (12.11 in. diameter, 14.3 in. height) • Meets Type B package constraints (10 CFR 71)
	"Suitcases"	Similar to Kennedy kits, except filled with egg-crate type foam padding and ~51 cm (~20) in long
Nuclear Explosives/ Nuclear Explosive Components	None/Various	Various
	DT-20	• Outer confinement is 552.6 liter (146-gal) drum with 16-gauge stainless steel wall and lid • Inner containment constructed of stainless steel ASME SA312 pipe; O-ring sealed heads; construction meets ASME Pressure Vessel Code; contoured polyurethane supports/centers components • 11.6 cm thick (4-9\16 in. thick) Celotex fiberboard insulation between inner pipe and outer drum • Meets Type B package constraints (10 CFR 71)
Chlorine	Cylinders	68 kg (150 lb) capacity metal cylinder with valve
Most Chemicals	Various	Containers of various sizes, many 3.8 liter (1 gal) or less, are used to store hazardous chemicals. The containers may be either glass or plastic.

safety hazards for the current transportation environment. The AL-R8 was certified as a DOT Type B container previously. The AT-400 will be certified as a DOT Type B container.

Plutonium pits may also be placed in FL containers, which are double-containment stainless steel drums categorized as Type B shipping packages. The outer containment drum of an FL shipping package measures 57 cm (22½ in.) in diameter and 127 cm (50 in.) high. The drum is constructed of 16-gauge 0.15-cm thick (0.0595-in.) stainless steel. The inner containment drum (where the pit is located) is constructed of 12-gauge 0.27-cm thick (0.1054-in.) stainless steel and measures 35.1 cm (13.8 in.) in diameter and 96.5 cm (38 in.) high. Celotex packing material is used between the inner and outer containment drums and also around the pit inside the inner containment drum.

Pits made only of uranium (i.e., no plutonium components) are placed and transported in either DT-9 or DT-23 containers. DT-9 containers are 18-gauge, DOT-specification 17H steel drums, 33.6 cm diameter and 88.9 cm high (24 in. in diameter and 35 in. high). As with the AL-R8 pit containers, the pit is secured on a metal frame and surrounded by Celotex. DT-23 containers are double-containment, stainless steel drums categorized as Type B shipping packages. The outer containment of this package consists of a 84.3-cm (33 3/16-in.) diameter, 103.9-cm (40 7/8-in.) tall drum constructed of 16-gauge stainless steel. The inner containment drum, where the component is located, is 52.8 cm (20 4/5 in.) in diameter, 68.6-cm (27-in.) tall, and constructed of 0.42-cm thick (0.165-in. thick) stainless steel. Celotex packing material is used between the inner and outer containment drums and around the component inside the inner containment drum.

ORO components are staged and transported in several other types of containers. These containers fall into two broad categories. The majority of these components are contained in metal drums, which are generally categorized by DOT as specification 6C steel barrels or drums. Various sizes of metal drums are used in the bays, ranging in size from 114 to 416 liter (30 to 110 gal). These containers are manufactured of 18-gauge to 14-gauge 0.19-cm thick (0.075-in. thick) carbon or stainless steel. The other type of ORO component container used in the bays is a steel and wooden box. The two types of steel and wooden boxes used for these components are the 4000 series box and the 7000/8000 series box. Both types of box consist of a massive steel base, with a nominal 7.6-cm wide (3-in. wide) steel band that secures the component to the base along the width of the box; 1.9-cm (3/4-in.) plywood planks forming the exterior surfaces of the box; and steel angle iron along the edges of the box. The 4000 series box is approximately 58.4-cm (23-in.) high, 61-cm (24- in.) deep, and 96.5-cm (38-in.) long. The 7000/8000 series box is approximately 99.1-cm (39-in.) high, 86.4-cm (34-in.) deep, and 198.1-cm (78-in.) long.

RTGs are staged and transported in DT-6M containers. The DT-6M containers are standard 37.9 liter (10 gal), DOT-specification 6M metal packages, which are constructed of 20-gauge 0.1-cm thick (0.035-in. thick) carbon steel. These containers measure about 33 cm (13 in.) in diameter and 61-cm (24-in.) high. The DT-6M containers have at least four 0.27-cm diameter (½-in. diameter) vents near the top, each covered with either weatherproof tape or a fusible plug. A layer of porous refractory fiber is placed behind these pressure-relief vent holes.

Explosives can be packaged and transported in many different kinds of containers, including metal drums (called AN cans), metal detonator suitcases, cardboard and wooden boxes, and other types of containers. Except for the metal drums and suitcases, these containers provide little or no physical protection to their contents, unless packaged to meet DOT requirements for transportation.

Tritium reservoirs are placed and transported in suitcase type containers called Kennedy kits and suitcases. Kennedy kits are constructed of light sheet metal and are lined with urethane foam. These kits accommodate a wide variety of tritium reservoir sizes and shapes for onsite transport. Suitcases are similar to Kennedy kits, except they are longer and an egg-crate type padding is used. The H1616 container is used for off-site transportation of reservoirs. The H1616 is certified as a Type B container. The outer drum and the inner container are separated by fiberboard insulation. Components to be shipped are supported and centered inside the inner container by contoured polyurethane forms. The inner container is constructed to meet ASME Pressure Vessel Code constraints.

Some nuclear explosives are placed in metal fixtures while they are inside the bays whereas some are not placed in any fixture. The fixtures for each type of nuclear explosive differ, and the only common feature of these fixtures is that they are all constructed of steel. The DT-18 and DT-20 containers are approved for off-site transportation of specific nuclear explosives, components, and ORO items. The containers consist of outer steel drums and inner stainless steel containers. The outer drum and the inner container are separated by fiberboard insulation. Components to be shipped are supported and centered inside the inner container by contoured polyurethane forms. The inner container is constructed to meet ASME Pressure Vessel Code constraints.

Chlorine gas and other hazardous gases are stored in metal cylinders with a valve. Most other liquid chemicals are stored in glass or plastic containers. The chemical containers are usually one gallon or less in capacity.

The containers described in this section are illustrative. Containers designed to comparable criteria, in particular DOT criteria for Type B packages, can be used for components.

5.12 SAFETY DOCUMENTATION

A Safety Analysis Report (SAR) has been recently completed for the transportation operations and loading docks at the site and is currently being reviewed by the DOE. A series of Nuclear Explosive Safety Studies (NESSs) and Safety Analysis Reports for Packaging (SARPs) have been completed. Neither the NESSs nor the SARPs address a worst-case unmitigated accident. The safety evaluation for the NESS was performed using a modified task analysis very similar to a hazard and operability study and a failure modes and effects analysis (FMEA), similar to a SAR. The consequence and likelihood categories from DOE/AL 5481.1B were used[22]. All DOE nuclear explosive operations, including transportation, are evaluated to examine compensatory measures and when necessary to put measures in place that will:

1. prevent nuclear explosives involved in accidents or incidents from producing a nuclear yield;
2. prevent deliberate prearming, arming, or firing of a nuclear explosive;
3. prevent the inadvertent prearming, arming, or releasing of a nuclear explosive in all normal and credible abnormal environments;
4. ensure adequate security of nuclear explosives pursuant to the DOE safeguard and security requirements; and
5. prevent accidental, inadvertent, and deliberate unauthorized dispersal of plutonium to the environment[23].

Other guidance documents include TP 20-7, TP 45-51, TP 45-51A, and TP 45-51D[24,25,26,27].

NESSs are divided into general master studies that include seven analyses for general activities and operations and program NESS and thirty analyses for specific programs. Lists of the current general master studies and program NESSs are shown in Tables 5.12-1. and 5.12-2. SARPs contain analyses similar to SARs, but are specific for transportation and handling of weapon components. A list of the SARPs applicable to

TABLE 5.12-1.—*List of General Master Studies*

Approval	Title
10/12/88	General Use Handling and Transportation Equipment at the US DOE Pantex Plant
11/15/88	General Use Nuclear Explosives Processing Facilities at the US DOE Pantex Plant
12/22/88	Operating and Staging Facilities at the US DOE Pantex Plant
07/03/89	Nuclear Explosive-Like Assemblies
12/21/89	Over-the-Road and Rail Transportation of Nuclear Explosives
01/26/93	Pantex Plant Security Operations
05/28/93	Critical Assembly Area Testers and Other Electrical Equipment Qualification, Verification, Control, and Use at the US DOE Pantex Plant

TABLE 5.12-2.—*List of Program NESSs*

Program	Date	Title
B28	01/15/87	NESS of B28 Bomb Assembly Operations
B28	11/18/87	NESS of B28 RI Disassembly Operations
W31	05/20/87	NESS of W31 MOD 2 Disassembly Operations
W43	02/26/87	NESS of W43 Disassembly Operations
W44	02/24/88	NESS of W44 Disassembly/Reassembly Operations
W48	04/22/92	NESS of W48 Disassembly Operations
W50	08/12/87	NESS of W50 Disassembly Operations
W53	12/17/87	NESS of W53 Disassembly Operations
B53	02/18/88	NESS of B53 Disassembly Operations
B54	01/18/89	NESS of B54 Disassembly Operations
W55	08/30/91	NESS of W55 Disassembly Operations
W56	03/27/92	NESS of W56 Disassembly Operations
B57	10/06/88	NESS of B57 Disassembly Operations
B61-7	12/12/91	NESS of B61-7 Disassembly/Reassembly Operations
B61-3/4	05/17/91	NESS of B61-3/4 Disassembly/CDS Operations
B61-10	02/14/90	NESS of B61-10 Assembly/Disassembly Operations
B61-0/1/2/5	08/25/88	NESS of B61-0/1/2/5/ Disassembly/Reassembly Operations & CDS Operations
W62	05/22/92	NESS of W62 Disassembly Operations
W68	10/03/92	NESS of W68 Disassembly Operations
W69	02/26/88	NESS of W69 Disassembly/Reassembly Operations
W70	09/25/92	NESS of W70 Disassembly Operations
W71	10/24/91	NESS of W71 Disassembly Operations
W76	03/03/89	NESS of W76 Disassembly/Reassembly Operations
W78	08/31/89	NESS of W78 Disassembly/Reassembly Operations
W79	09/13/91	NESS of W79 Disassembly/Reassembly Operations
W80-0/1	11/02/90	NESS of W80-0/1 Disassembly/Reassembly Operations & CDS Operations
B83	09/27/91	NESS of B83 Assembly/Disassembly Operations
W84	09/04/92	NESS of W84 Disassembly/Reassembly Operations
W87	11/22/91	NESS of W87 Disassembly/Reassembly Operations
W88	07/21/88	NESS of W88-0/MK 5 Operations

Pantex operations is shown in Table 5.12-3. The NESSs and SARPs contained in these three tables are classified. NESSs and SARPs are approved and updated every five years. Three input documents have recently been completed. The General Use Nuclear Explosives Processing Facilities Master Study describes the facilities, equipment, operations, and safety analysis of resources that support any and all nuclear explosives operations on more than one program[28]. This master study incorporates activities in Building 12-26 (Bay 27), 12-41, 12-50, 12-60, and 12-94. The General-Use Handling and Transportation Equipment Master Study describes an overview of the Tooling and Machine Design Department's operations, the Preventive Maintenance program, and the personnel training including nuclear explosives program-specific training and forklift training. The Operations and Staging Facilities Master Study describes the operating and staging facilities used in processing and staging nuclear explosives, the equipment/systems associated with the facilities, and activities/responses related to the equipment systems[29]. This new master study incorporates activities in the Modified-Richmonds and SACs in Zone 4 MAA, Building 12-44 (Cells 1 to 6), 12-64, 12-84, 12-85, 12-96, 12-98, 12-99, and 12-104.

In addition to the SAR and SARPs for transporting weapon components, a "Safety System Evaluation of On-Site Transportation of Nuclear Explosives and Nuclear Components" was recently completed. This safety evaluation dealt with onsite transportation of nuclear explosives and weapon components at Pantex Plant. This evaluation covered only those parts of the onsite transportation that involve the actual movement of the trailers over the roadways between Zone 12 MAA and Zone 4 MAA. This evaluation specifically focused on nuclear explosives and pits; however, it is applicable to NELAs and OROs since any risks associated with these two items are subsumed by those of the previous two items. Pits are transported in the AL-R8 shipping containers which are secured in pallets that hold either four or six containers. The AL-R8 container was a Type B container certified for offsite transportation. The SARP has not been updated and the certification has not been renewed[30].

TABLE 5.12-3.—*List of SARPs*

Approval	Title
11/00/89	Model DT-21 Package with Uranium Metal Contents
02/06/91	Model DT-23 Package Containing Parts/Pits
12/22/89	Shipping the B28 in its Casing
06/18/92	MH2800 SAR for Packaging
11/02/89	Shipping B43 Type 35 Secondary in its Casing
11/22/91	Model DT-20 Package with W50 Final Assembly
01/10/90	Model DT-23 Package with W55 Canned Subassembly
06/20/90	Model DT-19 Package with B61 Case
10/30/89	Model DT-19 Package with B61 Canned Subassembly
10/26/90	Model DT-23 Package with B61/W86 Subassembly Contents
09/22/89	Model DT-23 Package with B61/W85 Canned Subassembly
02/28/91	Model DT-22 Package with W62 Canned Subassembly
03/16/90	Model DT-22 Package with W62 Contents
06/00/89	Model DT-18 Packaging with W68 Assembly Contents
06/00/89	Model DT-18 Packaging with W69 Assembly Contents
03/19/90	Model DT-20 Package with W70 Contents
03/21/90	Model DT-22 Package with W76 Contents
01/08/90	Model DT-18 Package with W78 Canned Subassembly
11/03/89	Model DT-20 Package with W80 Canned Subassembly/Case
05/00/88	Model B83 Package for Enriched Uranium
03/05/90	Model DT-20 Package with W84 Canned Subassembly
05/00/88	Model DT-17 Package for Enriched Uranium
01/04/91	Model DT-20 Package with W87 Canned Subassembly

5.13 REFERENCES

1. DOE Order 5480.23, *Nuclear Safety Analysis Reports, U.* S. Department of Energy, April 10, 1992.

2. U. S. Code of Federal Regulations, Title 40, Protection of Environment. Part 355, "Emergency Planning and Notification."

3. U. S. Code of Federal Regulations, Title 29, Labor. Part 1910.119, "Process Safety Management of Highly Hazardous Chemicals, Explosives, and Blasting Agents."

4. Jacobs Engineering Group, *Hazardous Materials Hazard Assessment,* Pantex Plant, Amarillo, Texas, November 1992.

5. U.S. DOE, "Programmatic Information Document", Prepared by Mason & Hanger, Silas-Mason Co., Inc. For the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components Environmental Impact Statement, Amarillo, TX, October 1995.

6. DOE, *Explosives Safety Manual,* DOE/EV/06194, Revision 7, U. S. Department of Energy, August 1994.

7. U.S. Code of Federal Regulations, Title 49, Transportation. Part 383, "Commercial Drivers License Standards: Requirements & Penalties."

8. U.S. Code of Federal Regulations, Title 49, Transportation. Part 390, "Federal Motor Carrier Safety Regulations: General."

9. U.S. Code of Federal Regulations, Title 49, Transportation. Part 391, "Qualifications of Drivers."

10. U.S. Code of Federal Regulations, Title 49, Transportation. Part 392, "Driving of Motor Vehicles."

11. U.S. Code of Federal Regulations, Title 49, Transportation. Part 393, "Parts & Accessories Necessary for Safe Operation."

12. U.S. Code of Federal Regulations, Title 49, Transportation. Part 394, "Notification & Reporting of Accidents."

13. U.S. Code of Federal Regulations, Title 49, Transportation. Part 395, "Hours of Service of Drivers."

14. U.S. Code of Federal Regulations, Title 49, Transportation. Part 396, "Inspection, Repair, & Maintenance."

15. U.S. Code of Federal Regulations, Title 49, Transportation. Part 397, "Transportation of Hazardous Materials Driving & Parking Rules."

16. U.S. Code of Federal Regulations, Title 29, Labor. Part 1910.1200, "Hazardous Communication."

17. U.S. Code of Federal Regulations, Title 49, Transportation. Part 172, "Hazardous Materials Tables, Hazardous Materials Communication Requirements, and Emergency Response Information Requirements." October 1994.

18. U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 262, "Standards Applicable to Generators of Hazardous Waste." January 1990.

19. Mason & Hanger - Silas Mason, Co., Inc., *Input for the Nuclear Explosives Safety Master Study of General-Use Handling and Transportation Equipment, Pantex Plant,*

Pantex Plant, Amarillo, Texas, June/July 1993.

20. U.S. Code of Federal Regulations, Title 10, Energy. Part 71, Subpart H, "Packaging and Transportation of Radioactive Material." January 1994.

21. Mason & Hanger - Silas Mason Co., Inc., *Systems Safety Evaluation of On-site Transportation of Nuclear Explosives and Nuclear Components at Pantex Plant,* Pantex Plant, Amarillo, Texas, July 30, 1993.

22. DOE/AL Order 5481.1B, *Safety Analysis and Review System,* U.S. Department of Energy, January 27, 1988.

23. DOE Order 5610.11, *Nuclear Explosive Safety*, U.S. Department of Energy, October 10, 1990.

24. DOE/DOD Technical Publication, *Nuclear Safety Criteria*, U.S. Department of Energy, September 1, 1986.

25. DOE/DOD Technical Publication, *Transportation of Nuclear Weapons Material, General Shipping and Limited Life Components (LLC)*, U.S. Department of Energy, March 16, 1984.

26. DOE/DOD Technical Publication, *Transportation of Nuclear Weapons Material (Supplement), Shipping and Identification Data for Stockpile Major Assemblies*, U.S. Department of Energy, February 1, 1980.

27. DOE/DOD Technical Publication, *Transportation of Nuclear Weapons Material, (Supplement), Shipment by Safe-Secure Trailer (SST)*, U.S. Department of Energy, July 14, 1989.

28. Mason & Hanger - Silas Mason Co., Inc., *Input Document General Use Nuclear Explosives Processing Facilities Master Study,* Pantex Plant, Amarillo, Texas, June 1993.

29. Mason & Hanger - Silas Mason Co., Inc., *Input Document Nuclear Explosives Operations and Staging Facilities Master Study,* Pantex Plant, Amarillo, Texas, July 30, 1993.

30. "Rocky Flats Container, Model AL-R8 Safety Analysis Report for Packaging," RFE-8801, Rocky Flats Plant, April 1988, (SRD).

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6.0 HISTORICAL INCIDENT/ACCIDENT EXPOSURES

6.1 RADIATION EXPOSURES HISTORICAL DATA

Pantex Plant has a comprehensive Radiation Safety program administered by the Radiation Safety Department, which establishes the radiation protection requirements contained in plant standards and technical procedures in accordance with the current DOE requirements[1]. The objective is to maintain personnel exposure to ionizing radiation at a level that is "As Low as Reasonably Achievable" (ALARA). These objectives are met through an external and internal dosimetry program, radiation safety support for Plant operations, radiation surveys, contamination control, the ALARA program, identifying and posting radiologically controlled areas, conducting dose and risk-benefit analysis, and developing staffing qualifications for the Radiation Safety Program. Detailed information about the Pantex Plant Radiation Safety Program is provided in Chapter 4.0 of the Programmatic Information Document.

At Pantex Plant, the following radioactive materials may be present during operations:

- Plutonium
- Tritium
- Uranium
- Thorium
- Nondestructive radiography sources (e.g., cobalt)
- Miscellaneous encapsulated sources (e.g., instrument check and calibration sources).

Plutonium is considered the most significant radiological hazard associated with a nuclear weapon accident. Plutonium releases would be in oxide form. The alpha particles emitted by Pu-239 are not capable of penetrating through the outer layer of skin on the surface of the body. The primary hazard from plutonium results from entry into the body by inhalation. Inhaled plutonium is retained in the lungs, and the alpha particles interact with tissue. Oxide forms of plutonium are slowly transferred from the lungs to the bones and liver via the blood stream. Plutonium deposited in the body, primarily by respiration, can result in long term health effects such as lung or bone cancer.

Tritium is a potential health hazard when personnel are engaged in weapon assembly or disassembly procedures. The hazardous nature of tritium is due to its ability to combine with other materials to form compounds, particularly tritiated water, absorbed by and retained in the human body. Elemental tritium is not absorbed through the skin in any significant degree. Tritiated water vapor is readily absorbed through the skin or lungs and retained by the body. The tritiated water that enters the body is chemically identical to ordinary water and is distributed throughout the entire body tissue. The human body normally eliminates and renews about 50 percent of its water in about 8 to 12 days, varying with fluid intake.

The principal uranium isotopes (U-235 and U-238) are primarily alpha emitters, but, on a gram-for-gram basis, are less hazardous than plutonium because of their lower specific activity. The health risk from uranium is largely chemical (toxic), particularly for natural or depleted uranium. Uranium in any form is both radiotoxic and chemically toxic. Exposure hazards are due to internal and external radiation exposure, and chemical toxicity. The permissible levels for soluble compounds are based on chemical toxicity, while the permissible body level for insoluble compounds (e.g., metal and oxides) is based on radiotoxicity. The chemical toxicity of uranium and its compounds results in kidney damage, which may not be reversible. Insoluble uranium compounds express their toxicity primarily through increased residence in and irradiation of lung tissues by inhaled particles.

Thorium-232 is a naturally occurring radionuclide used as a component in some weapons. Th-232 decays into a series of radioactive isotopes which emit both alpha and beta particles, as well as gamma rays. Thorium is predominately an internal hazard, but due to its low specific activity, it is not as great a hazard as either plutonium or uranium.

Other sources of radiation at Pantex Plant include radioactive sources and machine-generated x-rays and neutrons. The radiation sources include alpha, beta, gamma, x-ray, and neutron emitters. These sources of radiation are typical of the types and quantities employed by other industrial or process-related users. As in commercial industry or in the public utilities, strict safeguards are placed on handling and use of these sources. Pantex Plant has not had any radiographic exposure incidents which resulted in personnel exposures above existing federal limits.

Pantex Plant personnel may be exposed either internally or externally to radiation. Internal exposures occur when radioactive materials are deposited through inhalation, ingestion, or absorption. Under normal operating conditions, the airborne concentrations of radionuclides present in Pantex Plant facilities are very low. Internal exposure is minimized by administrative controls, personal protective equipment, and other methods described in the Chapter 4.0 of the Programmatic Information Document as part of the Radiation Safety Program. Internal exposure is determined from the analysis of bioassay samples. Bioassay samples are collected monthly from personnel who work in areas where there is a potential for internal exposure. In addition, workers participate in a special bioassay program when any of the following occurs:

- Facial contamination is detected that indicates a potential for intake of radioactive materials.
- Air monitoring indicates the potential for intakes resulting in committed effective dose equivalent exceeding 100 mrem.

External exposures are those received from radiation emitting sources such as x-ray machines and assembly/disassembly operations. All personnel who enter areas of the site where there is a potential to receive a radiation dose are monitored for radiation exposures. Radiation dosimeters are issued monthly or quarterly depending on a worker's duties. The largest exposure potential to external radiation at Pantex Plant is due to nondestructive evaluation operations and handling plutonium pits during assembly, disassembly, and staging operations. External exposure is minimized through the use of administrative controls such as limiting the duration of exposure, increasing the distance between personnel and radiation sources whenever possible, and use of proper protective equipment such as lead lined aprons and gloves. Engineering controls such as shielding are used to reduce or mitigate radiation exposure to workers.

Various instrumentation is utilized throughout the site for monitoring radiation levels and detecting contamination. Examples include the Continuous Air Monitors (CAMS), which are used to detect airborne releases of alpha and beta emitters. Portable hand held instruments are used extensively throughout the site for monitoring radiation levels and detecting contamination.

Pantex Plant has had an administrative control level (i.e., the level of whole-body exposure that employees can receive without additional approval) of 1 rem/yr since 1990. Recently, this level was reduced to 900 mrem/yr for personnel in the manufacturing division and 500 mrem/yr for all other plant personnel. Pantex Plant administrative control levels are based on an evaluation of Pantex Plant activities and the potential radiation exposures to the workers. The administrative control levels are adopted to help implement the ALARA concept. Chapter 4.0 of the Programmatic Information Document provides detailed information on the Pantex Plant ALARA program.

Exposure limits have been established for the rare situations where exposure to radiation may be necessary to rescue personnel or to protect major property[1]. In these cases, individual, voluntary exposures may be received up to 10 rem to protect major property, up to 25 rem for lifesaving or protection of large populations, and greater than 25 rem to protect life or large populations; only if personnel are fully aware of risks involved.

Tables 6.1-1. and 6.1-2. show the history of radiation exposure for Pantex Plant operations over the past 44 and 24 years respectively[2]. In Table 6.1-1., the total population dose represents the external exposure dose received by staff. Since radiation workers turn their dosimeters in monthly and work in a multitude of facilities it is not possible to provide facility-specific data. However, most of the reported doses are from activities in Zone 4 and Zone 12. In Table 6.1-2., the data is based upon routine and special urine bioassays. Pantex does not perform routine fecal bioassay or in-vivo monitoring. Internal doses from bay and cell operations are minimized due to engineering controls, safety procedures, and protective equipment. The largest single source of internal exposures at the Plant was from tritium related to contamination of a cell in an accident in 1989. The integrated (over time and population) dose to Plant staff due to that accident and cleanup of the cell is estimated as 2 person-rem.

A trend analysis indicates that the collective radiation dose has fluctuated from year to year. This fluctuation is due to varying worker population levels and intrinsic radiation levels of certain weapon programs. Even though the worker population continues to grow, the total dose is dropping due to continual improvement in work practices.

Neutron exposure from a weapon will vary greatly dependent upon its design. Since 1988 neutrons have accounted for an average of 16 percent of the total dose to the Pantex population (ranging from 1 percent to 30 percent). Table 6.1-3. provides the total dose percentage attributed to neutron radiation.

6.2 Industrial Hygiene Exposure Historical Data

The following types of potential exposure hazards may be present during Plant operations:

- Chemical Hazards
- Laser Hazards
- Noise Hazards
- Radiowave or Microwave Radiation Hazards.

Numerous programs exist to ensure that exposure potentials in all of the above areas are kept as low as possible. Detailed information about the Pantex Plant Industrial Hygiene Program is provided in Chapter 4.0 of the Programmatic Information Document. The Plant establishes exposure guidelines based on exposure limits set by the Occupational Safety and Health Administration (OSHA) and the American Conference of Governmental Industrial Hygienists (ACGIH), whichever is most conservative[3,4].

The Pantex Plant has established aggressive programs to anticipate, recognize, evaluate, and control potential employee exposures to the various nonradiological hazards that are inherent in Plant operations. These programs include the engineering review of proposed facilities, operations, procedures, or activities and the ongoing review of existing operations. Plant surveys are periodically conducted to determine if control or protective measures are adequate for employee protection or if new technology or methods will allow for an even higher degree of protection. Industrial Hygienists participate routinely in actual operations to evaluate the effectiveness of hazard or caution warnings included in procedures and to provide information directly to employees.

Employee education plays a significant role in maintaining potential exposures as low as reasonably achievable. Initial hazard training is provided to all employees, and supplemental

TABLE 6.1-1.—*History of External Radiation Exposures at Pantex Plant*

Year	Total Population Dose (Person-REM)	Maximum Individual Dose (REM)	Number Monitored	Number with Zero Dose	Percent of Plant with Zero Dose	Average Population Dose (REM)
1952	0.000	0.000	1	1	100	0.000
1953	0.000	0.000	1	1	100	0.000
1954	0.000	0.000	2	2	100	0.000
1955	0.000	0.000	1	1	100	0.000
1956	0.000	0.000	1	1	100	0.000
1957	0.020	0.020	3	2	67	0.007
1958	0.090	0.049	19	14	74	0.005
1959	0.350	0.075	22	14	64	0.016
1960	10.348	0.848	69	20	29	0.150
1961	8.740	0.831	71	13	18	0.123
1962	5.268	0.342	64	15	23	0.082
1963	18.201	2.654	218	102	47	0.083
1964	79.911	4.410	253	19	8	0.316
1965	47.406	3.690	416	188	45	0.114
1966	70.460	2.750	581	240	41	0.121
1967	78.330	3.330	563	240	43	0.139
1968	29.642	1.200	423	217	51	0.070
1969	30.835	2.850	432	235	54	0.071
1970	85.464	2.787	468	120	26	0.183

TABLE 6.1-1.—*History of External Radiation Exposures at Pantex Plant (Continued)*

Year	Total Population Dose (Person-REM)	Maximum Individual Dose (REM)	Number Monitored	Number with Zero Dose	Percent of Plant with Zero Dose	Average Population Dose (REM)
1971	101.419	3.560	495	201	41	0.205
1972	70.843	2.950	467	179	38	0.152
1973	86.349	6.550	441	21	4	0.196
1974	75.606	5.060	500	32	7	0.151
1975	61.887	10.800*	493	49	10	0.126
1976	45.765	1.050	463	33	7	0.099
1977	58.080	1.630	465	21	5	0.125
1978	50.460	2.300	518	73	14	0.097
1979	178.910	5.140	714	27	4	0.251
1980	147.520	4.500	819	100	12	0.180
1981	201.190	5.230	915	320	35	0.220
1982	110.760	2.070	1002	660	66	0.111
1983	103.180	2.330	1027	687	67	0.110
1984	141.708	2.200	1113	464	42	0.127
1985	133.558	2.540	1172	775	66	0.114
1986	85.590	1.510	1129	765	68	0.076
1987	34.850	1.410	1160	976	84	0.030
1988	24.980	1.240	1121	913	81	0.022
1989	33.560	1.440	1438	1264	88	0.023
1990	23.460	0.740	2090	1862	89	0.011
1991	22.310	0.530	2126	1905	90	0.010
1992	50.591	0.905	2317	1977	85	0.022
1993	44.825	0.850	2624	2228	85	0.017
1994	28.817	0.662	2978	2649	89	0.010
1995	36.623	0.764	3107	2791	90	0.012

* Federal limits in 1975 were 3 rem per quarter not to exceed 5 x (age of worker - 18) rem.

TABLE 6.1-2.—*History of Internal Radiation Exposures at Pantex Plant*

Year	Total Population Tritium Dose (Person-mREM)	Maximum Individual Tritium Dose (mREM)	Number Monitored for Tritium	Average Population Dose (mREM)
1972	32.0	12.0	4	8.0
1973	0.0	0.0	1	0.0
1974	0.0	0.0	0	0.0
1975	0.0	0.0	0	0.0
1976	0.0	0.0	463	0.0
1977	0.0	0.0	466	0.0
1978	0.0	0.0	519	0.0
1979	0.0	0.0	712	0.0
1980	612.0	114.0	14	43.8
1981	582.0	122.0	41	14.2
1982	101.0	37.0	5	20.2
1983	0.0	0.0	0	0.0
1984	0.0	0.0	0	0.0
1985	11.0	3.0	17	0.6
1986	55.0	6.0	626	0.1
1987	8.0	2.0	481	0.02
1988	6.0	3.0	499	0.01
1989	1811.0	1180.0	212	8.5
1990	5.0	3.0	2341	0.002
1991	18.0	5.0	1115	0.02
1992	48.0	5.0	879	0.05
1993	183.0	14.0	1078	0.2
1994	115.0	11.0	1108	0.1
1995	101.0	12.0	971	0.10

ABLE 6.1-2.—*History of Internal Radiation Exposures at Pantex Plant (Continued)*

Year	Total Population Uranium Dose (Person-mREM)	Maximum Individual Uranium Dose (mREM)	Number Monitored for Uranium	Average Population Dose (mREM)
1991	109.0	109.0	424	0.3
1992	778.0	502.0	239	3.3
1993	76.0	15.0	13	5.8
1994	0.0	0.0	0	0.0
1995	0.0	0.0	89	0.0

Year	Total Population Plutonium Dose (Person-mREM)	Maximum Individual Plutonium Dose (mREM)	Number Monitored for Plutonium	Average Population Dose (mREM)
1991	0.0	0.0	0	0.0
1992	0.0	0.0	12	0.0
1993	0.0	0.0	0	0.0
1994	0.0	0.0	0	0.0
1995	0.0	0.0	28	0.0

Year	Total Population Thorium Dose (Person-mREM)	Maximum Individual Thorium Dose (mREM)	Number Monitored for Thorium	Average Population Dose (mREM)
1991	0.0	0.0	0	0.0
1992	0.0	0.0	17	0.0
1993	0.0	0.0	0	0.0
1994	0.0	0.0	0	0.0
1995	0.0	0.0	67	0.0

TABLE 6.1-3.—*Percent of Total Doses Attributed to Neutron Radiation*

Year	Percent of Total Dose Attributed to Neutron Radiation
1988	11
1989	10
1990	8
1991	1
1992	30
1993	29
1994	23
1995	28

information is provided during specialized training on the various operations throughout the Plant. The Medical Program effectively monitors employees for evidence that individuals have not received overexposures to chemicals or other hazards. The program also allows for the identification of employees who may be sensitive to exposures at levels well below those considered safe to the average Plant population. As a supplement to the Medical Program, the ability to collect and analyze biological samples such as urine or blood enhances the Plant's capability to detect exposures to a large number of chemical hazards.

Large scale bulk storage of chemicals is not required to support Plant operations. This significantly reduces the risk of personnel exposures from spills. Formal spill control procedures have been developed and personal protective equipment is available for trained spill responders to use if a spill occurs. Small quantities of low hazard materials can be cleaned up by trained local personnel, and larger or more hazardous materials are controlled and cleaned up by the Plant Hazardous Materials Team.

Chemical Hazards. Chemicals are used throughout Plant operations. The locations where various hazardous chemicals are used are tracked electronically, along with the quantities distributed. The information is used to ensure that the proper material safety data sheet is on hand in the work areas for employees and supervision and to ensure that potential exposure hazards are evaluated.

Chemical exposure may come in a number of forms or routes depending on the chemical being used and the operation it is being used in. Several possible forms are:

- Vapors
- Mists
- Fumes (hot metal)
- Gases
- Dusts (particles and fibers)

The potential routes of exposure include inhalation, absorption, injection (penetration), and ingestion.

As mentioned above, OSHA and the ACGIH exposure guidelines have been adopted for use at Pantex. Permissible Exposure Limits (PELs) are OSHA guidelines, and Threshold Limit Values (TLVs) are ACGIH guidelines. During exposure surveys, airborne levels of chemicals are determined and compared against the guidelines to ensure that employees do not receive overexposures. The Pantex definition for overexposure is the TLV/PEL or the established action limit. If it is determined that there is a possibility of an overexposure, controls are put in place to protect the employees in the area. Substitution of a known hazardous substance with a less hazardous or non-hazardous substance is always considered first. If that is not an option, then engineering controls, like local exhaust systems or enclosures and filtration systems, are the next best choice. If engineering controls are not feasible, or cannot be implemented within a reasonable amount of time, other controls, such as relocation, time limits for workers, or, as a last resort, personal protective equipment will be used. A summary of employee chemical exposure monitoring is provided below.

The Breathing Zone Monitoring database is used to track information on samples taken in the industrial complex to quantify potential occupational exposures to hazardous chemicals. Through 1995, this database has 2,824 records, dating back to 1977. These samples are personnel samples taken in the breathing zone of a representative worker in a specific location for a specific task. For this report, "TLV" will be used indicate the exposure limit used, regardless of whether it is actually a TLV or PEL. The aforementioned records were used to compile the following information:

Number of Breathing Zone
Samples to Date = 2,824

Number of samples where the calculated TWA exceeds the TLV = 181

Percentage of samples taken that are above the TLV = 6 percent.

A total of 118 chemical substances have been sampled for, and 15 (13 percent) have been found to be present in excess of the TLV on at least one occasion. Table 6.2-1. is a breakdown of those instances.

In all cases on record except one, personal protective equipment (PPE) was in use and workers were adequately protected from the hazards of the chemicals for which sampling was conducted. The single exception is a sample for carbon monoxide taken in November of 1978 where the TLV was exceeded (TWA = 62.5 ppm: TLV = 50 ppm), and there is no indication of PPE in use. In this one instance, the concentration was only 25 percent above the TLV.

The use of chemicals identified by OSHA or the ACGIH as human carcinogens is closely regulated in Plant operations. Whenever possible, less hazardous materials are substituted. When this is not feasible, tight controls are required to minimize the potential for any employee exposures. Close review is given to, not only the proposed use of carcinogens, but also the type of hazard posed by a particular carcinogen. Some chemicals may only be a cancer hazard if inhaled, others only if ingested. Specific consideration is given to protecting the most hazardous route of exposure. The types of controls used to prevent exposure vary significantly depending on the chemical and process. Full enclosure systems such as glove boxes may be used along with laboratory hoods, regulated entry areas, explicit procedures, and various types and levels of personal protective equipment.

Table 6.2-2. provides a list of carcinogens and carcinogen-containing substances that are currently being used or have been used in the past at Pantex Plant. The MSDS from the manufacturer was used as the source of information on whether the chemical substances or products on the list are carcinogenic. For some of the materials (e.g., Static Guard®), there is a chemical constituent in the end-product that is carcinogenic. (Substances that contain carcinogens in concentrations as low as [illegible] percent by weight or volume are coded as carcinogens under this system.) The list is conservative since it is based on the manufacturers' MSDS and not TLVs for given substances.

Laser Hazards. A number of laser systems are in use at the Plant. The majority of these are used as alignment or positioning aids for precision instrumentation. The most significant hazard involved in the use of lasers is the potential for causing burns to the eye or skin. This hazard is controlled mainly through shielding that prevents the laser beam from reaching an employee's eyes or skin and interlocks that prevent a laser from operating unless the shields are in place. Laser operators are given specific training on the hazards of lasers and specific medical examinations to ensure that they have not received hazardous exposures. There have not been any laser related injuries at the Pantex Plant.

Noise Hazards. Persons exposed to excessive noise levels for extended periods of time may receive permanent hearing damage. The ACGIH has published guidelines establishing limits for acceptable worker exposure to noise. These limits, which have been adopted at Pantex Plant, are much more stringent than OSHA regulations. Workplaces at Pantex are regularly monitored and evaluated in comparison to the ACGIH guidelines.

Continual high production of noise at Pantex is not common, but some sporadically high noise production may be found in such areas as the air handler equipment motors, carpenter shop, and mechanics garage.

When noise exposure levels approach the ACGIH limit, action is taken to reduce employee noise

TABLE 6.2-1.—*History of Industrial Hygiene Exposures at Pantex Plant*

Chemical	Total Number of Samples Taken	Total Number of Samples > TLV	Percentage > TLV
Asbestos	255	9	4
Beryllium	305	78	26
Carbon Monoxide	24	4	17
Chromium VI	65	2	3
HDI	23	1	4
Lead	434	9	2
Mercury	166	11	7
Methylene Chloride	48	2	4
Mock - Barium	8	1	13
Silica, Total	1	1	100
Silica, Total Cryst.	8	5	63
Toluene	81	3	4
Uranium	204	40	20
Welding Fumes	2	1	50
Xylene	82	14	17
Total	1,706	181	11

TABLE 6.2-2.—*List of Carcinogens and Carcinogen-Containing Substances*

Chemical Substance	Health Hazard Rating	Fire Hazard Rating	Reactivity Hazard Rating	Form	MSDS Number
#110 (HC) SMOKE GRENADE	4	4	3	S	3346.1
*01841ATF DEXRON II HAVOLINE	2	2	1	L	8555.1
1175 QUANTAB TITRATOR	4	1	1	S	4719.2
1176 QUANTAB TITRATOR	4	1	1	S	9048.1
1,2-DIBROMO-3-CHLOROPROPANE	3	1	0	L	7255.1
2-ETHYLHEXYL ACRYLATE - 15 PPM MEHQ	4	1	1	L	3410.1
20-8192 EDGEMET KIT SOLUTION A	2	0	0	L	9753.1
300 SERIES ARCALOY AC-DC STAINLESS STEEL	3	0	0	S	7547.1
31 P NMR STANDARD	4	4	1	L	6026.1
3,3'-DIMETHOXYBENZIDINE	3	0	1	S	3983.1
35 percent HMDS IN BENZENE D6	3	4	0	L	6072.1
3M BRAND CARPET PROTECTOR	3	2	0	L	4731.1
4-CHLORO-1,1'-BIPHENYL	4	1	1	S	4118.1
5400 SILVER ALLOY	4	1	1	S	8778.1
75726 TEXSOLVE C	3	4	1	L	8431.1
763 RUST TRANSFORMER AEROSOL	3	3	1	L	4580.1
*A-100 ALKYD WOOD PRIMER	2	2	0	L	5255.1
*AAS STD.1000 PPM ARSENIC IN 2% HNO3	4	0	1	L	2068.1
ACCELERATOR GC-450	4	1	1	L	4892.1
*ACID CLEANING SOLUTION	4	0	1	L	6613.1
ACME AUTOMOTIVE PAINT NON-LEAD	3	4	0	L	7436.1
*ACRIDINE	4	3	0	S	4000.1
ACRYLIC ENAMEL PRIMER	4	4	0	L	5321.1
ACRYLIC LACQUER PANTEX YELLOW	4	4	0	L	7445.1
ACRYLIC LACQUER PRIMERS AND SEALERS 30S	3	4	1	L	2483.1
AIR DRY HI GLOSS LACQUER P/N XAYL-7017	4	4	1	L	1665.1
ACRYLIC LATEX FLOOR ENAMEL	3	1	0	L	5256.1

TABLE 6.2-2.—*List of Carcinogens and Carcinogen-Containing Substances (Continued)*

Chemical Substance	Health Hazard Rating	Fire Hazard Rating	Reactivity Hazard Rating	Form	MSDS Number
AIR DRY HI GLOSS LACQUER P/N XAYL-7017	4	4	1	L	1665.1
ALKALUME 1744	4	0	1	S	6935.1
*ALODINE 1200	4	0	1	L	8527.1
ALODINE 1200S	4	0	1	S	788.1
*ALODINE 1200TOUCHUP, CHROMIC ACID	4	0	1	L	4774.1
ALODINE 1500	4	0	1	L	6237.1
ALODINE 600	4	1	0	S	787.1
*ALUMANATION 301	4	2	1	L	1269.1
ALUMINUM BLACK METAL FINISH PAB17	4	0	0	L	8212.1
ALUMINUM FIERY RED ML	3	1	0	S	1954.1
ALUMINUM ROOF COATING (STANDARD)	4	2	0	L	2311.1
*ALUMINUM WELDING WIRE AND ROD	4	0	0	S	8482.1
ALUMINUM YELLOW 4A	3	1	0	S	1955.1
*AMERCOAT BUTYL WASH PRIMER	4	4	1	L	608.1
*AMERCOAT BUTYL WASH PRIMER	4	4	1	L	9669.1
AMITROLE	4	1	0	S	7631.1
*AMMONIUM CHROMATE	4	0	3	S	3933.1
*AMMONIUM DICHROMATE	4	1	1	S	279.1
AMMONIUM DICHROMATE	4	1	1	S	279.2
ARMSTRONG 520 ADHESIVE	3	4	1	L	5637.2
ARMSTRONG MINERAL FIBER CEILINGS	4	0	0	S	8725.1
ARMSTRONG'S 520 ADHESIVE	3	4	1	L	5637.1
AROCLOR 1242	3	1	1	L	4058.1
AROCLOR 1268	4	1	1	L	4117.1
ARSENIC IN 2 percent HNO3	4	0	1	L	2068.1
ARSENIC IN HNO3	4	0	1	L	2294.1
*ARSENIC IN NITRIC ACID	4	0	1	L	7509.1

TABLE 6.2-2.—*List of Carcinogens and Carcinogen-Containing Substances (Continued)*

Chemical Substance	Health Hazard Rating	Fire Hazard Rating	Reactivity Hazard Rating	Form	MSDS Number
ARSENIC SPECTROMETRIC STANDARD SOLUTION IN HNO3	4	1	1	L	9495.1
*ARSENIC SPECTROMETRIC STD SOLUTION IN HCL	4	0	1	L	9513.1
ARSENIC STANDARD, CONOSTAN	4	1	1	L	1534.1
*ARSENIC TRIOXIDE	4	0	0	S	294.1
ARSENIC TRIOXIDE	4	0	0	S	294.2
ASBESTOBOARD	3	0	0	S	6308.1
ASBESTOS	4	0	0	S	1581.1
ASTM C-13, NMR REFERENCE STANDARD	3	4	0	L	6076.1
ATOMIC ABSORPTION STD 1,000PPM OF NICKEL IN 2% NITRIC	4	0	1	L	8693.1
*AURAMINE HYDROCHLORIDE	4	1	3	S	4114.1
*BAR-OX (R) INT/EXT ALKYD QUICK DRY GLOSS ENAMEL	4	3	0	L	3425.1
*BARE WELDING WIRE #308	4	0	0	S	8649.1
*BARIUM CHROMATE	4	0	1	S	4106.1
*BENZENE	4	4	1	L	237.2
*BENZENE	4	4	1	L	237.3
*BENZENE, 99+ percent SPECTROPHOTOMETRIC GRADE	4	4	1	L	237.1
*BENZENE-D6	4	4	1	L	7046.1
*BENZIDINE	4	0	1	S	4102.1
BERYLLIUM IN HCL	4	0	1	L	2285.1
BERYLLIUM IN HCL	4	0	1	L	2285.2
*BERYLLIUM IN HNO3	4	0	1	L	3125.1
*BERYLLIUM IN HNO3	3	0	1	L	8339.1
*BERYLLIUM IN AAS	4	4	1	L	2265.1
BERYLLIUM IN XYLENE	4	4	1	L	2265.1
BERYLLIUM STANDARDS, CONOSTAN	4	1	1	L	1547.1
BETA-NAPHTHYLAMINE	4	0	0	S	266.1
BETZ POTASSIUM CHROMATE INDICATOR CODE 213	4	0	2	S	1620.1

TABLE 6.2-2.—*List of Carcinogens and Carcinogen-Containing Substances (Continued)*

Chemical Substance	Health Hazard Rating	Fire Hazard Rating	Reactivity Hazard Rating	Form	MSDS Number
[illegible] TCW 2 CYCLE OIL & INJECTOR OIL	2	1	1	L	9185.1
BITUMASTIC NO. 50	4	2	0	L	1703.1
BROWNELLS ALUMA HYDE PRIMER	4	4	1	L	8461.1
BROWNELLS SOLDER BLACK	4	0	0	L	8460.1
BTEX IN WATER/SOIL (CAT #BTX-96)	4	4	0	L	9095.1
CADMIUM AAS	4	0	1	L	2073.2
CADMIUM IN HYDROCHLORIC ACID	4	0	1	L	7869.1
CADMIUM IN NITRIC	4	0	1	L	7507.1
CADMIUM SPECTROMETRIC STANDARD SOLUTION SRM #3108	4	0	1	L	8245.1
CADMIUM SULFIDE	4	0	1	S	3931.1
CALCIUM CHROMATE	4	0	0	S	7083.1
ELECTRO-BRITE Z-200	4	0	0	S	6859.1
ELECTROLYTIC NICKEL	3	0	0	S	2256.1
ELECTROSTATIC POLYAMIDE PRIMER-YEL	4	4	1	L	8330.1
ENAMEL, ALKYD, CAMOUFL. FOREST GREEN 0254800	4	3	0	L	982.1
ENAMEL, ALKYD, CAMOUFL. FOREST GREEN MIL-E-52929 AM TI	4	4	1	L	9642.1
*ENAMEL, BLACK CENTARI DUPONT 99A	3	4	1	L	7354.1
*ENAMEL, CENTARI CLEAR #780S	2	4	1	L	7370.1
*ENAMEL, RED ACRYLIC DUPONT B8418A	2	4	1	L	7362.1
ENPLATE NI-410A	4	0	0	L	3430.1
EP\TC FLAT BLACK 595B-37038	3	4	1	L	8329.1
EPI-18000 (MAR-8000) BATTERY	4	0	0	S	7988.1
EPOLON 22 BLACK MASTIC A & B	3	3	1	L	6969.1
*EPON RESIN 871	2	1	2	L	831.1
*EPOXY PA COMPL PRIMER	4	4	1	L	9109.1
EPOXY POLYAMIDE PRIMER GREEN 34552	3	4	4	L	3166.1
EPOXY PRIMER, RED E2R 978	4	4	0	L	7768.1
EPOXY SYSTEM, ADX 3126 PART B	3	1	1	L	3176.1

TABLE 6.2-2.—*List of Carcinogens and Carcinogen-Containing Substances (Continued)*

Chemical Substance	Health Hazard Rating	Fire Hazard Rating	Reactivity Hazard Rating	Form	MSDS Number
*EP\TC FLAT BLACK 595B-37038	3	4	1	L	8329.1
EUTECTOR 157 FLUX	3	0	0	S	3099.1
FAST PRODUCTION ENAMEL - LEAD COLORS	4	4	0	L	5345.1
FERRO-TIC GRADE CM	3	0	1	S	8708.1
FORMALDEHYDE 37 percent	4	1	1	L	236.1
*FORMED MOLECULAR SIEVES (VARIOUS) GRADES)	2	0	0	S	5166.1
FRONTIER COLD PROCESS	4	2	0	L	2305.1
FRONTIER LIQUID ROOF COATING FIBERED	4	2	0	L	2303.1
FRONTIER PLASTIC ROOF CEMENT	4	2	0	L	2307.1
*G322 SILICONE GREASE COMPOUND	4	1	0	S	1847.1
GALVA-KOTE GRAY 37 13F12M	4	0	1	S	4739.1
GASOLINE, AUTOMOTIVE, LEADED	2	4	1	L	5897.1
GASOLINE, AUTOMOTIVE, UNLEADED	3	4	1	L	8253.1
*GLIDDEN CONVENTIONAL YELLOW 2851	4	4	1	L	1225.1
GLIDDEN WATER REDUCIBLE YELLOW	4	0	0	L	1239.1
GLOBE-O-SIL 15-1-G	3	0	0	S	3466.1
GLYPTAL C-1103	4	3	1	L	6985.1
*GRAPHITE DRY LUBE	4	3	1	S	8548.1
*GRAY FILL 'N SAND PRIMER SURFACER 131-S	3	4	1	L	7352.1
GRAY PRODUCT CODE 93482D	4	3	0	L	7450.1
GREEN EPOXY PRIMER	4	4	0	L	7998.1
GREEN LACQUER	4	4	1	L	8469.1
HCP 800 SERIES ALL COLORS	4	1	1	L	1805.1
*HEAVY DUTY LACQUER THINNER 6782	3	3	1	L	689.1
*HEXACHLOROBENZENE	3	1	1	S	4181.1
HEXACHLOROBENZENE	3	1	1	S	4181.2

TABLE 6.2-2.—*List of Carcinogens and Carcinogen-Containing Substances (Continued)*

[illegible] Substance	Health Hazard Ratint	Fire Hazard Rating	Reactivity Hazard Rating	Form	MSDS Number
[illegible] CHLORINATED RUBBER ENAMEL LEAD [illegible]	4	4	1	L	2781.1
[illegible] CUSTOM POLYURETHANE ENAMEL [illegible] A LEAD C	4	4	1	L	2785.1
[illegible] SHER-TAR COAL TAR EPOXY ENAMEL - [illegible] A	3	2	1	L	2798.1
[illegible]KINS THERMOCOUPLE ALLOYS	3	0	0	S	2194.1
[illegible] GARD TRANSMISSION AND HYDRAULIC OIL	1	1	1	L	8819.1
[illegible]IUM NITRATE, ANHYDROUS	4	0	1	S	5127.1
INDUSTRIAL COATING 3M 244(FORMERLY [illegible] 226)	3	4	1	L	1669.1
INDUSTRIAL ENAMEL - LEAD COLORS	4	2	1	L	2754.1
INDUSTRIAL ENAMEL - VOC COMPLYING LEAD CONTAININ	4	2	1	L	2756.1
INDUSTRIAL WASH PRIMER P60G2	4	4	0	L	3458.1
INDUSTRIAL WASH PRIMER P60G2 GREEN	4	4	1	L	4750.1
INORGANIC LEAD COMPOUND	4	0	0	S	973.1
IRIDITE 1P-OD	4	0	1	S	3574.1
IRONCLAD SAFETY ZONE PAINT (ALL COLORS)	4	4	1	L	8409.1
J 1345 BASIC ZINC CHROMATE	4	0	0	S	6856.1
JDM F2A2GREEN ALKYD RESIN ENAMEL	4	2	1	L	6865.1
KEL-GUARD ZINC CHROMATE/RED OXIDE PRIMER 1710-120	4	2	1	L	5074.1
KEL-SEAL 88 WATERPROOFING SEALER CLEAR #88-001	2	1	1	L	4981.1
KEL-SEAL ELASTOMERIC SEALANT WHITE 1108-100	4	1	0	L	5025.1
KEM A&A EPOXY ENAMEL - LEAD COLORS	4	4	1	L	2768.1
KEM A&A EPOXY PRIMER	4	3	1	L	2769.1
KEM AQUA WATER REDUCIBLE PRIMER	4	1	0	L	5325.1
KEM KROMIK METAL PRIMER BROWN	4	3	1	L	2747.1
KEM LUSTRAL - CHROMIUM CONTAINING COLORS	4	2	0	L	5331.1
KETOS AISI 01	4	1	1	S	1136.1

TABLE 6.2-2.—*List of Carcinogens and Carcinogen-Containing Substances (Continued)*

Chemical Substance	Health Hazard Rating	Fire Hazard Rating	Reactivity Hazard Rating	Form	MSDS Number
*KIT 82-A2 (SCOTCHCAST 4)	3	4	1	L	5161.1
KOROETCH PRIMER BASE 513X355	4	4	1	L	3458.2
KROMIK METAL PRIMER	4	2	1	L	2770.1
*LACQUER, ACRYLIC N/C GLOSS RED	3	4	1	L	1815.1
LACQUER, YELLOW SPRAYING #13655	4	4	3	L	3338.1
*LEAD CHROMATE	4	1	0	S	2005.1
LEAD FREE PLUMBING SOLDERS;BRIDGIT STAY-SAFE 50 NICK	4	0	0	S	7519.1
LEAD THIOCYANATE	4	1	0	S	5390.1
LEAD THIOCYANATE	4	1	0	S	5390.2
LIGHT CANYON RED B8418A	2	4	1	L	7888.1
LIGHT GRAY CRU 4707 PART A	4	1	0	L	7654.1
LIGHTER FLUID	4	4	0	L	5914.1
LOCK-EASE LE-4 & LE-18	4	2	1	L	8705.1
LOCTITE ADHESIVE/SEALANT 262PART #262	1	1	0	L	2685.1
LT BLUE S.E. PAINT 43617L	4	4	1	L	8052.1
M-COAT G CURING AGENT	4	1	0	L	3753.1
M-COAT GL CURING AGENT	4	1	0	L	3751.1
*M-LINE RSK-1ROSIN SOLVENT	2	4	1	L	3768.1
METAL PRIMERS	4	3	1	L	2747.1
*METAL TREATMENTS, LACQUER REMOVE PAINT REMOVER	4	0	0	L	8370.1
METALATEX SEMI-GLOSS - LEAD COLORS	4	1	0	L	2740.1
MIL-E-52929 ENAMEL, ALKYD, CAMOUFLAGE FLASH DRY	4	4	1	L	526.1
MIRROLAC COVER UP ALKYD-URETHANE INT/EXT GLOSS ENAMEL	2	2	0	L	8203.1
MOISTURE/FUNGUS PROOF	4	4	0	L	3165.1
MOLY GEAR-GARD AEROSOL 1048	4	4	0	L	3117.1

Table 6.2-2.—*List of Carcinogens and Carcinogen-Containing Substances (Continued)*

Chemical Substance	Health Hazard Rating	Fire Hazard Rating	Reactivity Hazard Rating	Form	MSDS Number
[illegible] ALUMINUM ROOF COATING	4	2	0	L	2310.1
[illegible] ALUMINUM ROOF PAINT	4	2	0	L	2313.1
[illegible]ODIPHENYLAMINE	2	0	0	S	3658.1
NICKEL	4	0	1	S	3662.1
NICKEL	4	0	1	S	3662.2
NICKEL	4	0	1	S	3662.3
NICKEL	4	1	1	S	5393.2
NICKEL (II) OXIDE	4	0	1	S	8627.1
NICKEL (II)CHLORIDE	4	0	1	S	8628.1
NICKEL ACETATE	4	0	1	S	7085.2
NICKEL CADMIUM BATTERY	4	0	0	S	7900.1
NICKEL CHROMIUM ALLOY	4	0	0	S	5905.1
NICKEL CYCLOHEXANEBUTYRATE	4	0	0	S	4217.1
NICKEL HYDROXIDE	4	0	0	S	2943.2
*NICKEL IN HNO3	4	0	1	L	3011.1
*NICKEL IN HNO3	4	0	1	L	7503.1
NICKEL IN XYLENE	3	3	1	L	8145.1
NICKEL NITRATE, HEXAHYDRATE	4	0	1	S	6022.2
NICKEL PLATED ABRASIVE PRODUCTS (BROWN)	4	0	0	S	7933.1
*NICKEL SPECTROMETRIC STANDARD SOLUTION SRM #3136	4	0	1	L	8243.1
NICKEL STANDARDS, CONOSTAN	4	1	1	L	1552.1
*NICKELOUS CHLORIDE, 6-HYDRATE	4	0	0	S	2880.1
*NICKELOUS SULFATE, 6-HYDRATE	4	0	0	S	3795.1
NISSEN METAL MARKER/NISSEN LOW-CHLORIDE METAL MARKER	2	3	1	L	8716.1

TABLE 6.2-2.—*List of Carcinogens and Carcinogen-Containing Substances (Continued)*

Chemical Substance	Health Hazard Rating	Fire Hazard Rating	Reactivity Hazard Rating	Form	MSDS Number
NISSEN SOLID PAINT MARKER	3	1	1	S	8715.1
NON SMUDGE ALUMINUM METALLIC, 98169D	3	3	0	L	7446.1
O-TOLIDINE, 3,3'DIMETHYLBENZIDINE	4	3	1	S	8629.1
OAKITE DEOXIDIZER 34	4	0	1	S	62.1
OD GLOSS A/D ENAMEL X-776	4	3	1	L	1214.1
OPEX PRODUCTION LACQUER - LEAD COLORS	4	4	0	L	5357.1
OSTALLOY 158	4	0	0	S	6511.1
*P-415 RESIN COMPONENT DOD-P-153280 PRIMER, PRETREATMEN	4	4	1	L	609.1
*PAINT, EPOXY PRIMER KIT, PART I YELLOW	4	4	1	L	614.1
PAINT, PRIMER PRETREATMENT 0415	4	4	1	L	1726.1
PAINT, RED OXIDE PRIMER	2	4	0	L	3398.1
PAINT, ZINC CHROMATE PRIMER COATING COLT	4	4	1	L	2259.1
PARAFIN OIL	3	1	0	L	3719.1
PEMCO 1680-A	4	1	0	S	6330.1
*PERMANENT THREADLOCKER 262	1	1	0	L	2685.1
PHENACETIN	4	1	0	S	7632.1
*PHOS PHO NEAL WASH PRIMER	3	4	1	L	8805.1
PHOTORECEPTOR, XEROX	4	0	0	S	4628.1
PLASITE 7122-H LIGHT GRAY	3	4	0	L	3336.1

TABLE 6.2-2.—*List of Carcinogens and Carcinogen-Containing Substances (Continued)*

Chemical Substance	Health Hazard Rating	Fire Hazard Rating	Reactivity Hazard Rating	Form	MSDS Number
PLATINUM GRAY PX PRIMER SURFACER NO [illegible]	4	4	1	L	7972.1
[illegible]ANE II/T POLYURETHANE ENAMEL SYSTEM [illegible]	3	4	1	L	4936.1
POLY(ACRYLIC ACID), POWDER, MW 250,000	4	0	1	S	6049.1
POLYURETHANE SEMI GL & GLOS LC97	3	4	1	L	5778.1
*POTASSIUM CHROMATE	4	0	0	S	3676.1
*POTASSIUM CHROMATE	4	0	1	S	1620.4
POTASSIUM CHROMATE INDICATOR	4	0	1	S	1620.3
POTASSIUM CHROMATE INDICATOR CODE 213	4	0	1	S	1620.2
*POTASSIUM DICHROMATE	4	1	1	S	991.2
POTASSIUM DICHROMATE	4	1	1	S	991.3
POTASSIUM DICHROMATE	4	1	1	S	991.4
*POTASSIUM DICHROMATE, DILUT-IT ANALYTICAL CONC N/10(0.1	4	1	1	S	991.1
*PR-1422A-2, B-2, PART A	4	0	0	L	6319.1
*PR-1436-G CLASS A, PART B	4	4	1	L	4953.1
PR-420PART A	4	3	1	L	6917.1
PRIMER, FOR GALVANIZED METAL DUPONT 615S	4	4	0	L	2664.1
PRIMER PAINT	4	4	0	L	5322.1
*PRIMER TINTED ZINC CHROMATE COLOR T COMP. G	4	4	1	L	579.1
*PRO-MAR 200 LATEX FLAT WALL PAINT	4	1	0	L	5276.1

TABLE 6.2-2.—*List of Carcinogens and Carcinogen-Containing Substances (Continued)*

Chemical Substance	Health Hazard Rating	Fire Hazard Rating	Reactivity Hazard Rating	Form	MSDS Number
PRO-MAR 400 LATEX FLAT PAINT	4	1	0	L	5279.1
PRO-MAR 700 LATEX FLAT PAINT	4	1	0	L	5281.1
PRO-MAR ALKYD FLAT FINISH	2	2	0	L	5283.1
PRO-MAR ALKYD FLAT WALL PAINT - PURE WHITE	4	2	0	L	5284.1
PRO-MAR BRONZETONE ENAMEL	2	2	0	L	5287.1
*PRO-MAR TRAFFIC MARKING PAINT YELLOW	4	4	0	L	2738.1
PRO-SEAL 870ALL CLASSES & TYPES, EXCEPT B 1/2	4	1	1	L	9192.1
PROGRADE ALUMINUM ROOF COATING	4	2	0	L	2312.1
PROGRADE FIBERED ROOF COATING	4	2	0	L	2301.1
PROGRADE PLASTIC ROOF CEMENT	4	2	0	L	2308.1
PROTECTO - LUBE, CA-46000, CA-91323	1	1	0	S	7323.1
PUMICE	4	1	1	S	4440.1
PUNCH FINISH 481	3	0	0	S	7311.1
*Q.D. INDUSTRIAL ENAMEL INTERNATIONAL RED #185-140	4	4	1	L	4987.1
Q.D. INDUSTRIAL ENAMEL INTERNATIONAL ORANGE #185-144	4	4	1	L	4988.1
*Q.D. INDUSTRIAL ENAMEL JOHN DEERE GREEN #185-139	4	4	1	L	4986.1
*QUALITY METAL CLEANER	4	0	0	L	1369.1
QUANTOR IR-75, BLEACH PART 3	4	0	0	L	6828.1
QUICK DRY ENAMEL - LEAD COLORS	4	4	0	L	5349.1

TABLE 6.2-2.—*List of Carcinogens and Carcinogen-Containing Substances (Continued)*

Chemical Substance	Health Hazard Rating	Fire Hazard Rating	Reactivity Hazard Rating	Form	MSDS Number
[illegible]Y NICKEL CATALYST #28	3	3	1	S	5393.1
[illegible] RB-2	3	0	0	L	4638.1
[illegible] ENAMEL #11105 OR #11136 FORM [illegible]CKHEED	4	4	1	L	4364.1
[illegible]FINISH GLOSS BLACK DUCO LACQUER #44S	3	4	1	L	7430.1
RHODIUM (III) CHLORIDE	4	0	1	S	2095.1
RODINE 92A	4	1	1	L	6782.1
ROOF RESATURANT 425	4	2	0	S	400.1
RUSTMASTER 1225	3	4	1	L	8207.1
RX-08-EL (ECX)	4	1	4	L	4916.1
RX-08-GS (ECX)	4	1	4	L	4915.1
*SAFETY-KLEEN 105 SOLVENT	3	2	1	L	1970.1
*SAFETY YELLOW PAINT	4	4	0	L	8211.1
SEALTIGHT HYDROMAT MASTIC	2	2	0	L	1617.1
SEMI-VOLATIEL ORGAICS KIT (3/90SOW)	4	4	1	L	8838.1
SF-283 (SS323208-01)	0	1	1	L	3023.1
SF-283 (SS323208-01)	1	1	0	L	3390.1
SHELL TELLUS OIL 68	1	1	1	L	1315.1
SILICONE GREASE G322L	4	1	0	S	1847.1
SILOO WHITE LUBE 14B	1	1	1	S	8854.1
SILVER-BRITE ALUMINUM PAINT HEAVY DUTY RUST RESIST	4	2	1	L	2764.1
SMAW ELECTRODE, TYPE DRAG'N ARC 308	3	0	0	S	3828.1
SMAW ELECTRODE, TYPE E6011	3	0	0	S	3827.1
*SODIUM DICHROMATE	4	1	0	S	280.1

TABLE 6.2-2.—*List of Carcinogens and Carcinogen-Containing Substances (Continued)*

Chemical Substance	Health Hazard Rating	Fire Hazard Rating	Reactivity Hazard Rating	Form	MSDS Number
SODIUM DICHROMATE	4	1	0	S	280.2
SODIUM DICHROMATE	4	1	0	S	280.3
*SODIUM DICHROMATE DIHYDRATE	4	0	1	S	5636.1
SOLDER CREAM (VAPORETTE)	4	1	0	L	7826.1
STAINWELD 308L-16	3	0	0	S	6400.1
*STAMP PAD INKER	1	1	0	L	4733.1
*STATIC GUARD	2	4	0	L	3977.1
STATICIDE	2	1	1	L	4585.1
STENTOR DRILL ROD MEDIUM BLUE PAINT	3	0	0	S	2076.1
STRUCTURAL STEEL SHOP COAT PRIMER RED OXIDE	4	4	0	L	5320.1
STYLE PERFECT INTERIOR LATEX PAINT	4	1	0	L	5299.1
SUFFIX PHOTO RECEPTOR XEROX 4045/XP10/XP10	4	0	0	S	4220.1
SUN-PROOF S/G LATEX HOUSE AND TRIM 78-LINE	4	0	0	L	9315.1
*SUNFIRE 421 ACRYLIC URETHANE FINISH, LEAD COLORS	4	4	0	L	7656.1
SUNFIRE 421ACRYLIC URETHANE BASECOAT LEAD COLORS	4	4	0	L	7839.1
SUNFIRE LOW VOC ACRYLIC URETHANE FINISH, LEAD COLO	4	4	0	L	7783.1
*SUPER-SPARE GLOSS VARNISH CLEAR 1233	2	2	1	L	5313.2
SUPER UNLEADED GASOLINE	4	4	1	L	8528.1
TADCO FORMULA 9805B	4	1	1	L	8821.1

TABLE 6.2-2.—*List of Carcinogens and Carcinogen-Containing Substances (Continued)*

Chemical Substance	Health Hazard Rating	Fire Hazard Rating	Reactivity Hazard Rating	Form	MSDS Number
[illegible] MATRIX SPIKING CONCENTRATES [illegible]	4	4	0	L	9100.1
[illegible] MATRIX SPIKING CONCENTRATES [illegible] VOLATILES	4	4	0	L	9096.1
[illegible] MATRIX SPIKING CONCENTRATES [illegible] BASE/NEUTRAL/ACI	4	4	0	L	9098.1
[illegible] VOLATILES MIXTURE IN METHANOL:WATER (90:10).	2	4	1	L	9576.1
[illegible] AQ 1450F	4	1	1	L	8968.1
THIOURACIL	2	0	1	S	4547.1
THORIUM	2	1	1	S	6163.1
THORIUM DIOXIDE	4	1	1	S	2851.1
THORIUM DIOXIDE	4	1	1	S	2851.2
THORIUM METAL/POWDER	2	1	1	S	6163.2
TILE CLAD II ENAMEL - PART A - LEAD	4	3	1	L	2772.1
TIN, SPECPURE, OIL BASED STD SOL 14206	4	1	1	L	8578.1
TMS IN BENZENE-D6	4	4	1	L	7047.1
TOUCH UP I	4	0	0	L	517.1
TOUCH-UP II	4	0	0	L	4492.1
TRAFFIC LINE FINISH YELLOW 2130-131	4	4	1	L	5083.1
TRAFFIC LINE INT/EXT ALKYD TRAFFIC MARKING PAINT-YELLO	4	4	1	L	8404.1
TT-E-489G TYPE 1, CLASS A LOCKHEED PSI-8699-2	4	4	1	L	3169.1
TT-E-527C 33538 YELLOW FLAT AIR DRY OR BAKE ENAMEL	4	3	1	L	8878.1
TT-P-1757A YELLOW PRIMER ZINC CHROMATE	4	1	1	L	2442.1

TABLE 6.2-2.—*List of Carcinogens and Carcinogen-Containing Substances (Continued)*

Chemical Substance	Health Hazard Rating	Fire Hazard Rating	Reactivity Hazard Rating	Form	MSDS Number
*TT-P-636 RED OXIDE PRIMER	3	2	1	L	3398.1
*TUNGSTEN PURE ZIRCONIATED, 1 AN percent 2% THORIATED	4	1	1	S	7316.1
*TUNING STD MIXTURE 625/8250/8270CLP IN METHYLEN CHLOR	3	0	1	L	9570.1
*URANIUM SOLUTION IN HNO3	4	0	2	L	2326.1
URANIUM SPECTROMETRIC STANDARD SOLUTION	4	0	1	L	6640.1
*URANYL ACETATE, ANHYDROUS	4	1	1	S	4519.1
*URETHANE ACTIVATOR #782S	3	4	1	L	7376.1
VEGA TOOL STEEL AIAI-A-6 BROWN PAINT	3	0	0	S	2075.1
VENICE GREEN AEROSOL PAINT	4	4	0	L	4536.1
VINYL CHLORIDE	4	4	2	G	290.1
VINYL CHLORIDE	4	4	2	G	290.2
VOLATILE ORGANICS KIT (CAT.#30050 AND) 30150)	4	4	1	L	8837.1
*VOLATILES CALIBRATION CHECK MIX-CLP IN METHANOL	2	4	1	L	9554.1
VOLATILES MATRIX SPIKE MIX-8260/CLP IN METHANOL	2	4	1	L	9539.1
WATER EPOXY 406 PART B	4	1	1	L	7646.1
*WATERBORNE YELLOW PRIMER	4	1	0	L	8085.1
WELDING ROD, NON-FERROUS COATED ELECTRODES	4	0	0	S	4596.1
WHEATLAND YELLOW B9044A	4	4	1	L	9156.1
WOOD DUST	3	4	1	S	7774.2

TABLE 6.2-2.—*List of Carcinogens and Carcinogen-Containing Substances (Continued)*

Chemical Substance	Health Hazard Rating	Fire Hazard Rating	Reactivity Hazard Rating	Form	MSDS Number
WOOD DUST	2	1	0	S	7774.3
WOOD DUST, HARDWOODS	3	4	1	S	7774.1
*WOODMASTER SPAR VARNISH HIGH GLOSS #85	4	2	1	L	9044.1
*WRINKLE FINISH SPRAY (ALL COLORS)	3	4	1	L	8709.1
Y-469-D PIGMENT, CHROME YELLOW MED.	4	0	0	S	6872.1
YELLOW OPAQUE CLEAR PRINT STAMP PAD INK #9	3	1	0	L	5174.1
*YELLOW STREET MARKING PAINT	4	4	1	L	1457.1
ZINC CHROMATE GREASE GE-D50H47 MOBIL 78-201-R-1	4	0	0	L	1818.1
ZINC CHROMATE PRIMER	4	2	1	L	2750.1
ZINC CHROMATE PRIMERS	4	2	1	L	1758.1
ZINC CLAD I ZINC-RICH COATING	4	4	1	L	2791.1
ZP-14 ZYGLO DEVELOPER	2	0	0	S	6420.1
ZYGLO ZP-5 AQUEOUS DEVELOPER	3	0	0	S	6463.1

* Indicates substances currently used at Pantex.

exposure through changing machinery, isolating the noise source, posting caution signs, limiting employee exposure time, etc. If these methods are not effective, hearing protection is recommended. In addition, employees who have a potential to receive significant noise exposures undergo annual audiograms by the Medical Department to ensure that they are being adequately protected.

Radiowave or Microwave Radiation Hazards. Electromagnetic Radiation (EMR) is energy emitted by some electrical source traveling in waveform in opposing electric and magnetic fields at the speed of light. Ionizing radiation can cause damage to humans and other life by splitting electrons off of some atoms in the cells of the body. Nonionizing radiation, which possesses less energy than ionizing radiation, can cause damage in humans by causing excessive heat to certain organs. At most industrial sites, including Pantex, nonionizing EMR sources include radars, satellite dishes, and microwave ovens.

At Pantex, evaluation and controls of equipment is used to ensure that employee exposure to EMR is minimal and below ACGIH limits. At Pantex, minimal employee exposure to EMR below ACGIH limits is ensured through evaluation and control of equipment. Any new piece of radar or microwave equipment must be submitted to the industrial hygiene department for evaluation and for requirements concerning the safe operation of the equipment. In addition, all new microwave ovens are evaluated using EMR instruments to ensure that no leakage occurs. There have not been any injuries at Pantex Plant due to nonionizing radiation exposures.

6.3 INDUSTRIAL SAFETY INCIDENT/ ACCIDENT HISTORICAL DATA

The hazards that resulted in the greatest number of injuries or lost or restricted workdays are discussed in this section. Pantex Plant, like other industrial facilities, also experiences a broad range of accidents that may not cause injury or lost work or restricted workdays. Many safety training and awareness programs are in place to minimize physical hazards and injuries. Occupational safety was evaluated through a review of recorded occupational injuries from 1990 through 1995. Detailed information about the Pantex Plant industrial safety program is provided in Chapter 4.0 of the Programmatic Information Document.

Pantex operations experienced an average of 139 recordable injuries per year during 1990–1995. Approximately 17 percent of those injuries resulted in lost time, with an average of 473 lost days and 996 restricted workdays reported by Pantex each year. One fatality occurred at Pantex between 1990 and 1995. The resultant 1990 to 1995 average Total Recordable Case (TRC) and Lost Workday Case (LWC) rates for Pantex were significantly lower (5.13 and 2.29, respectively), than the Bureau of Labor statistics (BLS) average rates of 8.5 and 3.9.

Table 6.3-1. provides a direct comparison of the Pantex 6-year average rates with the BLS rates. Table 6.3-2. provides Pantex statistics for 1990 to 1995 and a 6-year average for the Plant. The table illustrates the decline in TRCs, LWCs, and lost workdays since 1990. This is significant because each year the number of employees and hours worked have increased. Table 6.3-3. provides information on injuries with lost workdays and injuries without lost work days from 1983 to 1995.

The data provided do not go back past 1990 because on January 1, 1990, DOE changed the reporting requirements and adopted title 29 code of federal regulations, part 1904, for recording and reporting occupational injuries and illnesses[5]. Field offices were advised to use the Department of Labor publication, "Record-keeping Guidelines for Occupational Injuries and Illnesses," for determining the recordability of injuries and illnesses. Prior to that time, Pantex Plant reported injuries and illnesses in accordance with the DOE-76-45/7A, SSDC-7B, "DOE Guide to the Classification of Recordable Accidents."[6] The intent in adopting

TABLE 6.3-1.—*Pantex Injury Rates Compared with BLS 1990 - 1995 Average Rates*

	TRC	LWC	LWD
Pantex Composite	5.13	2.29	54.22
BLS	8.5	3.9	75.2

TABLE 6.3-2.—*Pantex Composite Statistical Summary*

	1990	1991	1992	1993	1994	1995	Average
Equivalent Full-time Employment	2274	2468	2728	2907	3207	3348	2822
Work Hours (per 1000)	4321	4691	4966	5678	6143	6716	5419
Total Recordable Cases	138	103	116	147	163	168	139
Total Recordable Case Rate	6.39	4.39	4.67	5.18	5.31	5.00	5.13
Number of Illness Cases	10	11	7	20	35	48	22
Illness Rate	0.46	0.47	0.28	0.70	1.14	1.43	0.81
Number Lost Work Cases	84	29	43	67	71	75	62
Lost Work Case Rate	3.89	1.24	1.73	2.85	2.31	2.23	2.29
Lost Workdays: Away	1228	403	347	438	208	215	473
Lost Workdays: Restricted	2245	125	408	926	1278	996	996
Lost Workdays: Total	3473	528	785	1364	1486	1211	1469
Lost Work Day Rate	160.75	22.51	30.41	48.05	48.38	36.07	54.22
Number of Fatalities	0	0	0	0	0	1	

TABLE 6.3-3.—*Pantex Injuries with Lost Workdays and Injuries without Lost Workdays, 1983 - 1995*

Year	Number of Injuries with Lost or Restricted Work Days	Number of Injuries with Lost Work Days	Total Number of Lost Work Days	Total Number of Restricted Work Days	Number of Injuries without Lost Work Days
1983	21	21	960	134	34
1984	15	15	390	0	14
1985	19	19	213	97	14
1986	26	21	818	699	11
1987	36	10	881	169	9
1988	37	37	1203	527	40
1989	79	47	1480	2970	75
1990	84	26	1228	2245	54
1991	29	21	403	125	74
1992	43	29	347	408	73
1993	67	33	438	926	80
1994	71	23	208	1278	92
1995	75	24	215	996	64

...f Labor regulations was to ensure ...ures all data for the types of cases ...d by the rest of the nation, and to ...cordkeeping and reporting system at ... is comparable to the stringent ... of Labor system.

...ffsite Accident Data

...sportation is conducted by two separate ...ons. All SNM and weapons are moved ... DOE/TSD Couriers and all other ...t of material, both hazardous and non-...s, is moved by the Traffic Department of ... & Hanger. Almost all of the movements ...rdous materials are between the Plant and ...es in the city of Amarillo. For all ...ents of hazardous materials offsite by ...rcial vehicles, there have been no records ...idents meeting the DOT reporting criteria ... the last 20 years.

... the DOE/TSD Couriers, the Incident ...base was used to determine the number of ...dents that have occurred for vehicles carrying ...rdous materials. The TSD Incident Database ...udes all vehicle accidents that have occurred ...m Calender Years 1975-1995. However, not ... accidents were used to determine the accident ...s. For an accident to be included in the count, ... requirements were:

- Any accident in which a vehicle was towed away.
- Any accident in which a fatality occurred.

Any accident occurring during maintenance activities or non-operational activities (i.e., training) was not included in the AT/SST accident rate.

Of the 309 vehicle accidents, 13 met the tow-away criteria, and zero fatalities occurred. Thus, 13 was the number used for the total number of accidents. To obtain an accident rate, 13 was divided by the number of SST operational kilometers (miles). From this process, an AT/SST accident rate of 3.0×10^{-7} /km (0.5×10^{-6}/mile) was derived. These 13 accidents are summarized in Table 6.3.1-1.

Every attempt was made to locate data that were missing from the original incident reports. To accomplish this objective, the data in the database were validated by cross-checking using DOE-wide accident reporting systems Safety Performance Measurement System/Occurrence Reporting and Processing System (SPMS/ORPS) and the Lawrence Livermore National Laboratory risk assessment report. However, some information such as city, was not included in the original data. The DOE has completed a transportation risk assessment similar to a SAR for transportation activities between sites[7]. This assessment addressed only the movement of radioactive materials and did not include chemical and explosive materials. The report describes the methodology and overall results of a probabilistic risk assessment conducted to assess the probability and consequences of inadvertent dispersal of radioactive materials arising from severe transportation accidents. The materials considered in this study included isotopes of plutonium, americium, uranium, and hydrogen, which are shipped in various forms by the U.S. Department of Energy in support of Defense Programs activities. The primary mode of transportation is by public highways using the Armored Tractor/Safe-Secure Trailer (SST). Air transportation is also used on a limited basis and both commercial and military movers were considered. Event trees were developed to quantify probabilities of violent reaction, fire-driven and non-buoyant releases. The event trees are also used to quantify the probability of other conditions that affect consequences, including accident location, meteorological stability and wind direction. Health and environmental consequences are calculated in terms of the expected number of excess latent cancer fatalities and contaminated area, respectively. Uncertainties are considered in many of the input parameters using the Latin hypercube sampling technique.

TABLE 6.3.1-1.—*Summary of Offsite Courier Accidents*

Case No.	Date	Time	City	State	Vehicle Speed, km/hr (MPH)	Road Condition	Weather	Fire	Tow	Damage Amount, $	Vehicle Type
77-01	01/20/77	09:50	Lewiston	ID	64 (40)	Icy	Fog	N	Y	10,000	Trailer/Tractor
78-03	01/14/78	17:15	Wyoming	RI	61 (38)	Icy	Raining	N	Y	5,400	Trailer/Tractor
78-05	02/02/76	02:45	Corbin	KY	24 (15)	Icy	Clear	N	Y	15,000	Trailer/Tractor
78-06	02/14/78	02:45	-	NY	24 (15)	Icy	Snowing	N	Y	5,200	Trailer/Tractor
78-09	10/14/78	13:10	Martinsville	IL	88 (55)	Wet	Raining	N	Y	8,500	Trailer/Tractor
79-0124	01/24/79	03:40	Chambers	PA	64 (40)	Icy	Clear	N	Y	15,000	Trailer/Tractor
80-0421	04/21/80	16:00	Albuqueque	NM	80 (50)	Wet	Raining	N	Y	95,000	Trailer/Tractor
80-1219	12/19/80	13:49	Wellington	CO	24 (15)	Icy	Snowing	N	Y	10,000	Trailer/Tractor
81-001	01/20/81	20:45	Taos	NM	88 (55)	Dry	Clear	N	Y	310	Trailer/Tractor
81-0629	06/30/81	10:15	Boulder City	NV	72 (45)	Dry	Clear	N	Y	1,800	Trailer/Tractor
81-0908	09/09/81	15:00	Oak Ridge	TN	80 (50)	Dry	Clear	N	Y	86,292	Trailer/Tractor
82-0406	04/06/82	02:39	Baker	OR	40(25)	Icy	Snowing	N	Y	110,000	Trailer/Tractor
87-094	11/13/87	02:20	Lake City	TN	88 (55)	Dry	Clear	N	Y	5,040	Trailer/Tractor

radiological and hazardous materials to the interstate portion of the road system and to the national have been included in Appendix E of Management PEIS. Specific for the radioactive waste risk assessment is included in U of the same document.

EMERGENCY OPERATION INCIDENT/ACCIDENT HISTORICAL DATA

logical accidents and incidents, which are mented in the Occurrence Reporting and mation Processing System, provide the tial for further exposures. The following tions are provided to put the information that into proper context:

- Accident - A deviation from normal operations or activities associated with a hazard that has the potential to result in an emergency.
- Emergency - The most serious event, consisting of any unwanted operational, civil, natural-phenomenon, or security occurrence that could endanger or adversely affect people, property, or the environment.
- Event - Any real-time occurrence or significant deviation from planned or expected behavior that could endanger or adversely affect people, property, or the environment.
- Incident - Any deviation from normal operations or activities that has the potential to result in an emergency. An incident usually refers to a malevolent act.
- Off-Normal Occurrence - An abnormal or unplanned event or condition that adversely affects, potentially affects, or is indicative of degradation in the safety, security, environmental or health protection performance, or operations of a facility.
- Unusual Occurrence - An unusual or unplanned event having programmatic significance such that it adversely affects, or potentially affects, the performance, schedule, reliability, security or safety of a facility.

6.4.1 Emergencies

Two events have reached the emergency level at Pantex Plant since 1960. Other situations included accidents, events, and incidents involving operations to natural phenomena emergencies. Summaries of these events follow.

Press Explosion, 11-20, Bay 2. On August 6, 1960, at approximately 1:50 pm, there was an explosion of 5.4 kg (12 lbs) of TNT in a 272,160 kg (300-ton) mechanical press in Bay 2 of Building 11-20. The explosion resulted in $40,000 damage to the press and $35,000 damage to the building for a total of $75,000. There were no injuries to personnel as a result of the accident since the press was remotely operated. The accidental explosion is believed to have been caused by either (1) friction and/or impact on the explosives between the ram cap and the die, (2) fracture or separation of the die's casting and/or ram cap, or (3) extraneous materials in the explosives.

Assembly Cell Contamination w/Plutonium. On November 6, 1961, at 9:30 pm, operators on the second shift were removing a pit from a weapon when a tube in the pit ruptured. As a result of the accidental rupture, radioactive contamination was released in Building 12-44, Cell 6. This building is an assembly cell used during the assembly and/or disassembly of weapons with plutonium bearing pits. Since the weapon component was under a slight pressure, plutonium particles were blown into the air. The particulate plutonium was then caught up in the air conditioning and was scattered throughout the cell. There were no personnel injuries as a result of the incident. Three people were in the cell at the time, one foreman and two operators. Both operators were wearing the appropriate safety clothing, including respirators. The foreman was approximately 1.8 km (6 ft) away, opening the pit container to receive the pit. He was not wearing a respirator. One operator was lifting the pit and looked down and saw the tube bent completely back against the pit. At the same time he heard a hissing sound. The operators hurriedly placed the pit back in the HE and, together with the foreman, quickly evacuated the cell. A nearby safety man told the personnel to wait in a designated area while he notified safety and supervisory personnel and obtained monitoring equipment. When contamination was apparent, he furnished the men with clean respirators and isolated their clothing until the Radiation Safety personnel arrived. An immediate check by the Radiation Safety personnel indicated that the personnel were contaminated; however, it was possible to completely decontaminate them. Urinalysis was immediately begun on the these three individuals. Results indicated that none of the persons involved had received an internal deposition of plutonium.

The next day measurements were taken in the area of the cell, both in the enclosed ramp area and around the exhaust vents outside the cell. It was determined that no significant radiation contamination was released to the atmosphere. The second day following the incident, the airborne radioactive material inside the cell had substantially settled out, and approval was received to begin decontamination.

Subsequent decontamination removed all detectable plutonium from personnel, equipment, and the operating area. Property damage was limited to various pieces of tooling and equipment for which, due to their nature, decontamination was not possible and/or economically feasible. Cleanup efforts cost approximately $26,000.

Wind Damage to Plant. On September 3, [illegible] approximately 5:50 pm, severe [illegible] accompanied by rain and hail, struck Pantex [illegible] and the immediate vicinity. Before power [illegible] the Plant anemometer recorded wind velocities [illegible] excess of 161 km/hr (100 mph). At the time [illegible] storm struck, only standard nonoperational crews, primarily security, fire, and utility personnel, were present on the Plant site. The consensus among these 50 employees was that the storm struck with sudden violence - wind, rain, and hail - first from the west, then from the north. None reported sighting a funnel. No fire, disabling injury, fatality, or radiation exposure/contamination occurred. The storm did not cause any radioactive or explosive hazards. There was general damage to the roofs, glass, and utilities. There was localized structural damage, and, in some cases, collapse occurred. Roof and structural failures resulted in extensive water damage created by accompanying rain. Approximately 110 vehicles sustained glass damage and minor body damage.

Among the damaged structures and systems were: (a) the component warehouse (Building 11-7), which suffered major damage when the north bay collapsed. Severe damage occurred to the roof of the remaining portion (in addition to AEC weapon components, the collapsed section housed all locally stored UK material and many DOD owned components for Joint Test Fire Units); (b) the electrical distribution systems, which had to be repaired, including replacement of over 80 snapped-off or severely damaged electrical poles, plus numerous transformers and associated electrical equipment; (c) utilities, other than electrical, which involved repair, testing, and/or replacement of several thousand feet of air, steam and condensate lines; (d) several production and support buildings which sustained damage (Most of this involved roofing and roof decking. In some cases, however, walls were collapsed and other structural members required repair or replacement.); (e) the vehicle maintenance garage (Building 12-35), which partially collapsed and, after debris was cleared away, was largely replaced; (f) north and east sides of a major shipment loading-unloading building (Building 4-

[illegible] was destroyed by high winds; (g) [illegible] wing of the administration building [illegible] 13-36), which sustained severe water [illegible] a result of loss of roofing.

[illegible] damage halted production activity until [illegible] 11. In order to resume production, the [illegible] undamaged or restored facilities were [illegible] No compromise with safety or security [illegible] and good practices were made. [illegible] production and support buildings sustained [illegible] damage. Damage amounted to [illegible] 000. This figure did not include monetary [illegible] resulting from damage to weapons, weapons [illegible] components, and weapons-related support [illegible] equipment and supplies.

[illegible] Explosion, 12-17A. On January 10, 1968, [illegible] approximately 12:35 pm, there was an [illegible] explosion involving Press Vessel No. 1 located on [illegible] east side of a Press Bay during the [illegible] overpressing of 7.5 kg (16.5 lb) of explosive. The explosion occurred in Bay 12-17A, which contained two 50.8 cm (20 in.) naval gun presses. Press Vessel No. 1 exploded when intensification reached approximately 7.7 x 10^6 kg/m^2 (11,000 psi). Press Vessel No. 2 was on the same cycle with identical material. Press Vessel No. 2 was not damaged significantly by the explosion. The material being processed in Press Vessel No. 2 was removed by remote procedures.

The explosion, starting early in the pressure cycle, broke the vacuum connection, venting gases to the atmosphere. Immediately following the incident, efforts were made to unclog the breach block closure mechanism and/or remove the opposite end closure nut and plug with special hydraulic torque tooling; however, these efforts failed. Investigation indicated that the incident was caused by omission of four segment rings of the overpressing mandrel. The Cemesto-weak walls, blowout walls, air conditioning ductwork, and roof of the bay were broken up and displaced by overpressure to within a 61-m (200-ft) radius of the press vessel. No high density fragments were propagated. The press vessel was overstressed from internal pressure to the extent that attempts to open it remotely with 27,660 to 41,490 kg-m (200,000 to 300,000 foot-lbs) of torque were unsuccessful.

For reasons of security and safety, the press was buried in 1968 and disinterred in 1981. Operations to remotely open the press were begun on November 15, 1982, at Firing Site 21. Samples of debris taken from the press cavity were screened for explosive content by the Safety Department. None was found. Samples were also taken from six suspicious areas on the classified items and analyzed by Differential Scanning Calorimetry for HMX explosive. None was found. Classified contents of the pressure vessel were flashed and melted at the Burning Ground. The pressure vessel, including the cut-off pieces, after flashing, was inspected by the Safety Department and was determined to be at a safe decontamination level for release to the public.

Total damage to building and press amounted to $57,763. Action was taken to prevent environmental damage to equipment in the bay. The cost of repair and replacement of the facility were $57,000 and the cost of replacing items of special tooling lost was $763.

Press Explosion, 11-20, Bay 3. On December 26, 1969, at approximately 10:23 am, there was an explosion involving a 50.8 cm (20 in.) isostatic press in Bay 3 of Building 11-20. No radioactive materials were involved, and no one was injured; however extensive damage was sustained. The press and other equipment in the bay, hoists, pressurization equipment, and vacuum equipment were demolished, as well as the roof and blow-out wall. The blow-out walls and roofs of adjacent bays were extensively damaged. Roof and other damage were sustained when fragments, some weighing hundreds of pounds, fell through the roofs. Loss of the press did not directly affect production schedules but did interfere with development work. The direct cause of the accident was the result of the operator leaving out a "mushroom plate," which seals the pressure vessel. The press had been set up for a captive water isostatic pressing and contained billets of chemical explosive. High density fragments were distributed over a wide area. The operator stayed at the remote control panel until the debris stopped falling and then left the building. He returned later to look for other personnel. Six other personnel were in the building at the time of the explosion. They started to leave and then decided it was safer inside, so they stayed. Several pieces of debris fell through the roof of the building, but no one in or out of the building was injured. An addition to Building 11-21, located about 244 m (800 ft) east of Building 11-20, was nearing completion. The building was being built by an outside contractor, but no one was working there the day of the explosion. The building was near the maximum range of missiles, but none struck it.

Total damage to the building, press, and upgrading for additional protection was over $200,000 to restore the facilities to pre-explosion condition. Desirable changes for safety and upgrading reasons added about $120,000 to that figure. Those included changes to the press and a debris attenuation structure. Time for repair was about 30 weeks. The loss of the press impaired operations in Zone 11 because of loss of pressing capacity and likewise jeopardized production capacity, since that press was essentially identical to production presses and served as direct and immediate backup.

<u>Accidental Electrocution of Lineman</u>. On Saturday, February 13, 1971, at approximately 8:45 am, an electrician was accidentally electrocuted when he contacted an energized conductor while assisting in disconnecting a feeder line. The work was being performed near Building 12-5C from the steel boom of an electrical line truck. An electrical pole line truck, used by electrical crews as a utility vehicle, had a hydraulically operated steel boom for power pole setting and removal and an auger for digging pole holes. This truck had been positioned near pole 6-8. Personnel had their climbing gear on, preparing to climb the pole and remove jumpers with a shotgun stick when it was suggested that they use the line truck's boom to reach the jumpers rather than climb the pole. Th occasionally been done before. From the end of the boom an electrician used a 2.9-m (ft) long shotgun stick to remove the hot cl connecting the two jumpers but had diff removing the third jumper. Until all jumpers were disconnected from the primary l any one of the three feeder lines had a pot through the downstream transformers and requ only completion of a circuit to ground. Th electrician asked that the boom be raised remove the third line.

A scream alerted the crew to the accident. The electrician was seen falling from a standing position toward the energized portion of the east guy wire; his right arm and hand then contacted the energized portion of the guy wire. The principal path of current through the body, after contact with the energized line, was right hand, to right foot, to the boom of the truck and to the ground through a steel leveling jack. Upon being knocked free of the energized line with the insulated shotgun stick, he fell to the bed of the truck, struck his head, and then fell to the ground. Mouth-to-mouth resuscitation and heart massage were started immediately by crew members. The Utilities Foreman used the emergency number to summon an ambulance from the Fire Department. The ambulance attendants attempted to use a mechanical resuscitator, but, because of the previous removal of the electrician's dentures, they had difficulty forming a seal around his mouth. Heart massage and mouth-to-mouth were applied continuously all the way to St. Anthony's Hospital in Amarillo, Texas. The Texas Highway Patrol provided an escort to the hospital. There, the electrician was pronounced dead on arrival at 9:15 am. The cause of death was electrocution. There was no monetary loss, no production down time, and no property damage.

<u>Chemical Reaction Vessel Explosion, 11-17, Bay 4</u>. On August 18, 1971, at approximately 4:00 pm, an explosion occurred in a chemical reactor in Bay 4 of Building 11-17. The most likely cause of this incident was a structural failure of the glass reaction flask allowing material to enter the

..., resulting in overheating and a ...xplosion. An explosion of an ...6.8 kg (15 lb) mixture of FEFO (bis- ...dinitro-ethyl, -formal) and AFNOL ...aval Ordnance Laboratory developed ...olymer) occurred in a 50 liter (13.2 ...hemical reactor. These two chemicals ... been studied by Naval Ordnance ... prior to Lawrence Livermore ...y selection of the chemicals.

...active materials were involved, and no ... injured. The reactor and related ...ent in the incident bay were totally ...yed, a roof section directly above the bay ...lown off, and the hollow tile wall was ...ed, necessitating expeditious removal for ... of safety. Minor wall and ceiling damage ... breakage in the laboratory glassware occurred ...jacent rooms in Building 11-17. The loss did ... affect production schedules but did ...ficantly delay development projects ...ciated with extrusion cast explosives.

... August 18, the operation of distilling ethylene ...hloride solvent from the FEFO plasticized ...FNOL was being performed. Near the end of ... shift, at about 3:45 pm, the technicians ...duced the amount of heat input to the distillation ...peration. The supervisor instructed the ...echnician to terminate the distillation operation by turning the heat off, but to leave the product under vacuum and agitation overnight. The technician returned to Bay 4, turned the heating system off, and observed brown nitrogen oxide fumes in the reactor. The supervisor was alerted. The nitrogen oxide gas had filled the reactor system and was escaping into the bay. The main power switches to the heaters and agitators were turned off. The clamp was removed to relieve the pressure from the system. The bay was evacuated and locked to prevent personnel injury. The personnel had traveled about 9.1 m (30 ft) when the explosion occurred.

The Fire Department responded immediately and used about 379 liters (100 gal) of water to put out a small fire and wash chemicals from the floor. Guards were set up to control access. The equipment and utilities services inside Bay 4 were either completely destroyed or damaged beyond repair. Bay 3 sustained extensive damage primarily to cabinets and glassware from a pressure pulse entering through the opening between Bays 3 and 4. Damage to the building and equipment amounted to $19,867.

Machining Explosion, 11-14A. On March 30, 1977, two high order detonations of different types of HE occurred at the Pantex Plant. The explosions occurred in Zone 11, Building 11-14A, Bay 8. This resulted in two immediate fatalities and ultimate fatal injuries to a third employee. The Pantex Emergency Plan was activated.

On the day of the explosion, an experienced Engineering Technician, with 25 years of Plant experience, was performing contact machining on the outer surface of a 34 kg (75 lb) billet of LX-09 high explosive. He was working alone at a 50.8 cm (20 in.) lathe. Sufficient energy was imparted to the billet of high explosive to cause it to explode at spindle height on the lathe. This initial explosion provided missiles with enough kinetic energy to detonate a completed rough machined billet of about 23 kg (50 lb) of LX-14 high explosive. The LX-14 billet was also in Bay 8, at rest on a granite surface plate located about 102 cm (40 in.) off the floor and approximately 4.6 m (15 ft) from the initial explosion.

The Engineering Technician operating the lathe was killed instantly. A co-worker was in the hallway opposite Bay 8 at the time the explosion occurred. Portions of the north wall of Bay 8 struck him causing immediate fatal injuries. A third worker was waiting outside the east entrance for a Plant taxi. After the explosion, he was found in a face-up position about 10.7 m (35 ft) east of the entrance. He died on April 4, 1977.

Building 11-14A was damaged beyond repair. Replacement costs in 1977 were $2.5M. Damage to surrounding buildings was estimated at $40K. Repairs were made to surrounding buildings.

Demolition of Building 11-14A was completed, and the building was not replaced.

At the time of the accident, Zone 11 was the Plant's high explosive development area. High explosives activities in this area included remotely operated pressing, contact machining (meaning the operator was very near the work being done and was not protected in the event of an explosion), and certain support functions for high explosive operations. Contact machining is no longer permitted at Pantex Plant.

Wind and Hail, Plant and Vehicle Damage. A thunderstorm hit the Plant on June 10, 1984. During the storm, golfball to baseball size hail damaged 116 roofs on buildings. The hail broke windshields and caused extensive body damage to 132 vehicles. There was damage to real property (chilled water line insulation, duct work insulation, steam line insulation, and condenser coils). The storm dumped 10.5 cm (4.15 in.) of rain on the Plant site. Extensive damage was done to buildings, external insulation on piping, and exterior duct work. A Guard Station at the west gate was totally destroyed. The total damage was estimated to be $2,546,000. Hail damage to 116 buildings accounted for most of the amount. Cost of the repairs to these buildings was $2,380,000. Hail damage to 132 vehicles was $112,000 of which $80,000 was body damage which was not repaired. The remainder was $54,000 of hail damage to real property.

The storm was an act of nature and could not be controlled. Therefore, it was requested that protective construction be investigated for the Pantex Plant. The investigation identified some suggestions for construction which were as follows:

- Concrete or 0.6 cm (1/4 in.) steel plate roofs and no glass areas
- 0.6 cm (1/4 in.) steel plate protective covers for condenser coils, duct work, and sky lights
- Heavy steel buildings for parking all v out of the weather.

Forklift Fire in Zone 4 MAA. At approxim 11:30 a.m. on Saturday, September 7, 19 forklift being used in Zone 4 caught fire. employee was driving the forklift as part transportation group moving W76 units 4-128 to 4-123. The units were being mov permit construction activities (removal of posts) around 4-128. An employee arrived a 123 on a 4,082 kg (9,000 lb.) capacity Caterpil gasoline-powered forklift carrying a W76 in shipping container. The employee then lower the tines to the ground, shut off the engine a climbed off the forklift waiting for previous carried containers to be moved into the magazin Seconds later, personnel observed flames comin from beneath the forklift seat. Personnel obtaine a 1.1 kg (2½ lb.) ABC fire extinguisher from security vehicle, unsuccessfully attempted t operate it, and then ascertained that the fire wa too extensive for them to extinguish. Personnel then attempted to move the shipping container away from the forklift. Concurrent with these efforts, the Security Inspector reported the fire via radio to Guard Headquarters.

The employee observed that the lowered tines precluded removal of the container. He climbed back onto the burning forklift and placed the gearshift in reverse. He then abandoned the forklift leaving the engine running and in reverse gear. The forklift backed off the magazine apron, crossed the road, and stopped in the bar ditch across the road.

As the burning forklift was backing across the road, the driver of a second forklift involved in moving the W76s set down the unit he was carrying in front of 4-123 and picked up the unit that the other employee had just put down. He then placed the second unit so it could be put into 4-123.

While operations involving the forklift were occurring, other personnel in the area moved the W76 units into 4-123, then closed and secured the [illegible]sonnel then proceeded to move [illegible] burning forklift. Shortly after the [illegible] been secured, the Pantex Fire [illegible] arrived and began efforts to [illegible] fire. The Fire Department used [illegible]0 liters (95 gal) and a 10# ABC fire [illegible] to put out the fire.

[illegible] this event were restricted to the [illegible]cause of the protection afforded to the [illegible]ping container by the body of the [illegible] there was no fire involvement of the [illegible]container or the W76 it contained. Fire [illegible] to the forklift was be limited to those [illegible]ible items in the cab and engine [illegible]ment, including glass damage, seating, [illegible]al insulation hoses and electrical [illegible]nents. Gasoline spillage also damaged the [illegible] tires of the forklift causing one to blow out.

[illegible] mechanism for ignition and the material [illegible] first ignited cannot be stated with great [illegible]ty. However, examination of the forklift's [illegible]tenance log (the log showed an abnormally [illegible] number of fuel system/line repairs) and [illegible]riptions of fire development (little smoke [illegible]wed initially and the fire expanded rapidly) [illegible]icate that gasoline leaking from the fuel line [illegible] the fire's first fuel. The ignition source could [illegible]ve come from a fault in any of the electrical systems present in the engine compartment. The cost to repair the fire damages was estimated to be between $5,000 and $10,000.

A major factor which contributed to the severity of the fire involved the installation of an electric fuel pump on the forklift. The electric fuel pump was installed without a device to prevent fuel flow when the engine is not running but the ignition is on. The use of such a device is recommended by the fuel pump manufacturer (AC) in the literature provided with the fuel pump.

Waterline Break in Ceiling Damaged Computer Equipment. On March 11, 1987, an ell in a chill waterline ruptured, and water poured through the ceiling onto several computers, peripherals, and instruments in Building 12-21, Gas Lab. Before the line was valved off, water was 7.6- to 12.7-cm (3- to 5-in.) deep in portions of the laboratory. Three Bernoulli drives, some surge protectors, computer boards and miscellaneous equipment were destroyed at a loss of approximately $15,000.

Water in Control Panel from Deluge Activation Caused Short Circuit. On November 11, 1988, an instrument mechanic was removing a temperature sensor probe from a hot water line in the equipment room of Building 12-84, Bay 5. Water from the line squirted onto the fire control panel causing a short circuit in the electrical contacts. The short circuit caused the fire deluge system to activate in five bays of the building causing water damage to equipment and weapon components located within the bays.

Deluge System Water Damage, 12-44, Cell 6. An employee was performing the quarterly preventative maintenance inspection on the deluge system at Building 12-44, Cell 6 on January 6, 1989. During the inspection, the employee noted that the low air pressure indicator lamp was not functioning properly. After completion of the preventative maintenance, employee was checking the indicator when he operated the low air pressure indicator lamp. The deluge system had been blocked out for the maintenance procedure, but restored prior to inspection of the low pressure indicator switch. At this time, the indicator light actuated and the deluge system operated, causing water to flow into the cell. The cell contained three weapon physics packages, a Data Pathing System, a humidity indicator, an alpha radiation monitoring system and some programmatic tooling. The water flowed approximately 3 minutes before an employee turned off the blocking valve outside the cell. In addition to the employee, two production technicians were present in the cell at the time of the deluge. The total dollar loss was $40,000.

Storm Damage to Plant and Vehicle. On May 4, 1989, a severe thunderstorm struck the Pantex Plant at approximately 5:30 pm Central Daylight Time (CDT). The storm was tracked by the

National Weather Service, which had classed the storm in its most severe classification. Sustained wind speeds were recorded at 97 km/hr (60 mph) with gusts peaking at 177 km/hr (110 mph). Notifications were made to evacuate personnel to their storm shelters and no personnel were injured. The resulting damage was predominantly limited to temporary buildings, roof damage, and vehicle windows broken by flying roof gravel. No danger of radioactive or chemical contamination to the environment, the Plant, or any personnel resulted from the storm. The total estimated damage to DOE property was $658,000.

Data received from the various weather station recordings around the Plant show that the storm consisted of sustained winds of approximately 32 km/hr (20 mph) over an extended period which was interrupted by a drastic change in wind direction, accompanied by greatly increased wind velocity and a drastic decrease in temperature. Printouts from both Firing Site No. 1 (FS-1) and the Emergency Operations Center (EOC) indicate winds prior to 5:30 pm to be coming from the southeast at approximately 32 km/hr (20 mph). At 5:30 pm, the winds abruptly shifted direction and began coming from the north. They began to increase in velocity until they reached a maximum gust velocity at about 5:38 pm which exceeded 161 km/hr (100 mph) at 10 m (33 ft) above ground (163 km/hr [101 mph] from FS-1 and 177 km/hr [110 mph] from the EOC monitor) and more than 276.8 km/hr (172 mph) at 60 m (197 ft) above ground at which point the gauge ran off scale. Over the period from 5:30 to 5:45 pm, the winds averaged approximately 97 km/hr (60 mph). Readings obtained from the roof-mounted anemometer from Security Headquarters, Building 12-75, were basically illegible. Following the peaks, the winds subsided to about 40 km/hr (25 mph) for an hour and then continued to decline for the remainder of the evening. The strong winds from the storm were accompanied by 1.9 cm (0.75 inches) of rain and hail as recorded by the U.S. Army Corps of Engineers rain gauge from the Steam Plant, currently under construction, between Zones 11 and 12 of the Plant. The National Weather Service, 23 km (14 mi) west of the Plant, officially recorded 1.42 cm (0.56 in) of rain.

A severe wind, rain, and hail storm struck Pantex Plant on Sunday, September 3, 1967 with approximately the same intensity and at the same time of day. The wind speed in the 1989 storm was sustained at 97 km/hr (60 mph) with peak gusts at over 161 km/hr (100 mph) at the 10-m (33-ft) level whereas the 1967 storm showed a maximum sustained velocity of 48 km/hr (30 mph) and peak gusts over 161 km/hr (100 mph). In both storms, the prevailing winds were from the southwest. The peak gusts occurred as the winds abruptly changed direction and began blowing from the north Approximately 85 percent of the 27 facilities involved in these two severe storms were constructed from 1944 to 1953. Several modifications to the facilities and their equipment/systems had been made since the 1967 storms, minimizing damage caused by the May 4, 1989, storm. Such things as new roofs, regular preventive maintenance programs, structural modifications, and the replacement of overhead utility lines with underground lines have been accomplished over the period between the 1967 and 1989 storms.

Tritium Release, 12-44, Cell 1. Another incident occurred in May 1989, during a normal weapon disassembly and retirement operation[8]. An electroexplosive squib was initiated, which resulted in the actuation of the reservoir valve. Operation of the valve caused deuterium-tritium gas to be transferred into the pit and resulted in the subsequent release of deuterium-tritium into the assembly cell. The tritium release to the room occurred when the operator/technician, who did not realize the valve had functioned, loosened a pit tube gland nut before removing the reservoir. None of the five operator technicians present heard or smelled the firing of the explosive squib. The two operator/technicians working on the weapon did not notice that the protective cover on the valve's thermal plug had been ejected. Investigation of the valve confirmed actuation by means of explosive firing. It should be noted that although the valve actuation, gas transfer to the

...equent personnel exposures are ... from an environmental or ... safety and health point of view, at no ... a nuclear explosives safety concern ... have endangered any person at ... or within the general population. An ... 40 kCi of tritium gas was released into ... ring the incident. The dose to the ... y exposed individual was 1.3 rem and ... 1.5 man-rem for all monitored ... The dose estimate at the site ... y was less than 1 mrem. Tritium is a ... used radioisotope at many DOE ... ories. It decays by beta emission to ^{3}He ... half-life of 12.32 years.

...ximum energy of the beta particles emitted ... keV, and the average energy is about 5.7 ... With one exception, this is the lowest-... y beta emitter known. These beta particles ... have enough energy to penetrate the dead ... of skin covering the human body; therefore, ... is not an external hazard but is of concern ... gas is inhaled or absorbed through the skin. ... amount of skin absorption equals the rate of ... milation through inhalation. Building 12-44, ... 1 is designated a contamination area at the ... and is no longer used.

...luge Trip, 12-104, Bay 2. On May 22, 1990, ...o preventative maintenance personnel entered ... work bay and proceeded to perform an annual ...eck of the deluge system. One of the people ...roceeded to close the outside valves in order to ...erform the inspection. One of the seals hung on ...e manual deluge release valve actuating the ...ystem prior to the OSY being fully closed, ...ausing approximately 76 liters (20 gal) of water to flow into the bay.

Cracked Pit, 12-98, Cell 1. In addition to the emergencies summarized above, a serious event occurred in November 1992. Specifically, a weapon component unexpectedly cracked during the dismantlement of a W48. A summary of the event follows:

On November 12, 1992, during dismantlement of a W-48 unit in Building 12-98, Cell 1 (a specially designed weapon disassembly structure), the outer nonradioactive layer of the plutonium-containing component (pit) cracked. The cracking occurred while the component was being thermally treated to remove the HE. There were no immediate nuclear explosives safety concerns.

The Supervisor and Production Technicians working in the cell immediately exited the cell and notified the Pantex Operations Center and Radiation Safety Department that the component had cracked. Radiation Safety personnel responded and, dressed in anticontamination clothing and respirators, entered the cell. Two radiation swipe samples were taken on the pit, with one smear taken directly over the crack. The results were 9,000 disintegrations per minute for the smear taken on a location away from the crack and 57,000 disintegrations per minute for the one taken directly over the crack. The component was then triple bagged and placed in a temporary container to prevent possible spread of plutonium. The filter from the cell's Continuous Air Monitor was removed and analyzed. The cell was surveyed for plutonium contamination. Only a tray that the pit had been placed on earlier was found to be contaminated. Nasal smear samples taken from the workers who evacuated were not contaminated.

The cracked component was radiographed using a cobalt-60 source. The radiograph confirmed that the crack was restricted to only the outer, nonradiological material. Procedures were developed by key personnel from Lawrence Livermore National Laboratory (LLNL) and Pantex, and the final pieces of HE removed from the component. The pit was packaged for shipment to LLNL on January 15, 1993. LLNL evaluated the crack and determined that there was a defective weld in the waist area. The occurrence was determined to be "not avoidable." All necessary remedial actions were performed in a manner that eliminated the risk of the spread of plutonium contamination and any degradation of safety. No nuclear explosive safety concerns existed.

6.4.2 Non-Emergencies

On September 1, 1990, a new occurrence reporting and information processing system was instituted DOE-wide. Between September 1, 1990, and June 30, 1996, at Pantex Plant, there were 783 reportable occurrences (Off-Normal Occurrences and Unusual Occurrences). The complete reports for these occurrences are filed in the DOE Occurrence Reporting and Processing System (ORPS) data base. The host computer for ORPS is located at the Idaho National Engineering Laboratory, Idaho Falls, Idaho. The total number of reportable occurrences increased dramatically in 1994 because Pantex started using site-specific criteria for reporting consistent with the new conduct of operations philosophy. The site-specific criteria are at a lower threshold for reporting than they were in previous years. This increase was expected, and the number of reportable occurrences is expected to decrease as the site becomes adjusted to the new conduct of operations philosophy. A description of the occurrence categories is provided in Table 6.4.2-1. Table 6.4.2-2. contains a summary of the reportable occurrences from 1990 through 1995. A complete list of the reportable occurrences in fiscal year 1996, from October 1, 1995 through June 30, 1996, can be found in Table 6.4.2-3. Reportable occurrences are either off-normal (O), unusual (U), or canceled (C).

TABLE 6.4.2-1.—*Listing of Occurrence Categories*

[illegible]	Description
	Group 1 - Facility Condition
1A	Nuclear Criticality Safety.
1B	Fires/Explosions.
1C	Any unplanned occurrence that results in the safety status or the analytical basis of a facility or process being seriously degraded.
1D	Loss of Control of Radioactive Material/Spread of Radioactive Contamination.
1E	A deficiency such that a structure, system, or component vital to safety or program performance does not conform to stated criteria and cannot perform its intended function.
1F	Violation of procedures (include maintenance requirements and system lineups) or inadequate procedures either of which result in adverse effects on performance, safety, or reliability.
1G	Unsatisfactory Surveillance/Inspections.
1H	Any deficiency in a structure, system, component, or facility vital to program continuity which, to redesign or repair or otherwise establish the adequacy of the item, will result in a program significant delay or cost.
1I	Operations.
1J	Inadequate experiment/test performance resulting in program significant delay or cost.
	Group 2 - Environmental
2A	Radionuclide Releases.
2B	Release of Hazardous Substances/Regulated Pollutants/Oil.
2C	Discovery of hazardous material contamination due to DOE operations.
2D	Ecological Resources.
2E	Agreement/Compliance Activities.
	Group 3 - Personnel Safety
3A	Occupational Illness/Injuries.
3B	Vehicular Incidents.
3C	Miscellaneous.
	Group 4 - Personnel Radiation Protection
4A	External Radiation Exposure.
4B	Personnel Contamination.
4C	Internal Exposure.
	Group 5 - Safeguards and Security
5A	Criminal Acts.
5B	Loss of Control of Classified Matter.
5C	Substance Abuse.
5D	Foreign Intelligence Activities.

TABLE 6.4.2-1.—*Listing of Occurrence Categories (Continued)*

Category	Description
	Group 5 - Safeguards and Security (Cont.)
5E	Computer Equipment/Systems.
5F	Unplanned/Unscheduled Outage of Site Security System.
5G	Demonstrations/Protests.
5H	Firearms.
5I	Other Security Concerns.
5J	Material Control and Accountability.
	Group 6 - Transportation
6A	Offsite Transportation (DOT jurisdiction) Occurrences.
6B	Onsite Transportation (DOE jurisdiction) Occurrences.
	Group 7 - Value Basis Reporting
	Group 8 - Facility Status
8A	Any unplanned occurrence in any portion of a program conducted in accordance with approved requirements and procedures which results in the facility, process, or activity being secured or operations significantly curtailed.
8B	Any unplanned occurrence in any portion of a program conducted in accordance with approved requirements and procedures which results in a current facility, process, or activity shutdown being extended.
8C	Any unplanned occurrence in any portion of a program conducted in accordance with approved requirements and procedures that results in a new facility, process, etc., startup being delayed.
	Group 9 - Cross Category Items
9A	A series of related occurrences which individually do not warrant reporting under preceding criteria, but which collectively are considered significant enough to warrant reporting.
9B	A near miss to one of the reporting classifications under preceding categories.
9C	Identification of potential concerns or issue, that are deemed to be worthy of reporting.

TABLE 6.4.2-2.—*Summary of Occurrence Reports from 1990 - 1995*

Year	Category	0	1	2	3	4	5	6	7	8	9	10
1990	Off-Normal	-	5	3	2	-	6	1	-	-	1	
	Unusual	-	1	-	-	-	-	-	-	-	-	
	Canceled	-	-	-	-	-	-	-	-	-	-	
1991[*]	Off-Normal	-	38	11	8	1	4	2	1	1	12	
	Unusual	-	3	6	-	-	1	-	-	1	1	
	Canceled	-	5	-	1	-	-	-	-	-	-	
1992	Off-Normal	-	37	3	12	-	1	2	5	1	11	
	Unusual	-	5	1	-	-	-	-	-	-	1	
	Canceled	-	2	1	-	1	1	-	-	-	-	
1993[*]	Off-Normal	-	28	5	1	1	-	5	-	1	8	
	Unusual	-	2	1	-	-	1	-	-	-	1	
	Canceled	-	7	-	-	-	-	-	-	-	2	
1994	Off-Normal	-	153	4	2	-	6	3	2	1	11	
	Unusual	-	12	-	-	-	2	-	-	-	2	
	Canceled	-	2	-	-	-	-	-	-	-	-	
1995[*]	Off-Normal	-	136	6	4	-	2	2	2	-	1	41
	Unusual	-	15	-	1	-	-	-	-	-	-	1
	Canceled	-	22	-	-	-	-	-	-	-	-	4

[*]In 1991, 91-1008 was three groups (1, 2, and 9).
[*]In 1991, 91-1009 was two groups (1 and 8).
[*]In 1993, 93-0010 was not used and is not included in this table.
[*]In 1995, Category type 9, "Cross-Category Items" was changed to Category 10; Category 9 is now "Nuclear Explosive Safety."

TABLE 6.4.2-3.—*FY1996 Occurrence Reports at Pantex (10/1/95 thru 6/30/96)*

Report	Group	Category	Description of Occurrence
95-0158	1	O	Alpha Monitor in Failure Mode, 12-98, Cell 4
95-0159	10	O	Suspect Counterfeit Fasteners on Electric Walk-Behind Forklift
95-0160	10	O	Improperly Stored/Labeled Radioactive Material, 12-26, Bay 22
95-0161	10	O	Radiation alarm Panel Transformer Malfunction, 12-84
95-0162	1	O	Leak from 6 Inch Diameter Pipe for a Fire Main to 12-86, Bays 1-8
95-0163	1	O	Tritium Monitor Malfunction, 12-104, Bay 14
95-0164	1	O	Evacuation of 12-26 Due to Fire Alarm
95-0165	3	O	Contractor Employee's Arm Caught in Pipe Threader
95-0166	1	O	Metal Panel Blocking Exhaust Damper, 12-84, Bay 1
95-0167	1	O	Loss of Electrical Power, 12-104 West
95-0168	1	O	Fire Department Remote Automatic Alarm System
95-0169	1	O	Alpha Monitor Malfunction, 12-98, Cell 3
95-0170	1	O	Vacuum Equipment Failure, 12-44, Cell 8
95-0171	1	O	Explosive Material Found in Unauthorized Areas
95-0172	1	O	Procedural Violation During an Assembly Process, 12-104, Bay 5
95-0173	1	O	Uninterruptable Power Supply #4 Failure, 12-104, Electric Room #4
95-0174	1	O	Neutron Monitor Quarterly Surveillance Failure, 12-21, East Bay
95-0175	1	O	Blast Door Interlock Failure, 12-104, Bay 6
95-0176	10	O	Suspect/Counterfeit Fasteners on Hoists & Cranes (Roll-Up 24)
95-0177	1	O	Explosives Storage Compatibility Violation, 11-42
95-0178	1	O	Army-Navy Cans in Ramp, 12-84
95-0179	1	O	Alpha Monitor Malfunction, 12-104, Bay 6
95-0180	1	O	Tritium Monitor Malfunction, 12-84, Bay 20
95-0181	10	O	Unapproved Modification to Alpha Monitor, Model 442
95-0182	1	O	Alpha Monitor Surveillance Failure, 12-99, Bay 5
95-0183	1	O	Fire System Surveillance Failure, 12-86
95-0184	7	O	Damaged Monitor Cable on W87, 12-104, Bay 13

TABLE 6.4.2-3.—*FY1996 Occurrence Reports at Pantex (10/1/95 thru 6/30/96)(cont.)*

Report	Group	Category	Description of Occurrence
95-0185	1	O	Task Exhaust Surveillance Failure, 12-104, Bay 2
95-0186	3	O	Safety Concern on Excavation for the High Pressure Fire Loop near T9060
95-0187	1	U	Emergency Light Surveillance Failure, 12-44, Cell 8
95-0188	1	O	Alpha Monitor Surveillance Failure, 12-64, Bay 15
95-0189	1	O	Alpha Monitor Surveillance Failure, 12-64, Bay 3
95-0190	1	U	Emergency Light Surveillance Failure, 12-44, Cell 4
95-0191	2	O	Diesel Spill by USACE at Construction Site of 12-130
95-0192	1	O	Tritium Monitor Malfunction, 12-104, Bay 4
95-0193	1	O	Alpha Monitor Malfunction, 12-64, Bays 8 & 9
95-0194	1	O	Unapproved High Explosive Move to BG From Magazine D-63
95-0195	10	O	Suspect/Counterfeit Fasteners on Stage Right Forklift
95-0196	1	O	Fire Alarm Evacuation, 12-84, Bay 5
95-0197	10	O	Suspect/Counterfeit Fasteners on Diesel Generators
95-0198	1	O	Contaminated Waste Isolation Valve Surveillance Failure, 12-98, Cells 2 & 4
95-0199	1	O	Fire System Surveillance Failure, 12-98, Cell 2
95-0200	7	O	Damaged Detonator Cables on B83, 12-84, Bay 4
95-0201	1	O	Radioactive Material in a Non-Radioactive Material Area, 12-61
95-0202	10	O	Inadequate Controls for Maintaining Compliance w/Personnel Limit, Zone 4
95-0203	1	O	Radioactive Material in a Non-Radioactive Material Area, 12-64, Bay 2
95-0204	1	O	Tritium Monitor Malfunction, 12-64, Bay 4
95-0205	10	O	Suspect/Counterfeit Fasteners on Testers, 11-5, Bays 4 & 5
95-0206	9	O	Violation of Two-Person Concept Requirements
95-0207	10	O	Suspect/Counterfeit Fasteners on Blast Door Interlocks, 12-104
95-0208	1	O	Alpha Monitor Surveillance Failure, 12-96
95-0209	1	O	Radioactive Material in a Non-Radioactive Material Area, 12-104, Bay 4
95-0210	1	O	Radioactive Material Transported w/out Prescribed Controls, 12-86
95-0211	1	O	Radioactive Material in a Non-Radioactive Material Area, 12-61

TABLE 6.4.2-3.—*FY1996 Occurrence Reports at Pantex (10/1/95 thru 6/30/96)(cont.)*

Report	Group	Category	Description of Occurrence
95-0212	1	C	Radioactive Material in a Non-Radioactive Material Area, 12-68
95-0213	1	O	Failed surveillance of Emergency Lights, 12-65
95-0214	1	O	Malfunctioning Tritium Monitor, 12-104, Bay 12
95-0215	1	O	Tooling Failure, 12-84, Bay 16
95-0216	1	U	Potential Cell Safety Status Degradation
95-0217	1	O	Damage to B83 During Forklift Transportation
95-0218	1	O	Maintenance Mode Violation, 12-44, Cell 8
95-0219	1	O	Chain Hoist Problem While Lifting W88 Hoist, 12-60, Bay 2
95-0220	1	O	Malfunctioning Alpha Monitor, 12-85
95-0221	1	O	Alpha Monitor Failure, 12-64, Bay 1
95-0222	1	O	Uninterruptible Power Supply #3 Failure, 12-104, Electric Room #3
95-0223	3	U	Occupational Illness/Injury During Physical Fitness Qualification, Resulting Fatality
95-0224	2	O	HE Contamination Found in Offsite Perched Aquifer Investigative Test Boring
95-0225	1	O	Damaged W80 Detonator Cable, 12-104, Bay 4
95-0226	1	O	Ultra-High Speed Deluge System Malfunction, 12-63, Bay 3
95-0227	10	O	Suspect/Counterfeit Fasteners on LINACS, 12-104A, Bays 17 & 19
95-0228	10	O	Suspect/Counterfeit Fasteners on Fire Suppression System
95-0229	1	O	Tie-Down Strap Used w/out Current Annual Inspection
96-0001	10	O	Suspect/Counterfeit Fasteners on Special Tooling, Roll-Up 5
96-0002	1	O	Alpha Monitor Monthly Surveillance Failure, 12-44, Cell 6
96-0003	1	C	Improperly Labeled & Documented Component Shipped to 12-84
96-0004	1	O	Alpha Monitor Surveillance Failure, 12-84, Bay 1
96-0005	1	O	Tritium Monitor Surveillance Failure, 12-84, Bay 1
96-0006	1	O	Alpha Monitor Surveillance Failure, 12-44, Cell 8
96-0007	1	O	Blast Valve Surveillance Failure, 12-44, Cell 4
96-0008	1	O	Improperly Labeled Radioactive Material Transfer, 12-82 to 12-104, Bay 4
96-0009	1	O	Dual Lock Violation, 12-84, Bay 6
96-0010	1	O	Emergency Light Surveillance Deficiency, 12-84 Ramp
96-0011	1	O	Explosive Movement Violation, 12-21

TABLE 6.4.2-3.—*FY1996 Occurrence Reports at Pantex (10/1/95 thru 6/30/96)(cont.)*

Report	Group	Category	Description of Occurrence
96-0012	1	O	Alpha Monitor, Mdl #441, P/N 750-1147, 12-84, Bay 14
96-0013	1	O	Diesel Generator Surveillance Failure, 12-98
96-0014	10	O	Non-Compliance w/Technical Publication
96-0015	1	U	Possible Inadequate Authorization Basis Documentation, 12-21
96-0016	10	O	Suspect/Counterfeit Fasteners Identified, 12-104, Bay 16
96-0017	10	O	Suspect/Counterfeit Fasteners Identified in Boiler House, 16-15
96-0018	10	O	Suspect/Counterfeit Fasteners Identified, 12-64
96-0019	1	U	Noncompliance w/Class I Explosive Bay Requirements, 11-50
96-0020	10	O	Suspect/Counterfeit Fasteners on Yard Crane
96-0021	1	O	Alpha Monitor Failure, 12-99
96-0022	10	O	Suspect/Counterfeit Fasteners Identified on Line
96-0023	10	O	Suspect/Counterfeit Fasteners Found in Work Spaces
96-0024	10	O	Suspect/Counterfeit Fasteners, 12-121
96-0025	1	O	BDI, Surveillance Failure, 12-84
96-0026	7	O	Damaged MSAD Actuator Cable, W87 JTA, 12-86, Bay 4
96-0027	1	O	Emergency Light Surveillance Failure, 12-98, Cell 1
96-0028	1	O	Evacuation of 12-64, Bay 8 Due to Acrid Odor
96-0029	1	O	Radioactive Material in a Non-Radioactive Area, 12-21, East Bay
96-0030	1	O	Uninterruptible Power Supply Battery Failure, 12-64
96-0031	1	O	Alpha Monitor Surveillance, 12-104, Bay 13
96-0032	1	O	Tritium Monitor Surveillance Failure, 12-104, Bay 13
96-0033	1	O	Alpha Monitor Malfunction, 12-84, Bay 3
96-0034	1	O	RAMS Surveillance Failure, 12-84, Bay 9
96-0035	1	O	Radioactive Material in a Non-Radioactive Material Area, 11-42
96-0036	1	O	Alpha Monitor Surveillance Failure, 12-64, Bay 7
96-0037	1	O	Radiation Alarm Monitor System Malfunction, 12-64, Bay 12
96-0038	1	O	Blast Valve Surveillance Failure, 12-44, Cells 5 & 6
96-0039	1	O	Blast Valve Surveillance Failure, 12-85
96-0040	1	U	Blast Valve Surveillance Failure, 12-96
96-0041	1	O	Failure to Change Operational Mode, 12-64, Bay 3
96-0042	1	O	Failure to Follow Nuclear Material Transfer Procedures, Zone 4

TABLE 6.4.2-3.—*FY1996 Occurrence Reports at Pantex (10/1/95 thru 6/30/96)(cont.)*

Report	Group	Category	Description of Occurrence
96-0043	1	O	Fire System Surveillance Failure, 12-44, Cell 3
96-0044	1	U	Exceedence of Nuclear Material Limit, 12-60, Bay 4
96-0045	1	O	Procedural Violation in Moving Tritium Reservoirs, 12-64, Bay 1
96-0046	1	O	Inoperative Fire Alarm Systems, Cables Cut Near 11-9
96-0047	1	O	Evacuation for DMSO Mist, 12-98, Cell 1
96-0048	1	O	Alpha Monitor Surveillance Failure, 12-26, Bay 27
96-0049	1	O	Tritium Monitor Surveillance Failure, 12-60, Bay 1
96-0050	9	O	Dual Lock Violation, 12-84, Bay 19
96-0051	1	O	Waste Isolation Valve Surveillance Failure, 12-98, Cells 2 & 4
96-0052	1	O	Tritium Monitor Surveillance Failure, 12-84, Bay 2
96-0053	1	O	Uninterruptible Power Supply Failure, 12-64
96-054	1	O	Deviation From Disassembly Procedure, 12-96
96-0055	1	O	Alpha Monitor Surveillance Failure, 12-84, Bay 10
96-0056	10	O	Suspect/Counterfeit Fasteners, 11-9
96-0057	1	O	Incorrect Setting on Alpha Monitor, 12-64, Bay 9
96-0058	1	O	Uninterruptible Power Supply Battery Failure, 12-84 East
96-0059	1	O	Radioactive Material Control Problems, 12-67
96-0060	5	O	Unaccounted for Classified Document, 12-11A
96-0061	10	O	Suspect/Counterfeit faasteners on Television System, Zone 4
96-0062	1	O	Improperly Stored/Labeled HE Bag, 12-83, Bay 4
96-0063	1	O	Incorrect Setting on Alpha Monitor, 12-26, Bay 27
96-0064	1	O	Malfunction of Inner Blast Door, 12-98, Cell 3
96-0065	1	O	Explosives Overload, 12-26, Bay 26E
96-0066	10	O	Suspect/Counterfeit Fasteners on Cranes/Hoists, 12-68
96-0067	9	O	Deviation from Two-Person Concept, 12-64, Bay 8
96-0068	1	O	Radioactive Material in a Non-Radioactive Area, 12-92
96-0069	1	U	Maintenance Mode Change Failure, 12-84, Bay 1
96-0070	1	O	Alpha Monitor Malfunction, 12-64, Bay 8
96-0071	1	O	Fire System Surveillance Failure, 12-92
96-0072	1	O	Radioactive Material in a Non-Radioactive Area, Firing Site 2
96-0073	1	O	Emergency Light Battery Surveillance Failure, 12-96

TABLE 6.4.2-3.—*FY1996 Occurrence Reports at Pantex (10/1/95 thru 6/30/96)(cont.)*

[illegible]	Group	Category	Description of Occurrence
96-0074	10	O	Portal Alarm from Check Source, 12-36
96-0075	1	O	RAMS Surveillance Failure, 12-99, Bay 4
96-0076	1	O	Emergency Light Surveillance Failure, 12-104
96-0077	1	O	Alpha Monitor Surveillance Failure, 12-84, Bay 6
96-0078	1	O	Alpha Monitor Surveillance Failure, 12-64, Bay 2
96-0079	1	O	Explosive Movement Violation, 12-42A to 12-61
96-0080	6	O	Improperly Labeled Material Shipped Offsite from 12-61
96-0081	1	O	Blast Door Interlock Malfunction, 11-50, Room 112
96-0082	1	O	Fire System Surveillance Failure, 12-98, Cell 3
96-0083	10	U	Procedural Change Violation, 12-64, Bay 9
96-0084	6	O	Container Shift During Offsite Shipment
96-0085	1	O	Procedural Violation, 12-60, Bay 2
96-0086	6	O	Improperly Staged HE, 11-45
96-0087	1	O	Alpha Monitor Surveillance Failure, 12-44, Cell 6
96-0088	1	O	Tritium Monitor Surveillance Failure, 12-44, Cell 4
96-0089	1	O	Tritium Monitor Malfunction, 12-104, Bay 10
96-0090	1	O	Alpha Monitor Surveillance Failure, 12-44, Cell 2
96-0091	1	O	Fire Alarm Evacuation, 12-21
96-0092	1	O	Radioactive Material in a Non-Radioactive Area, 12-66
96-0093	1	O	Emergency Light Surveillance Failure, 12-58, Bays 4 & 5
96-0094	1	O	Tritium Monitor Malfunction, 12-84, Bay 1
96-0095	1	O	Tritium Monitor Malfunction, 12-84, Bay 15
96-0096	1	O	Procedural Violation, 12-84, Bay 17
96-0097	1	U	Violation of CSSM, 12-84, Bay 16
96-0098	1	U	Exceedance of Limits for Depleted Uranium, 12-79
96-0099	1	O	Alpha Moniror Surveillance Failure, 12-64, Bay 9
96-0100	1	O	Tritium Monitor Surveillance Failure, 12-64, Bay 9
96-0101	1	O	Uninterruptible Power Supply Failure, 12-99
96-0102	1	O	Improperly Stored/Labeled Explosive Container, 12-95
96-0103	1	O	Uninterruptible Power Supply Failure, 12-84 East
96-0104	10	O	Near-Miss Excavating Around Electric Cable, Zone 4

TABLE 6.4.2-3.—*FY1996 Occurrence Reports at Pantex (10/1/95 thru 6/30/96)(cont.)*

Report	Group	Category	Description of Occurrence
96-0105	1	O	Blast Door Interlocks Malfunction, 12-104, Bay 13
96-0106	1	O	Administrative Control Deficiency, 12-60, Bays 1 & 2
96-0107	1	O	Discrepancy in Pre-Operational Standard Review, 12-66
96-0108	1	O	Radioactive Material in a Non-Radioactive Area, 12-53
96-0109	2	O	Potential Release of Radioactive Waste to Landfill
96-0110	1	O	Radioactive Material in a Non-Radioactive Area, 12-66
96-0111	1	O	Tritium Monitor Surveillance Failure, 12-60, Bay 2
96-0112	1	O	Preoperation Checklist Discrepancy, 12-84, Bay 4
96-0113	1	O	Exhaust Fan Disconnect Found in Off Position, 12-44, Cell 4
96-0114	1	O	Potential Cell Safety Status Degradation, 12-98, Cell 3
96-0115	1	O	Inadequate Control of Asbestos Insulation, 12-64
96-0116	1	O	Evacuation of 12-104, Bay 7, Due to Alpha CAM Alarm
96-0117	1	O	Evacuation of 12-98, Cell 3, Due to Tritium CAM Alarm
96-0118	1	O	Alpha CAM Surveillance Failure, 12-104, Bay 4
96-0119	1	O	Procedural Noncompliance w/Mode Change, 12-64, Bay 16
96-0120	1	O	Open Battery Disconnect Switch on UPS, 12-99
96-0121	1	U	Excessive Air Gap Around Cell Door, 12-96
96-0122	1	O	Exceedance of Temporary Material Limits, 12-44, Cell 6
96-0123	1	O	RAMS Surveillance Failure, 12-84, Bay 12
96-0124	10	O	Suspect/Counterfeit Fasteners on Stackers, 12-66
96-0125	1	O	RAMS Surveillance Failure, 12-64, Bay 12
96-0126	1	O	Exceedance of Temporary Material Limit, 12-104, Bay 5
96-0127	1	O	Fire Detection System Surveillance Failure, 12-99, Bay 8
96-0128	1	O	Improperly Stored/Labeled HE in 11-R-22 Ramp
96-0129	1	O	Improperly Controlled Radioactive Material Transfer, 12-61
96-0130	1	O	Procedure Deficiency in HE Machinging Operation, 11-50, Bay 1
96-0131	1	U	Pre-Operational Checklist Deficiency, 12-84, Bay 3
96-0132	1	O	Fire Alarm Evacuation of 11-50

...RENCES

...-02561, *U.S. DOE Radiological ... Manual*. U.S. Department of Energy, ...

... *Dosimetry Records Management ... Database*, Pantex Plant, Amarillo, ...

... Code of Federal Regulations, Title 29, ... Part 1910 (OSHA) "Occupational ... and Health Standards."

... *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices*, American Conference of Governmental Industrial Hygienists (ACGIH).

U.S. Code of Federal Regulations, Title 29, Labor Part 1904, "Recording and Reporting Occupational Injuries and Illnesses."

6. DOE-76-45/7A, SSDC-7B, *DOE Guide to the Classification of Recordable Accidents*. U.S. Department of Energy, 1976.

7. "Defense Programs Transportation Risk Assessment: Probabilities and Consequences of Accidental Dispersal of Radioactive Material Arising from Off-Site Transportation of Defense Programs Material," SAND93-1671, Sandia National Laboratories, September 1994, (SRD). Authors include David B. Clauss, Mathias J. Sagartz, James S. Phillips, William F. Hartman, and Clinton G. Shirley.

8. Mason & Hanger - Silas Mason Co., Inc., *Report of the Investigation of the Tritium Release Incident at the Pantex Plant on May 17, 1989*, Pantex Plant, Amarillo, Texas, July 1989.

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APPENDIX A
STATUTORY AND REGULATORY REQUIREMENTS

This appendix identifies DOE Orders, statutory and regulatory requirements, codes, and other applicable standards relevant to the design and safe operation of the Pantex Plant. Section A.1 provides a listing of all Federal statutes, regulations and DOE Orders applicable to Pantex facilities. Local regulations are listed in Section A.2. These requirements are continuously reviewed and updated. Environmental laws are discussed in Chapter 17 of the EID.

A.1 FEDERAL REQUIREMENTS

A.1.1 DOE Orders, Standards, and Other Requirements

DOE Order 1300.2A, "Department of Energy Standards Program." U.S. Department of Energy.

DOE Order 1324.2A, "Records Disposition." Change 1, U.S. Department of Energy.

DOE Order 1324.3, "Files Management." U.S. Department of Energy.

DOE Order 1360.2B, "Unclassified Computer Security Program." U.S. Department of Energy.

DOE Order 1540.2, "Hazardous Material Packaging for Transport - Administrative Procedures." U.S. Department of Energy.

DOE Order 2321.1B, "Auditing of Programs and Operations." U.S. Department of Energy.

DOE/AL Order 2321.1, "Auditing of Programs and Operations." U.S. Department of Energy, Albuquerque Operations.

DOE Order 3790.1B, "Federal Employees Occupational Safety and Health Program." U.S. Department of Energy.

DOE/AL Order 3790.1A, "Federal Employees Occupational Safety and Health Program." U.S. Department of Energy, Albuquerque Operations.

DOE Order 4300.1C, "Real Property Management." U.S. Department of Energy.

DOE Order 4320.1B, "Site Development Planning." U.S. Department of Energy.

DOE Order 4320.2, "Capital Asset Management Process." U.S. Department of Energy.

DOE Order 4330.4A, "Maintenance Management Program." U.S. Department of Energy.

DOE Order 4700.1, "Project Management System." U.S. Department of Energy.

DOE Order 5000.3B, "Occurrence Reporting and Processing of Operations Information." U.S. Department of Energy.

DOE Order 5400.1, "General Environmental Protection Program." U.S. Department of Energy.

DOE Order 5400.2A, "Environmental Compliance Issue Coordination." U.S. Department of Energy.

DOE Order 5400.3, "Hazardous and Radioactive Mixed Waste Program." U.S. Department of Energy.

DOE Order 5400.4, "Comprehensive Environmental Response, Compensation, and Liability Act Requirements." U.S. Department of Energy.

DOE Order 5400.5, "Radiation Protection of the Public and the Environment." U.S. Department of Energy.

DOE Order 5440.1E, "National Environmental Policy Act Compliance Program." U.S. Department of Energy.

DOE Order 5480.1B, "Environment, Safety, and Health Program for Department of Energy Operations." U.S. Department of Energy.

DOE Order 5480.3, "Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes." U.S. Department of Energy.

DOE Order 5480.4, "Environmental Protection, Safety, and Health Protection Standards." U.S. Department of Energy.

DOE Order 5480.6, "Safety of Department of Energy-Owned Nuclear Reactors." U.S. Department of Energy, September 23, 1986.

DOE Order 5480.7A, "Fire Protection." U.S. Department of Energy.

DOE Order 5480.10, "Contractor Industrial Hygiene Programs." U.S. Department of Energy.

DOE Order 5480.11, "Radiation Protection for Occupational Workers." Change 2, U.S. Department of Energy.

DOE Order 5480.15, "Department of Energy Laboratory Accreditation Program for Personnel Dosimetry." U.S. Department of Energy.

DOE Order 5480.16, "Firearms Safety." U.S. Department of Energy.

DOE Order 5480.17, "Site Safety Representatives." U.S. Department of Energy.

DOE Order 5480.18A, "Accreditation of Performance-Based Training for Category A Reactors and Nuclear Facilities." U.S. Department of Energy.

DOE Order 5480.19, "Conduct of Operations Requirements for DOE Facilities." U.S. Department of Energy.

DOE Order 5480.20, "Personnel Selection, Qualification, Training, and Staffing Requirements at DOE Reactor and Non-reactor Nuclear Facilities." U.S. Department of Energy.

DOE Order 5480.21, " Unreviewed Safety Questions." U.S. Department of Energy.

DOE Order 5480.22, "Technical Safety Requirements." U.S. Department of Energy.

DOE Order 5480.23, "Nuclear Safety Analysis Reports." U.S. Department of Energy.

DOE Order 5480.24, "Nuclear Criticality Safety." U.S. Department of Energy.

DOE Order 5480.28, "Natural Phenomena Hazards Mitigation." DRAFT, U.S. Department of Energy.

DOE Order 5481.1B, "Safety Analysis and Review System," Change 1. U.S. Department of Energy.

DOE/AL Order 5481.1B, "Safety Analysis and Review System." U.S. Department of Energy, Albuquerque Operations Office.

DOE Order 5482.1B, "Environmental, Safety, and Health Appraisal Program." U.S. Department of Energy.

DOE Order 5483.1A, "Occupational Safety and Health Program for DOE Contractor Employees at Government-Owned Contractor-Operated Facilities." U.S. Department of Energy.

DOE Order 5484.1, "Environmental Protection, Safety, and Health Protection Information Reporting Requirements." U.S. Department of Energy.

DOE/AAO Order 5484.1, "Environmental Protection, Safety, and Health Protection Information Reporting Requirements." U.S. Department of Energy, Amarillo Operations.

DOE/AL Order 5484.1, "Environmental Protection, Safety, and Health Protection Information Reporting Requirements." U.S. Department of Energy, Albuquerque Operations

DOE Order 5500.1B, "Emergency Management System." U.S. Department of Energy.

DOE Order 5500.2B, "Emergency Categories, Classes, and Notification and Reporting Requirements." U.S. Department of Energy.

DOE Order 5500.3A, "Planning and Preparedness for Operational Emergencies." U.S. Department of Energy.

DOE Order 5500.4, "Public Affairs Policy and Planning Requirements for Emergencies." U.S. Department of Energy.

DOE Order 5530.1A, "Accident Response Group." U.S. Department of Energy.

DOE Order 5610.1, "Packaging and Transportation of Nuclear Explosives, Nuclear Components, and Special Assemblies." U.S. Department of Energy.

DOE Order 5610.11, "Nuclear Explosive Safety." U.S. Department of Energy.

DOE Order 5630.12A, "Safeguards and Security Inspection Program." U.S. Department of Energy.

DOE Order 5630.13A, "Master Safeguards and Security Agreements." U.S. Department of Energy.

DOE Order 5630.14A, "Safeguards and Security Program Management." U.S. Department of Energy.

DOE Order 5632.1B, "Protection Program Operations." U.S. Department of Energy

DOE Order 5633.3A, "Control and Accountability of Nuclear Materials." U.S. Department of Energy.

DOE Order 5639.6, "Classified Computer Security Program." U.S. Department of Energy.

DOE Order 5700.6C, "Quality Assurance." U.S. Department of Energy.

DOE Order 5820.2A, "Radioactive Waste Management." U.S. Department of Energy.

DOE Order 6430.1A, "General Design Criteria." U.S. Department of Energy.

DOE/AL Order 6430.1A, "General Design Criteria." U.S. Department of Energy.

DOE/DNA TP-20-7, Nuclear Safety Criteria. (Classified), U.S. Department of Energy.

DOE/EH-0071, Internal Dose Conversion Factors for Calculation of Dose to the Public. U.S. Department of Energy.

DOE/EH-0135, "Performance Objectives and Criteria for Technical Safety Appraisals at DOE Facilities and Sites." U.S. Department of Energy.

DOE/EH-02561, U.S. DOE Radiological Control Manual, U.S. Department of Energy.

DOE/EH-0287T, "Radiation Exposures for DOE and DOE Contractor Employees - 1990." 23rd Annual Report, U.S. Department of Energy.

DOE/EH-0287T, "Radiation Exposures for DOE and DOE Contractor Employees - 1989." 22nd Annual Report, U.S. Department of Energy.

DOE/EH-0287T, "Radiation Exposures for DOE and DOE Contractor Employees - 1988." 21st Annual Report, U.S. Department of Energy.

DOE/EIS-0098, Final Environmental Impact Statement - Pantex Plant Site - Amarillo, Texas. U.S. Department of Energy.

DOE/EP 0108, Standard for Fire Protection of DOE Electronic Computer/Data Processing Systems. U.S. Department of Energy.

DOE/EP-0052, Automatic Sprinkler System Performance and Reliability in United States Department of Energy Facilities 1952-1980. U.S. Department of Energy.

DOE/EV/06194, Explosives Safety Manual. Revision 6, U.S. Department of Energy.

DOE/EV/1830-TS, A Guide for Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA). U.S. Department of Energy.

DOE/NE/SP-0001T, DOE Writer's Guide for Technical Procedures. U.S. Department of Energy.
DOE STD-1020-92 (Draft), Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities. U.S. Department of Energy.

DOE STD-1027-92, "Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports." U.S. Department of Energy.

DOE/TIC-11268, A Manual for the Prediction of Blast and Fragment Loadings on Structures. U.S. Department of Energy.

DOE/TIC-11603, Non-Reactor Nuclear Facilities: Standards and Criteria Guide. Rev. 1, U.S. Department of Energy.

DOE TSCM (Technical Surveillance Countermeasures) Procedural Guide. U.S. Department of Energy.

DOE-STD-3009-94, Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports. U.S. Department of Energy, July 1994.

SEN-35-91, "Nuclear Safety Policy." Secretary of Energy Notice.

SM-SSR-1, Operational Manual. U.S. Department of Energy.

SM-SSR-2, Maintenance Manual. U.S. Department of Energy.

SM-SST-3, Recovery Manual. U.S. Department of Energy.

A.1.2 Federal Statutes and Regulations

Clean Air Act (CAA), Pub. L. 88-206, 42 U.S.C. 1857 et seq.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Pub. L. 96-510, 42 U.S.C. 9601 et seq.

Clean Water Act (CWA), Pub. L. 89-753, 43 U.S.C. 431 et seq.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), 7 U.S.C. 136

Federal Water Pollution Control Act (FWPCA), Pub. L. 86-70, 33 U.S.C. 1157 et seq.

National Environmental Policy Act (NEPA), Pub. L. 91-190, 42 U.S.C. 4321 et seq.

National Historic Preservation Act (NHPA), Pub. L. 89-665, 16 U.S.C. 470 et seq.

Resource Conservation and Recovery Act (RCRA), Pub. L. 94-580, 42 U.S.C. 6901 et seq.

Safe Drinking Water Act (SDWA), Pub. L. 93-523, 42 U.S.C. 201 et seq.

Toxic Substances Control Act (TSCA), Pub. L. 94-469, 15 U.S.C. 2601 et seq.

Water Quality Act (WQA), Pub. L. 89-234, 33 U.S.C. 1151 et seq.

Executive Orders 11514 and 11991, Protection and Enhancement of Environmental Quality.

Executive Order 11593, Protection and Enhancement of Cultural Environment.

Executive Order 11988, "Floodplain Management."

Executive Order 12088, Federal Compliance with Pollution Control Standards.

Executive Order 12286, Response to Environmental Damage.

U.S. Code of Federal Regulations, Title 10, Energy. Part 20, "Standards for Protection Against Radiation."

U.S. Code of Federal Regulations, Title 10, Energy. Part 71, "Packaging and Transportation of Radioactive Material."

U.S. Code of Federal Regulations, Title 10, Energy. Part 820, "Procedural Rules for DOE Nuclear Activities."

U.S. Code of Federal Regulations, Title 10, Energy. Part 1022, "Compliance with Floodplains/Wetlands Environmental Review Requirements."

U.S. Code of Federal Regulations, Title 29, Labor. Part 1904, "Recording and Reporting Occupational Injuries and Illnesses"

U.S. Code of Federal Regulations, Title 29, Labor. Part 1910, "Occupational Safety and Health Standards."

U.S. Code of Federal Regulations, Title 29, Labor. Part 1926, "Safety and Health Regulations for Construction."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 61, "National Emission Standard for Radionuclide Emissions from Department of Energy Facilities."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 112, "Oil Pollution Prevention."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 116, "Designation of Hazardous Substances."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 117, "Determination of Reportable Quantities for Hazardous Substances."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 122, "EPA Administered Permit Programs: The National Pollutant Discharge Elimination System."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 125, "Criteria and Standards for the National Pollutant Discharge Elimination System."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 136, "Guidelines for Establishing Test Procedures for the Analysis of Pollutants."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 141, "National Primary Drinking Water Regulations."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 142, "National Primary Drinking Water Regulations Implementation."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 143, "National Secondary Drinking Water Regulations."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 165, "Regulations for the Acceptance of Certain Pesticides and Recommended Procedures for the Disposal and Storage of Pesticides and Pesticide Containers."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 253, "Standards Applicable to Transporters of Hazardous Waste."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 260, "Hazardous Waste Management System: General."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 261, "Identification and Listing of Hazardous Wastes."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 262, "Standards Applicable to Generators of Hazardous Wastes."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 265, "Interim Status Standards for Owners and Operators od Hazardous Waste Treatment, Storage and Disposal Facilities."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 266, "Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 268, "Land Disposal Restrictions."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 270, "EPA Administered Permit Programs: The Hazardous Waste Permit Program."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 300, "National Oil and Hazardous Substances Pollution Contingency Plan."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 302, "Designation, Reportable Quantities, and Notification."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 370, "Hazardous Chemical Reporting: Community Right To Know."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 372, "Toxic Chemical Release Reporting: Community Right to Know."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce and Use Prohibitions."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 763, "Asbestos."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 1500, "Purpose, Policy, and Mandate - NEPA."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 1501, "NEPA and Agency Planning."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 1502, "Environmental Impact Statement."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 1503, "Commenting."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 1504, "Predecisional Referrals of Proposed Federal Actions."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 1505, "NEPA and Agency Decisionmaking."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 1506, "Other Requirements of NEPA."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 1507, "Agency Compliance."

U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 1508, "Terminology and Index."

U.S. Code of Federal Regulations, Title 42, Public Health. Part 7414, "Recordkeeping, Inspections, Monitoring and Entry."

U.S. Code of Federal Regulations, Title 49, Transportation. Part 171, "General Information, Regulations, and Definitions."

U.S. Code of Federal Regulations, Title 49, Transportation. Part 172, "Hazardous Materials Tables, Hazardous Materials Communication Requirements, and Emergency Response Information Requirements."

U.S. Code of Federal Regulations, Title 49, Transportation. Part 173, "Shippers - General Requirements for Shipment and Packages."

U.S. Code of Federal Regulations, Title 49, Transportation. Part 174, "Carriage by Rail."

U.S. Code of Federal Regulations, Title 49, Transportation. Part 175, "Carriage by Aircraft."

U.S. Code of Federal Regulations, Title 49, Transportation. Part 176, "Carriage by Vessel."

U.S. Code of Federal Regulations, Title 49, Transportation. Part 177, "Carriage by Public Highway."

U.S. Code of Federal Regulations, Title 49, Transportation. Part 178, "Specifications for Packagings."

U.S. Code of Federal Regulations, Title 49, Transportation. Part 179, "Specifications for Tank Cars."

U.S. Code of Federal Regulations, Title 49, Transportation. Part 383, "Commercial Drivers License Standards: Requirements & Penalties."

U.S. Code of Federal Regulations, Title 49, Transportation. Part 390, "Federal Motor Carrier Safety Regulations: General."

U.S. Code of Federal Regulations, Title 49, Transportation. Part 391, "Qualifications of Drivers."

U.S. Code of Federal Regulations, Title 49, Transportation. Part 392, "Driving of Motor Vehicles."

U.S. Code of Federal Regulations, Title 49, Transportation. Part 393, "Parts & Accessories Necessary for Safe Operation."

U.S. Code of Federal Regulations, Title 49, Transportation. Part 394, "Notification & Reporting of Accidents."

U.S. Code of Federal Regulations, Title 49, Transportation. Part 395, "Hours of Service of Drivers."

U.S. Code of Federal Regulations, Title 49, Transportation. Part 396, "Inspection, Repair, & Maintenance."

U.S. Code of Federal Regulations, Title 49, Transportation. Part 397, "Transportation of Hazardous Materials Driving & Parking Rules."

A.1.3 Other Requirements and Guidance

DOD 6055.9-STD, Ammunition and Explosive Safety Standards. U.S. Department of Defense.

CAP88-PC Version 1.0, (Clean Air Act Assessment Package - 1988), Computer Software, U.S. Environmental Protection Agency, March 1992.

Design Manual for Tornado Resistant Structures at the Pantex Plant Site. U.S. Department of Energy, November 1974.

EPA/520/4-77/16, Proposed Guidelines on Dose Limits for Persons Exposed to Transuranium Elements in the General Environment. U.S. Environmental Protection Agency, 1977.

EPA Radiation Protection Guidance to the Federal Agencies for Occupational Exposure. U.S. Environmental Protection Agency, Federal Register, Vol. 52.

ERDA 76-21, (ORNL-NSIC-65-1), Nuclear Air Cleaning Handbook: The Design, Construction and Testing of High Efficiency Air Cleaning Systems. U.S. Energy Research and Development Administration.

MIL-HDBK-1004/4, "Electric Utilization Systems." Department of Defense.

MIL-HDBK-217F, "Reliability Prediction of Electronic Equipment." Department of Defense.

MIL-HDBK-419, "Grounding, Bonding, and Shielding for Electronic Equipment and Facilities." Department of Defense.

MIL-STD-1472C, "Human Engineering Design Criteria for Military Systems, Equipment, and Facilities." Department of Defense.

MIL-STD-1472D, "Human Engineering Design Criteria for Military Systems, Equipment, and Facilities." Department of Defense.

MIL-STD-1629A, "Procedures for Performing a Failure Mode, Effects and Criticality Analysis." U.S. Department of Defense.

NUREG/CR-1278, "Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications." U.S. Nuclear Regulatory Commission.

NUREG/CR-2300, "PRA Procedures Guide." U.S. Nuclear Regulatory Commission.

NUREG/CR-2496, "Human Engineering Design Considerations for Cathode Ray Tube Generated Displays." U.S. Nuclear Regulatory Commission.

NUREG/CR-3331, "A Methodology for Allocating Nuclear Power Plant Control Functions to Human or Automatic Control." U.S. Nuclear Regulatory Commission.

NUREG-0700, "Guidelines for Control Room Design Reviews." U.S. Nuclear Regulatory Commission.

NUREG-1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants." U.S. Nuclear Regulatory Commission.

NUREG-1230, "Nuclear Fuel Cycle Facility Accident Analysis Handbook." U.S. Nuclear Regulatory Commission.

NUREG-75/014, "Failure Data." U.S. Nuclear Regulatory Commission.

NUREG/CR-5531 (SAND90-0364), "MELCOR 1.8.0: A Computer Code for Nuclear Reactor Severe Accident Source Term and Risk Assessment Analyses." U.S. Nuclear Regulatory Commission.

R.G. 3.1.2, "General Design Guide for Ventilation Systems of Plutonium Processing and Fuel Fabrication Plants." U.S. Nuclear Regulatory Commission.

R.G. 3.1.4, "Seismic Design Classification for Plutonium Processing and Fuel Fabrication Plants." U.S. Nuclear Regulatory Commission.

R.G. 3.35, "Assumptions Used for Evaluating the Potential Radiological Consequences of Accidental Nuclear Criticality in a Plutonium Processing and Fuel Fabrication Plant." U.S. Nuclear Regulatory Commission.

R.G. 3.43, "Nuclear Criticality in the Storage of Fissile Materials." U.S. Nuclear Regulatory Commission.

A.2 STATE STATUTES AND REGULATIONS

Texas Administrative Code, Title 25, Health Services.

Texas Administrative Code, Title 25, Health Services, Part 289.141-289.157, "Asbestos Exposure Abatement in Public Buildings."

Texas Administrative Code, Title 31, Natural Resource and Conservation, Part 335, Subchapter G, "Location Standards for Hazardous Waste Storage, Processing, or Disposal Facilities."

Texas Administrative Code, Title 31, Natural Resource and Conservation, Part 335, Subchapter F, "Permitting Standards for Owners and Operators of Hazardous Waste Storage, Processing, or Disposal Facilities."Texas Administrative Code, Title 31, Natural Resource and Conservation, Part 335, Subchapter C, "Standards Applicable to Generators of Hazardous Waste."

Texas Administrative Code, Title 31, Natural Resource and Conservation, Part 305, Subchapter B, "Wastewater Discharge Permit Requirement for Waste or Pollutants Discharged Into or Adjacent to Any Waters of the State of Texas."

Texas Administrative Code, Title 31, Natural Resources and Conservation

Texas Administrative Code, Title 31, Natural Resource and Conservation, Part 334, "Underground and Above-Ground Storage Tanks."

Texas Administrative Code, Title 31, Natural Resource and Conservation, Part 335, Subchapter J, "Hazardous Waste Generation, Facility, and Disposal Fees System."

Texas Administrative Code, Title 31, Natural Resource and Conservation, Part 335, Subchapter H, "Standards for the Management of Specific Wastes and Specific Types of Facilities."

Texas Administrative Code, Title 31, Natural Resource and Conservation, Part 335, Subchapter L, "Control of Air Pollution from Hazardous Waste or Solid Waste Management Facilities."

Texas Administrative Code, Title 31, Natural Resource and Conservation, Part 335, Subchapter I, Prohibitions on Open Dumps

Texas Administrative Code, Title 31, Natural Resource and Conservation, Part 335, Subchapter A, "Industrial Solid Waste and Municipal Hazardous Waste Management (in General)."

Texas Administrative Code, Title 31, Natural Resource and Conservation, Part 335, Subchapter D, "Standards Applicable to Transporters of Hazardous Waste."

Texas Administrative Code, Title 31, Natural Resource and Conservation, Part 335, Subchapter O, "Land Disposal Restrictions.

"Texas Administrative Code, Title 31, Natural Resource and Conservation, Part 335, Subchapter B, "Hazardous Waste Management General Provisions."

Texas Threatened and Endangered Species. Texas Parks and Wildlife Department, January 1992.

Texas Asbestos Health Protection Act. Texas Revised Civil Statutes Annotated Article 4477-3A.

Permit for Industrial Solid Waste Management Site, Issued by the Texas Natural Resources Conservation Commission (TNRCC) and Environmental Protection, Permit Number HW-50284.

Underground Storage Tank (UST), Certificate of Registration for UST Installer/Supervisor License, Registration Number TX-4890110527.

Permit to Dispose of Wastes under provisions of Chapter 26 of the Texas Water Code, Permit Number 02296, approved May 19, 1980, and is reissued pursuant to 31 TAC Section 305.96(b).

APPENDIX B
INVENTORIES AND FACILITY LIMITS OF CHEMICAL HIGH EXPLOSIVES, CHEMICAL AND HAZARDOUS MATERIALS, AND RADIOLOGICAL MATERIALS

B.1 RADIOLOGICAL MATERIALS

Table B.1 lists the unclassified building limits for radiological materials at the Pantex Plant[1].

B.2 HAZARDOUS MATERIALS

Table B.2 provides a listing of hazardous chemicals listed in 29 CFR 1910.119, and exceeding the screening thresholds established as a part of the Hazardous Material Hazard Assessment[2,3]. Table B.3 provides a listing of extremely hazardous substances listed in 40 CFR 355 and matching items found in the Pantex Plant inventory[4]. The Threshold Planning Quantity (TPQ) shown in this table is the level established by the EPA as the lower limit of materials on hand that requires reporting to the Local Emergency Planning Committee (LEPC) for the purpose of emergency response planning. The screening methodology was based on the listing of highly hazardous chemicals found in 40 CFR 355 Appendix A and 29 CFR 1910.119. Tables B.2 and B.3 list the Threshold Planning Quantities (TPQs) for use in emergency planning activities as specified in those CFRs. The threshold quantity used for the "Hazardous Materials Hazards Assessment" was set at 10% of the listed TPQ to ensure a conservative analysis. Table B.4 contains an inventory of the actual quantities present at the Pantex Plant during the preparation of the Hazardous Materials Hazards Assessment.

B.3 CHEMICAL HIGH EXPLOSIVES

The tables that follow provide information that was used in the "Chemical High Explosive Hazards Assessment" to determine the associated hazards presented by the release of the material[5]. Table B.5 provides the maximum building HE and IHE limits and specifies the approximate distance of the facility from the Pantex Plant site boundary[1,6]. Table B.6 provides the UN Hazard Class/Division, and the HE constituents. Table B.7 identifies the mock HE and constituents. The quantity and type of material listed in this table may vary based upon programmatic needs.

TABLE B.1.—*Listing of Radioactive Material Limits by Facility*

Building	Approximate Distance to Site Boundary, km (mi)	Material	Limits
4-19 Side A or B	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-21 Side A or B	2.98 (1.85)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-25 Side A or B	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-26	2.98 (1.85)	Pu-239	20 kg or 44 lbs
4-30 Side A or B	2.98 (1.85)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-31 Side A or B	2.98 (1.85)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-32 Side A or B	2.98 (1.85)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-33 Side A or B	2.98 (1.85)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-34 Side A or B	2.98 (1.85)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-35 Side A or B	2.98 (1.85)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-36 Side A or B	2.98 (1.85)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-37 Side A or B	2.98 (1.85)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-38 Side A or B	2.98 (1.85)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-39 Side A or B	2.98 (1.85)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-40 Side A or B	2.98 (1.85)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-41 Side A or B	2.98 (1.85)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-42 Side A or B	2.98 (1.85)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-43 Side A or B	2.98 (1.85)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-44 Side A or B	2.98 (1.85)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-101	2.44 (1.52)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-102	2.44 (1.52)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-103	2.44 (1.52)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-104	2.44 (1.52)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-105	2.44 (1.52)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-106	2.44 (1.52)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-107	2.44 (1.52)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-108	2.44 (1.52)	Pu-239	30 kg or 66 lbs (weapon magazine)

TABLE B.1.—*Listing of Radioactive Materials Limits by Facility (Continued)*

Building	Approximate Distance to Site Boundary, km (mi)	Material	Limits
4-109	2.44 (1.52)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-110	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-111	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-112	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-113	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-114	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-115	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-116	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-117	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-118	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-119	2.44 (1.52)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-120	2.44 (1.52)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-121	2.44 (1.52)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-122	2.44 (1.52)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-123	2.44 (1.52)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-124	2.44 (1.52)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-125	2.44 (1.52)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-126	2.44 (1.52)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-127	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-128	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-129	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-130	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-131	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-132	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-133	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-134	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-135	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)

TABLE B.1.—*Listing of Radioactive Materials Limits by Facility (Continued)*

Building	Approximate Distance to Site Boundary, km (mi)	Material	Limits
4-136	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-137	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-138	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-139	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-140	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-141	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
4-142	2.07 (1.29)	Pu-239	30 kg or 66 lbs (weapon magazine)
12-26 Pit Vault	1.22 (0.76)	Pu-239	1,008 kg or 2,223 lbs
12-26 Bay 27	1.22 (0.76)	Pu-239	25 kg or 55 lbs
		H-3	40 g or 1.2 oz
12-26 Bay 28	1.22 (0.76)	H-3	240 g or 7.2 oz (no main charge HE)
12-41	1.02 (0.63)	Pu-239	25 kg or 55 lbs
		H-3	40 g or 1.2 oz
12-42 S. Vault	1.22 (0.76)	H-3	4,437 g or 9.8 lbs (no main charge HE)
12-42 N. Vault	1.22 (0.76)	Pu-238	no limit; must be in DOT approved containers
12-44 Cells 1-6	1.22 (0.76)	Pu-239	40 kg/cell or 88 lbs/cell
		H-3	100 g/cell or 3.2 oz/cell
			OR
		U	3,000 kg or 6,615 lbs
12-44 Cell 8	1.22 (0.76)	Pu-239	2,184 kg or 4,816 lbs (no HE)
12-50	1.54 (0.96)	Pu-239	6 kg or 13 lbs
		H-3	20 g or 0.6 oz
12-58 Bays 4-5		U	4,300 kg or 9,482 lbs (no main charge HE)
12-60 Bays 1,2,5,6		Pu-239	25 kg/bay or 55 lbs/bay (Remote Ops)
		H-3	20 g/bay or 0.6 oz/bay (Remote Ops)

TABLE B.1.—*Listing of Radioactive Materials Limits by Facility (Continued)*

Building	Approximate Distance to Site Boundary, km (mi)	Material	Limits
12-60 Bays 1-6		Pu-239	25 kg/bay or 55 lbs/bay (Hazard Class II Ops)
		H-3	20 g/bay or 0.6 oz/bay (Hazard Class II Ops)
			OR
12-60 Bays 3,4,5,6		U	3,000 kg/bay or 6,615 lbs/bay (Staging of ORO Components) (no main charge HE)
			OR
12-64 Bays 1,2,3,4	1.54 (0.96)	H-3	600 g or 1.3 lbs
			OR
12-64 All Bays	1.54 (0.96)	Pu-239	25 kg/bay or 55 lbs/bay
		H-3	100 g/bay or 3.2 oz/bay
			OR
		Pu-239	100 kg/bay or 220 lbs/bay (No HE in Bay)
			OR
		U	3,000 kg/bay or 6,615 lbs/bay (No main charge in bay)
12-84 Bays	1.54 (0.96)	Pu-239	25 kg/bay or 55 lbs/bay
		H-3	100 g/bay or 3.2 oz/bay
			OR
		Pu-239	100 kg/bay or 220 lbs/bay (No HE in bay)
			OR
		U	3,000 kg/bay or 6,615 lbs/bay (No main charge in bay)

TABLE B.1.—*Listing of Radioactive Materials Limits by Facility (Continued)*

Building	Approximate Distance to Site Boundary, km (mi)	Material	Limits
12-85 Cell	1.54 (0.96)	Pu-239	40 kg/cell or 88 lbs/cell
		H-3	100 g/cell or 3.2 oz/cell
	OR		
		U	3,000 kg/cell or 6,615 lbs/cell
12-94	1.54 (0.96)	Pu-239	25 kg or 55 lbs
		H-3	40 g or 1.2 oz
12-96 Cell	1.54 (0.96)	Pu-239	40 kg/cell or 88 lbs/cell
		H-3	100 g/cell or 3.2 oz/cell
	OR		
		U	3,000 kg/cell or 6,615 lbs/cell
12-98 Cells 1-4	1.54 (0.96)	Pu-239	40 kg/cell or 88 lbs/cell
		H-3	100 g/cell or 3.2 oz/cell
	OR		
		U	3,000 kg/cell or 6,615 lbs/cell
12-99 Bays	1.54 (0.96)	Pu-239	25 kg/bay or 55 lbs/bay
		H-3	100 g/bay or 3.2 oz/bay
	OR		
		Pu-239	100 kg/bay or 200 lbs/bay (No HE in Bay)
	OR		
		U	3,000 kg/bay or 6,615 lbs/bay (No main charge)
12-104 Bays	1.54 (0.96)	Pu-239	25 kg/bay or 55 lbs/bay
		H-3	100 g/bay or 3.2 oz/bay
	OR		
		Pu-239	100 kg/bay or 220 lbs/bay (no HE in bay)
	OR		
		U	3,000 kg/bay or 6,615 lbs/bay (no main charge in bay)

TABLE B.2.—*Highly Hazardous Chemicals, Toxics, and Reactives Listed in 29 CFR 1910.119 and Matching Items Found in Pantex Inventory*

Chemical Name	Pantex File Number(s)	CASRN[1]	Location	Quantity, kg (lb) on Inventory and Form	TQ[2], kg (lb)
4-Nitroaniline	05902.1	100-01-6	11-17 12-59	1.1 (2.4) (S)[3] 0	2,268 (5,000)
Ammonia	00243.5	7664-41-7	12-59	0.9 (2) (G)[4]	4,536 (10,000)
Ammonium Perchlorate	04065.1	7790-98-9	11-51	0.9 (2) (S)	3,402 (7,500)
Celloulose Nitrate, Solution in Isopropanol	01149.1	9004-70-0	12-59	0.5 (1.2) (L)[5]	1,134 (2,500)
Ethyl Nitrate	04161.1	109-95-5	11-17	0.5 (1.1) (L)	2,268 (5,000)
Formaldehyde, 37% Solution	03789.2	50-00-0	12-2A	0.7 (1.63) (L)	454 (1,000)
Hydrochloric Acid	00027.1 07090.1 08376.1 07058.1	7647-01-0	11-34 12-2A 12-59 12-9	44.9 (99.06)(L) 1.3 (2.97) (L) 4.9 (10.90) (L) 0.45 (0.99) (L)	2,268 (5,000)
Hydrofluric Acid 48% Solution	00259.1 00259.2	7664-39-3	12-59 11-17	0.38 (0.83) (L) 0.91 (2) (L)	454 (1,000)
Hydrogen Sulfide	07292.1	7783-06-4	12-2	0.45 (1) (G)	680 (1,500)
Iron Pentacarbonyl; Iron Carbonyl	04174.1	13463-40-6	11-17	4.5 (10) (L)	113 (250)
Nitric Acid (94.5% by weight or greater)	00240.1 00240.3 00240.4	7697-37-2	11-17 12-21 12-2A 12-59 12-68 12-5 12-5B 12-5G1 12-9 11-51	90.7 (200) (L) 10.6 (23.4) (L) 22.7 (50.0) (L) 1.8 (4.0) (L) 1.4 (3.0) (L) 0.45 (1.00) (L) 22.2 (49.0) (L) 16.3 (36.0) (L) 0.68 (1.50) (L) 3.9 (8.7) (L)	227 (500)
Nitromethane	056699.1	75-52-5	11-17	1.7 (3.80) (L)	1,134 (2,500)

TABLE B.2.—*Highly Hazardous Chemicals, Toxics, and Reactives Listed in 29 CFR 1910.119 and Matching Items Found in Pantex Inventory (Continued)*

Chemical Name	Pantex File Number(s)	CASRN[1]	Location	Quantity, kg (lb) on Inventory and Form	TQ[2], kg (lb)
Nitrous Oxide	00891.1	10102-44-0	12-59	2.7 (6) (G)	113 (250)
Perchloric Acid, 69-72%	07088.1 00006.1	7601-90-3	12-59 11-17 12-2A 11-34	2.0 (4.42) (L) 19.1 (42.00)(L) 1.3 (2.94) (L) 27.2 (60.00)(L)	2,268 (5,000)
Phosphorous Oxychloride	00260.1	10025-87-3	11-17	2.0 (4.4) (L)	454 (1,000)

[1]CASRN = Chemical Abstract Service Registry Number
[2]TQ = Threshold Quantity
[3]S = solid
[4]G = gas
[5]L = liquid

TABLE B.3.—*Extremely Hazardous Substances Listed in 40 CFR 355 And Matching Items Found in the Pantex Plant Inventory*

Chemical Name	Pantex File Number(s)	CASRN[1]	Location	Quantity, kg (lb) on Inventory and Form	TPQ[2], kg (lb)
Ammonia	00243.5	7664-41-7	12-59	0.9 (2) (G)[3]	227 (500)
Aniline	00251.1	62-53-3	11-17	4.6 (10.16) (L)[4]	454 (1,000)
Carbon Disulfide	00009.1	75-15-0	12-2A	1.0 (2.20) (L)	227 (500)
Chlorine	00314.1	7728-50-5	13-47 15-29	408 (900) (G) 408 (900) (G)	454 (1,000)
Chloroacetic Acid	04332.1	79-11-8	11-17 12-2A	0.27 (0.6) (S)[5] 0.5 (1) (S)	45.4/4,536 (100/10,000)
Chloroform	00322.1 00322.3 00322.5 00322.6 06397.1 02473.1	67-66-3	12-2A 12-59 11-17 11-51	0.00 16.3 (35.90) (L) 146.5 (323.06)(L) 93.2 (205.47) (L)	4,536 (10,000)
Ethylenediamine	02883.1	107-15-3	11-7	2.4 (5.25) (L)	4,536 (10,000)
Hydrazine	06197.1	302-01-2	11-17	0.18 (0.4) (L)	454 (1,000)
Hydrogen Sulfide	07292.1	7783-06-4	12-2	0.45 (1) (G)	227 (500)
Hydroquinone	05747.1 05445.1	123-31-9	11-17 11-51	0.45 (1.0) (S) 0.45 (1.0) (S)	227/4,536 (500/10,000)
Isophorone Diisocyanate	03877.1	4098-71-9	11-17	1.2 (2.64) (L)	45.4 (100)
Lithium Hydride	04326.1	7580-67-8	11-17 11-51	0.9 (2) (S) 0.09 (0.2) (S)	45.4 (100)
Malononitrile	02115.1	109-77-3	11-17 11-51	0.18 (0.4) (S) 0.36 (0.8) (S)	227/4,536 (500/10,000)
Mercuric Chloride	00115.1	7487-94-7	11-17	0.59 (1.3) (S)	227/4,536 (500/10,000)
Mercuric Oxide	00116.1	21908-53-2	11-51	0.45 (1.0) (S)	227/4,536 (500/10,000)

TABLE B.3.—*Extremely Hazardous Substances Listed in 40 CFR 355 And Matching Items Found in the Pantex Plant Inventory (Continued)*

Chemical Name	Pantex File Number(s)	CASRN[1]	Location	Quantity, kg (lb) on Inventory and Form	TPQ[2], kg (lb)
Nitric Acid	00240.1 00240.3 00240.4 08386.1	7697-37-2	11-17 12-2A 12-21 12-59 12-68 12-5 12-5B 12-5G1 12-9 11-51	90.7 (200) (L) 22.7 (50.0) (L) 10.6 (23.4) (L) 1.8 (4.0) (L) 1.4 (3.0) (L) 0.45 (1.0) (L) 22.2 (49) (L) 16.3 (36) (L) 0.68 (1.5) (L) 3.9 (8.7) (L)	453.6 (1,000)
Nitrobenzene	00255.1	98-95-3	12-59	200 (443.00) (L)	4,536 (10,000)
Phenol	00239.1	108-95-2	11-17 11-51	0.0 0.45 (1) (S)	227/4,536 (500/10,000)
Phosphoric Acid	00304.1	3254-63-5	11-17 12-68	13.6 (30) (L) 599 (1320) 5%(L)	227 (500)
Phosphorous Oxychloride	00260.1	10025-87-3	11-17	2.0 (4.4) (L)	227 (500)
Phosphorous Pentoxide	02026.1	1314-56-3	11-51 12-59	0.59 (1.3) (S) 1.4 (3) (S)	4.5 (10)
Piperidine	03672.1	110-89-4	11-17 11-51 12-59	1.0 (2.15) (L) 1.0 (2.15) (L) 9.1 (20.0) (L)	453.6 (1,000)
Propionitrile	05865.1	107-12-0	11-17	3.8 (8.48) (L)	227 (500)
Sodium Azide [$Na(N_3)$]	01877.2 01877.3	26628-22-8	11-51 11-17 11-39	0.09 (0.2) (S) 1.09 (2.4) (S) 1.4 (3) (S)	227 (500)
Sodium Cyanide [Na(CN)]	00264.1	143-33-9	11-51	0.09 (0.2) (S)	45.4 (100)

TABLE B.3.—*Extremely Hazardous Substances Listed in 40 CFR 355 And Matching Items Found in the Pantex Plant Inventory (Continued)*

Chemical Name	Pantex File Number(s)	CASRN[1]	Location	Quantity, kg (lb) on Inventory and Form	TPQ[2], kg (lb)
Sulfuric Acid	00254.1 00254.3 08012.2 02923.1	7664-93-9	11-17 11-36 12-2A 12-59 12-5B 11-34 11-51 12-5 12-68 12-5G1	95 (210) (L) 0.45 (1.0) (L) 2.7 (6.0) (L) 8.8 (19.5) (L) 0.45 (1.0) (L) 11.3 (25.0) (L) 1.0 (2.1) (L) 0.9 (2.0) (L) 1905 (4200) @ 20% (L) 18 (40) (L)	453.6 (1,000)
Tellurium	00085.1	13494-80-9	12-2A	0.14 (0.3) (S)	227/4,536 (500/10,000)
Thallium Sulfate	03928.1	1031-59-1	11-51	0.09 (0.2) (S)	45.4 (100)
Toluene 2, 6-Diisocynate	01162.1	91-08-7	12-2A 11-7N 12-59	0.04 (0.1) (L) 4.4 (9.76) (S) 0.18 (0.4)	45.4 (100)

[1]CASRN = Chemical Abstract Service Registry Number
[2]TPQ = Threshold Planning Quantity
G - gas
L - liquid
S - solid

TABLE B.4.—*Inventory of Actual Quantities of Hazardous Materials*

Approximate Distance, km (mi)[1]	Material	Quantity (if applicable)	Limits (if applicable)
Building 11-7N Production Waste Storage Pad			
2.27 (1.4)	Toluene Diisocyanate	4.4 kg or 9.76 lb	4.5 kg or 10.0 lb
Building 11-17 Chemistry Laboratory			
2.27 (1.4)	Nitric Acid	90.7 kg or 200.0 lb	90.7 kg or 200.0 lb
2.27 (1.4)	Phosphoric Acid	13.6 kg or 30.0 lb	13.6 kg or 30.0 lb
2.27 (1.4)	Sulfuric Acid	95.3 kg or 210.0 lb	95.3 kg or 210.0 lb
Building 11-34 Acid Storage Building			
2.27 (1.4)	Sulfuric Acid	11.3 kg or 25.0 lb	11.3 kg or 25.0 lb
Building 11-36 Synthesis Facility			
2.27 (1.4)	Sulfuric Acid	0.45 kg or 1.0 lb	0.7 kg or 1.5 lb
Building 11-51 Weapons Materials Analytical Laboratory			
2.27 (1.4)	Nitric Acid	3.9 kg or 8.7 lb	4.1 kg or 9.0 lb
2.27 (1.4)	Sulfuric Acid	0.95 kg or 2.1 lb	1.4 kg or 3.0 lb
Building 12-2A Safety Laboratory			
0.93 (0.58)	Nitric Acid	22.7 kg or 50.0 lb	22.7 kg or 50.0 lb
0.93 (0.58)	Sulfuric Acid	2.7 kg or 6.0 lb	2.7 kg or 6.0 lb
0.93 (0.58)	Toluene Diisocyanate	0.05 kg or 0.1 lb	0.04 kg or 0.1 lb
Building 12-5 General Stores, Shops, and Office			
0.93 (0.58)	Nitric Acid	0.45 kg or 1.0 lb	0.45 kg or 1.0 lb
0.93 (0.58)	Sulfuric Acid	0.9 kg or 2.0 lb	0.9 kg or 2.0 lb
Building 12-5B 35 Accounting Warehouse			
0.93 (0.58)	Nitric Acid	22.2 kg or 49.0 lb	22.2 kg or 49.0 lb
0.93 (0.58)	Sulfuric Acid	0.45 kg or 1.0 lb	4.5 kg or 10.0 lb

TABLE B.4.—*Inventory of Actual Quantities of Hazardous Materials (Continued)*

Approximate Distance, km (mi)[1]	Material	Quantity (if applicable)	Limits (if applicable)
Building 12-5-G1 Storage Shed			
0.93 (0.58)	Nitric Acid	16.3 kg or 36.0 lb	16.3 kg or 36.0 lb
0.93 (0.58)	Sulfuric Acid	471.7 kg or 1040.0 lb	472 kg or 1040.0 lb
Building 12-9 Inert Parts Fabrication and Offices			
0.93 (0.58)	Nitric Acid	0.7 kg or 1.5 lb	0.9 kg or 2.0 lb
Building 12-21 X-ray and Physical Testing			
1.09 (0.74)	Nitric Acid	10.6 kg or 23.4 lb	10.6 kg or 23.4 lb
Building 12-59 Chemistry Laboratory			
0.93 (0.58)	Nitric Acid	1.8 kg or 4.0 lb	1.8 kg or 4.0 lb
0.93 (0.58)	Sulfuric Acid	8.8 kg or 19.5 lb	9.1 kg or 20.0 lb
0.93 (0.58)	Toluene Diisocyanate	0.18 kg or 0.4 lb	4.4 kg or 9.8 lb
Building 12-68 Tool & Die Shop			
0.93 (0.58)	Nitric Acid	1.4 kg or 3.0 lb	4.0 kg or 9.0 lb
0.93 (0.58)	Phosphoric Acid	599 kg or 1320 lb at 5%	599 kg or 1320 lb
0.93 (0.58)	Sulfuric Acid	1905 kg or 4200 lb at 20%	4200 lb at 20%
Building 13-47 Sewer Control Building			
1.78 (1.11)	Chlorine	408 kg or 900 lb	<454 kg or 1,000 lb
Building 15-29 Chlorinator Building			
1.36 (0.85)	Chlorine	408 kg or 900 lb	<454 kg or 1,000 lb

...tance of the facility in kilometers/miles from the Pantex site boundary.

TABLE B.5.—*Facility Limits and Approximate Site Boundary Distances For Chemical High Explosives*

Building #	Building Use	Approximate Distance[a], km (mi)	HE Limits[b], kg (lb)	IHE Limits[c], kg (lb)
4-21	Weapon Magazine	2.98 (1.85)	907 (2,000)	90,720 (200,000)
4-23 & 4-24	Joint Testing Assembly (JTA), Nuclear Explosive-Like Assembly (NELA), Core B Storage	2.98 (1.85)	136 (300)	no limit
4-25	Nuclear Materials Staging	2.98 (1.85)	907 (2,000)	90,720 (200,000)
4-26	Shipping Building	2.98 (1.85)	907 (2,000)	90,720 (200,000)
4-27	JTA, NELA, Core B storage	2.07 (1.29)	91 (200)	No limit
4-29	JTA, NELA, Core B Storage	2.98 (1.85)	91 (200)	No limit
4-30 to 4-44	Weapon Magazine	2.98 (1.85)	907 (2,000)	90,720 (200,000)
4-45	Explosives Magazine (Class 1.4S material only)	2.44 (1.5)	3,488 (7,690)	90,720 (200,000)
4-46 to 4-55	Explosives Magazine	2.44 (1.5)	22,680 (50,000)	90,720 (200,000)
4-57 to 4-64	Explosives Magazine	2.44 (1.5)	22,680 (50,000)	90,720 (200,000)
4-65 to 4-69	Explosives Magazine	2.07 (1.29)	27,216 (60,000)	90,720 (200,000)
4-70	Explosives Magazine	2.07 (1.29)	1.2 and 1.4 Storage	
4-71 to 4-75	Explosives Magazine	2.07 (1.29)	36,288 (80,000)	90,720 (200,000)
4-101 to 4-142	Weapons Magazines or Compartmentalized Magazine (6 per compartment)	2.07 (1.29) to 2.44 (1.5)	907 (2,000) or 95 (210) per compartment	No limit

TABLE B.5.—*Facility Limits and Approximate Site Boundary Distances For Chemical High Explosives (Continued)*

Building #	Building Use	Approximate Distance[a], km (mi)	HE Limits[b], kg (lb)	IHE Limits[c], kg (lb)
11-5	Explosive Test Facility:	2.27 (1.41)		
	Bay 1		13 (28)[7,8]	No Limit
	Bay 2		454 g (1)	6.8 (15)
	Bays 3, 4, and 6		550 g (1.2)	6.8 (15)
	Bay 8		100 g (0.2)	6.8 (15)
	Bay 21		1.8 (4)[7,8]	113 (250)
	Bay 25		454 g (1)	No Limit
11-16	Explosives Test Facility	2.27 (1.41)	35 (77)	45.4 (100)
11-17	Explosives Analysis and Test Facility	2.27 (1.41)		
	Bays 1-5, 7, 7A, 8		500 g (1.1)	No Limit
	Bay 9		4 (9)	No Limit
11-18	Test Fire Facility:	2.27 (1.41)		
	Staging		500 g (1.1)	No Limit
	Firing Chamber (Tank)		180 g (0.4)	No Limit
	Boom Box		1 g (0.002)	No Limit
11-20	Explosives Pressing and Test Facility:	2.27 (1.41)		
	Bay 1 - Explosive Prep		5.4 (12)	113 (250)
	Bay 2 - Pressing		5.4 (12)	113 (250)
	Bay 3 - Pressing		5.4 (12)[9]	113 (250)
	Bay 4 - Pressing		5.4 (12)	113 (250)
	Bay 5 - Pressing		11.3 (25)	113 (250)
	Bay 6 - Pressing		4.5 (10)[7,8]	113 (250)
	Bay 7 - Misc Activities		16.8 (37)[7,8]	113 (250)
	Bay 8 - Misc Activities		2.7 (6)	45.4 (100)
	Bay 9 - Assembly		8.6 (19)[7]	113 (250)
	Bay 11 - Misc Activities		0.9 (2)	No Limit
11-22	Explosives Analysis Facility	2.27 (1.41)	1.4 (3)	No Limit
11-23	Explosives Service Magazine	2.27 (1.41)	244 (538)	1,361 (3,000)
11-25	Explosives Service Magazine	2.27 (1.41)	105 (231)	136 (300)
11-36	Explosives Synthesis Facility:	2.27 (1.41)	Combined	
	Bay 1 - Process Bay		limit for Bays	No Limit
	Bay 2 - Oven Bay		1, 2,and 21 is	No Limit
	Bay 21 - Process Bay		68 (150)	No Limit
	Bay 22 - Laboratory		500 g (1.1)	500 g (1.1)

TABLE B.5.—*Facility Limits and Approximate Site Boundary Distances For Chemical High Explosives (Continued)*

Building #	Building Use	Approximate Distance[a], km (mi)	HE Limits[b], kg (lb)	IHE Limits[c], l (lb)
11-37	Explosives Staging and Drying Facility:	2.27 (1.41)		
	Bay 1		172 (380)	227 (500)
	Bay 2		105 (231)	136 (300)
11-38	Explosives Assembly and Testing Facility:	2.27 (1.41)		
	Bay 1 - Projectile Impact Test		60 g (0.13)	No Limit
	Bay 2 - Misc Activities		1.4 (3)	No Limit
	Bay 3 - Misc Activities (General Assembly)		5.4 (12)	12 (26)
11-42	Explosives Staging and Service Magazine:	2.27 (1.41)		
	Bay 1		39 (85)	No Limit
	Bay 2		91 (200)	No Limit
	Bay 3		234 (515)	907 (2,000)
	Bay 4		642 (1,415)	9,072 (20,000)
	Bay 5		1,363 (3,005)	9,072 (20,000)
	Bay 6		1,071 (2,360)	9,072 (20,000)
	Loading Dock		386 (850)	907 (2,000)
11-45	Explosive Sample Storage Facility	2.27 (1.41)	23 (50)	No Limit
11-50	Explosive Machining and Metrology Facility:	2.27 (1.41)		
	Bay 1-(Machining)		45.3 (100)	113 (250)
	Bay 2-(Machining)		45.3 (100)	113 (250)
	Bay 3-(Machining)		45.3 (100)	113 (250)
	Bay 4-(Machining)		45.3 (100)	113 (250)
	Bay 5-(Machining)		175 (385)	227 (500)
	In-Process & Staging		175 (385)	227 (500)
	Metrology		175 (385)	227 (500)
	Waste-Water Treatment		136 (300)	177 (390)
11-51	Weapon Material Analytical Laboratory:	2.27 (1.41)		
	All Lab rooms		500 g (1.1)	500 g (1.1)
	Staging Bay		4.5 (10)	No Limit
	Coupon Bay		454 g (1.0)	454 g (1.0)
Station A	Zone 12 North Transfer Area	0.93 (0.58)	91 (200)	680 (1,500)
12-8	Explosives Preparation and Testing (Bay 102)	0.93 (0.58)	100 g (0.2)	100 g (0.2)

TABLE B.5.—*Facility Limits and Approximate Site Boundary Distances For Chemical High Explosives (Continued)*

Building #	Building Use	Approximate Distance[a], km (mi)	HE Limits[b], kg (lb)	IHE Limits[c], kg (lb)
12-17	Explosives Operations Facility:	1.09 (0.68)		
	Bays 1, 2, 3, 5, 6N, 7N,			
	8, 9N & 9S combined,		5.4 (12)	272 (600)
	11, 15, 17		0.9 (2)	No Limit
	Bays 6S, 7S, 14		5.4 (12)	No Limit
	Bays 10N & 10S		4.5 (10)	No Limit
	combined		5.4 (12)	No Limit
	Bay 12			
	Bay 16			
12-17A	Explosives Pressing Facility	1.09 (0.68)	64 (140)	No Limit
12-17B	Explosives Pressing Facility	1.09 (0.68)	64 (140)	No Limit
12-19 East	Explosives Formulation Facility:	1.09 (0.68)		
	Remote Operations			
	Bays 9 & 10		6.8 (15)/bay	No Limit
	Bay 12		0.25 (0.56)	No Limit
	Bay 9		22.7 (50)	No Limit
	Contact Operations:			
	Bays 8N, 9 to 12, & 17		45.4	113 (250)/bay
	Bays 13 & 213 combined		(100)/bay[13,15]	113 (250)
	Bays 14 & 214 combined		45.4 (100)[15]	113 (250)
	Bays 15 & 215 combined		45.4 (100)[15]	113 (250)
	Bays 16 & 216 combined		45.4 (100)[13, 15]	113 (250)
	Bays 11, 17, 15 & 215 combined		45.4 (100)[15]	113 (250)
12-19 West	Weapons Material Evaluation Facility: Bays 3, 4, 5, 6, 7	1.09 (0.68)		113 (250)
12-21	X-Ray & Gas Analysis:	1.09 (0.68)		
	Bay 1		0.9 (2)	22.7 (50)
	Bay 4		--	50 g (0.11)
	Bay 6		0.7 (1.6)	22.7 (50)
	Bay 1 to 3 and 10		0.9 (2)/bay	22.7 (50)/bay
	Bay 5		1.8 (4)[16]	22.7 (50)
	Bay 6		0.7 (1.7)	22.7 (50)
	Bays 7, 9, 11, & 14		45.4 (100)	113 (250)
	East X-Ray		4.5 (10)	22.7 (50)
	West X-Ray		4.54 (100)	256 (565)
	Analytical Bay		4.5 (10)	22.7 (50)
12-21A	Real-Time X-Ray Facility	1.09 (0.68)	113 (250)	256 (565)
12-24	IHE Machining Facility:	1.09 (0.68)		
	Bays 1-9 & 11-21		0	113 (250)
	Bay 24		0.9 (2)	0
	Bays 23, 25-33, 36, 37		5.4 (12)[17]	0

TABLE B.5.—*Facility Limits and Approximate Site Boundary Distances For Chemical High Explosives (Continued)*

Building #	Building Use	Approximate Distance[a], km (mi)	HE Limits[b], kg (lb)	IHE Limits[c] (lb)
12-26	Assembly & Inspection Facility:	1.22 (0.76)		
	Bay 1		2.2 (5)	No Limit
	Bays 3, 21		2.2 (5)/bay	113 (250)/bay
	Bays 5, 7, 19		2.2 (5)/bay	2.2 (5)/bay
	Bay 27		29.5 (65)[20]	113 (250)
	Bay 28		2.2 (5)	2.3 (6.5)
12-31	Subassembly:	1.33 (0.83)		
	Bays 2 to 4 & 6 to 8		5.4 (12)/bay[18]	68 (150)/bay
	Bays 1 & 5		4.5 (10)/bay[7]	68 (150)/bay
12-41	Spray Paint Facility	1.22 (0.76)	195 (430)	363 (800)
12-44-1	Assembly Cell	1.22 (0.76)	192 (423)	249 (550)
12-44-2	Assembly Cell	1.22 (0.76)	192 (423)	249 (550)
12-44-3	Assembly Cell	1.22 (0.76)	192 (423)	249 (550)
12-44-4	Assembly Cell	1.22 (0.76)	192 (423)	249 (550)
12-44-5	Assembly Cell	1.22 (0.76)	192 (423)	249 (550)
12-44-6	Assembly Cell	1.22 (0.76)	192 (423)	249 (550)
12-50	Separation Test Facility	1.54 (0.96)	27.2 (60)	35 (78)
12-55-1	Radiography Staging Facility	1.22 (0.76)	45.4 (100)	45.4 (100)
12-55-2	Radiography Staging Facility	1.22 (0.76)	45.4 (100)	45.4 (100)
12-55-3	Radiography Staging Facility	1.22 (0.76)	45.4 (100)	45.4 (100)
12-56	Neutron Facility	1.22 (0.76)	136.1 (300)	177 (390)
12-58-1	Explosive Service Magazine	1.22 (0.76)	9.1 (20)	12 (26)
12-58-3	Explosive Service Magazine	1.22 (0.76)	35 (77)	45.4 (100)
12-59	Chemistry Laboratory:	0.93 (0.58)		
	Rooms 101, 102, 1035, 106, 107		15 g (.002)	
	Room 105		30 g (.004)	
	Room 116		500 g (1.1)	
	Room 117		11.3 (2.5)	18.1 (40)
12-60-1	Dynamic Balancing Facility:	1.54 (0.96)		
	Hazard Class I Operations		12.2 (27)	18 (40)
	Hazard Class II Operations		22.7 (50)	136 (300)
12-60-2	Dynamic Balancing Facility:	1.54 (0.96)		
	Hazards Class I Operations		12.2 (27)	18 (40)
	Hazards Class II Operations		22.7 (50)	136 (300)

TABLE B.5.—*Facility Limits and Approximate Site Boundary Distances For Chemical High Explosives (Continued)*

Building #	Building Use	Approximate Distance[a], km (mi)	HE Limits[b], kg (lb)	IHE Limits[c], kg (lb)
12-60-3	Dynamic Balancing Facility	1.54 (0.96)	27.2 (60)	136 (300)
12-60-4	Dynamic Balancing Facility	1.54 (0.96)	27.2 (60)	136 (300)
12-60-5	Dynamic Balancing Facility: Hazard Class I Operations Hazard Class II Operations	1.54 (0.96)	 12.2 (27) 27.2 (60)	 18 (40) 136 (300)
12-60-6	Dynamic Balancing Facility: Hazard Class I Operations Hazard Class II Operations	1.54 (0.96)	 12.2 (27) 27.2 (60)	 18 (40) 59 (130)
12-62-1	Explosives De-aeration Facility	1.09 (0.68)	4.5 (10)	No Limit
12-62-2	Explosives Milling Facility	1.09 (0.68)	14.5 (32)	No Limit
12-62-3	Explosives Mixing Facility	1.09 (0.68)	14.5 (32)	No Limit
12-62-4	Explosives Heating and Weighing Facility	1.09 (0.68)	87.5 (193)	113 (250)
12-62-5	Explosives Refrigeration Facility	1.09 (0.68)	87.5 (193)	113 (250)
12-63-1	Explosives Pressing Facility: Hazard Class I Operations Hazard Class II Operations	1.09 (0.68)	 31.8 (70) 63.5 (140)	 68 (150) 68 (150)
12-63-2	Explosives Heating Bay	1.09 (0.68)	136 (300)	227 (500)
12-63-3	Explosives Staging Bay	1.09 (0.68)	174.6 (385)	227 (500)
12-64-1	Assembly & Inspection Facility	1.54 (0.96)	9.1 (20)	177 (390)
12-64-2	Assembly & Inspection Facility	1.54 (0.96)	22.7 (50)	177 (390)
12-64-3	Assembly & Inspection Facility	1.54 (0.96)	63.5 (140)	177 (390)
12-64-4	Assembly & Inspection Facility	1.54 (0.96)	22.7 (50)	177 (390)
12-64-5	Assembly & Inspection Facility	1.54 (0.96)	104 (230)	177 (390)
12-64-6	Assembly & Inspection Facility	1.54 (0.96)	104 (230)	177 (390)
12-64-7	Assembly & Inspection Facility	1.54 (0.96)	104 (230)	177 (390)
12-64-8	Assembly & Inspection Facility	1.54 (0.96)	104(230)	177 (390)
12-64-9	Assembly & Inspection Facility	1.54 (0.96)	104 (230)	177 (390)

TABLE B.5.—*Facility Limits and Approximate Site Boundary Distances For Chemical High Explosives (Continued)*

Building #	Building Use	Approximate Distance[a], km (mi)	HE Limits[b], kg (lb)	IHE Limits[c], kg (lb)
12-64-10	Assembly & Inspection Facility	1.54 (0.96)	104 (230)	177 (390)
12-64-11	Assembly & Inspection Facility	1.54 (0.96)	104 (230)	177 (390)
12-64-12	Assembly & Inspection Facility	1.54 (0.96)	104 (230)	177 (390)
12-64-13	Assembly & Inspection Facility	1.54 (0.96)	104 (230)	177 (390)
12-64-14	Assembly & Inspection Facility	1.54 (0.96)	104 (230)	177 (390)
12-64-15	Assembly & Inspection Facility	1.54 (0.96)	104 (230)	177 (390)
12-64-16	Assembly & Inspection Facility	1.54 (0.96)	104 (230)	177 (390)
12-64-17	Assembly & Inspection Facility	1.54 (0.96)	104 (230)	177 (390)
12-65-1	Explosives Service Magazine	1.09 (0.68)	--	2,948 (6,500)
12-65-2	Explosives Service Magazine	1.09 (0.68)	1,762 (3,885)	2,498 (6,500)
12-65-3	Explosives Service Magazine	1.09 (0.68)	1,762 (3,885)	2,948 (6,500)
12-65-4	Explosives Service Magazine	1.09 (0.68)	1,762 (3,885)	2,948 (6,500)
12-65-5	Explosives Service Magazine	1.09 (0.68)	1,762 (3,885)	2,948 (6,500)
12-65-6	Explosives Service Magazine	1.09 (0.68)	1,762 (3,885)	2,948 (6,500)
12-65-7	Explosives Service Magazine	1.09 (0.68)	1,762 (3,885)	2,948 (6,500)
12-71	Class C Explosives Staging Packaging Area Storage Area (Hazard Class 1.4 only)	1.54 (0.96)	 4.5 (10) No Limit	 No Limit No Limit
12-73	Explosive Decontamination Facility	1.09 (0.68)	2.3 (5)	3.0 (6.5)
12-83-1	Explosives Service Magazine	1.09 (0.68)	2,268 (5,000)	2,948 (6,500)
12-83-2	Explosives Service Magazine	1.09 (0.68)	907 (2,000)	2,948 (6,500)
12-83-3	Explosives Service Magazine	1.09 (0.68)	--	2,948 (6,500)
12-83-4	Explosives Service Magazine	1.09 (0.68)	--	2,948 (6,500)
12-83-5	Explosives Service Magazine	1.09 (0.68)	--	2,948 (6,500)
12-83-6	Explosives Service Magazine	1.09 (0.68)	204 (450)	2,948 (6,500)
12-83-7	Explosives Service Magazine	1.09 (0.68)	204 (450)	2,948 (6,500)
12-83-D	Loading Dock	1.09 (0.68)	635 (1,400)	1,134 (2,500)

TABLE B.5.—*Facility Limits and Approximate Site Boundary Distances For Chemical High Explosives (Continued)*

Building #	Building Use	Approximate Distance[a], km (mi)	HE Limits[b], kg (lb)	IHE Limits[c], kg (lb)
12-84-1	Radiography Facility	1.54 (0.96)	136 (300)	177 (390)
12-84-2	Assembly & Inspection Facility	1.54 (0.96)	136 (300)	177 (390)
12-84-3	Assembly & Inspection Facility	1.54 (0.96)	136 (300)	177 (390)
12-84-4	Assembly & Inspection Facility	1.54 (0.96)	136 (300)	177 (390)
12-84-5	Assembly & Inspection Facility	1.54 (0.96)	136 (300)	177 (390)
12-84-6	Assembly & Inspection Facility	1.54 (0.96)	136 (300)	177 (390)
12-84-7	Assembly & Inspection Facility	1.54 (0.96)	136 (300)	177 (390)
12-84-8	Assembly & Inspection Facility	1.54 (0.96)	136 (300)	177 (390)
12-84-9	Assembly & Inspection Facility	1.54 (0.96)	136 (300)	177 (390)
12-84-10	Radiography Facility	1.54 (0.96)	136 (300)	177 (390)
12-84-11	Assembly & Inspection Facility	1.54 (0.96)	136 (300)	177 (390)
12-84-12	Assembly & Inspection Facility	1.54 (0.96)	136 (300)	177 (390)
12-84-13	Assembly & Inspection Facility	1.54 (0.96)	136 (300)	177 (390)
12-84-15	Assembly & Inspection Facility	1.54 (0.96)	136 (300)	177 (390)
12-84-16	Assembly & Inspection Facility	1.54 (0.96)	136 (300)	177 (390)
12-84-17	Assembly & Inspection Facility	1.54 (0.96)	136 (300)	177 (390)
12-84-18	Assembly & Inspection Facility	1.54 (0.96)	136 (300)	177 (390)
12-84-19	Assembly & Inspection Facility	1.54 (0.96)	136 (300)	177 (390)
12-84-20	Assembly & Inspection Facility	1.54 (0.96)	136 (300)	177 (390)
12-85	Assembly Cell	1.54 (0.96)	192 (423)	249 (550)
12-86	Test Area: Bays 1, 3, 5, 7, & 8 Bay 4 Bays 2 & 6 combined Assembly Area: Bays 1 to 12	1.54 (0.96)	 0.11 (0.25)[21] -- 0.11 (0.25)[21] 0.23 (0.5)	 -- 5.2 (11.5) -- --
12-92	Explosives Service Magazine	1.54 (0.96)	136 (300)	177 (390)
12-94	Weapon Aging Facility	1.54 (0.96)	113 (250)	147 (325)

TABLE B.5.—*Facility Limits and Approximate Site Boundary Distances For Chemical High Explosives (Continued)*

Building #	Building Use	Approximate Distance[a], km (mi)	HE Limits[b], kg (lb)	IHE Limits[c], kg (lb)
12-95	Class C Explosives Staging Packaging Area Storage Area	1.54 (0.96)	 4.5 (10) No Limit	 No Limit No Limit
12-96	Assembly Cell	1.54 (0.96)	192 (423)	249 (550)
12-98-1	Assembly Cell	1.54 (0.96)	192 (423)	249 (550)
12-98-2	Assembly Cell	1.54 (0.96)	192 (423)	249 (550)
12-98-3	Assembly Cell	1.54 (0.96)	192 (423)	249 (550)
12-98-4	Assembly Cell	1.54 (0.96)	192 (423)	249 (550)
12-98	Loading Dock	1.54 (0.96)	318 (700)	567 (1,250)
12-99-1	Assembly & Inspection	1.54 (0.96)	136 (300)	177 (390)
12-99-2	Assembly & Inspection	1.54 (0.96)	136 (300)	177 (390)
12-99-3	Assembly & Inspection	1.54 (0.96)	136 (300)	177 (390)
12-99-4	Assembly & Inspection	1.54 (0.96)	136 (300)	177 (390)
12-99-5	Assembly & Inspection	1.54 (0.96)	136 (300)	177 (390)
12-99-6	Assembly & Inspection	1.54 (0.96)	136 (300)	177 (390)
12-99-7	Assembly & Inspection	1.54 (0.96)	136 (300)	177 (390)
12-99-8	Assembly & Inspection	1.54 (0.96)	136 (300)	177 (390)
12-99-9	Assembly & Inspection Loading Dock	1.54 (0.96)	136 (300) 295 (650)	177 (390) 1,134 (2,500)
12-104-1	Assembly Bay	1.54 (0.96)	136 (300)	177 (390)
12-104-2	Assembly Bay	1.54 (0.96)	136 (300)	177 (390)
12-104-3	Assembly Bay	1.54 (0.96)	136 (300)	177 (390)
12-104-4	Assembly Bay	1.54 (0.96)	136 (300)	177 (390)
12-104-5	Assembly Bay	1.54 (0.96)	136 (300)	177 (390)
12-104-6	Assembly Bay	1.54 (0.96)	136 (300)	177 (390)
12-104-7	Assembly Bay	1.54 (0.96)	136 (300)	177 (390)
12-104-8	Assembly Bay	1.54 (0.96)	136 (300)	177 (390)

TABLE B.5.—*Facility Limits and Approximate Site Boundary Distances For Chemical High Explosives (Continued)*

Building #	Building Use	Approximate Distance[a], km (mi)	HE Limits[b], kg (lb)	IHE Limits[c], kg (lb)
12-104-9	Assembly Bay	1.54 (0.96)	136 (300)	177 (390)
12-104-10	Assembly Bay	1.54 (0.96)	136 (300)	177 (390)
12-104-11	Assembly Bay	1.54 (0.96)	136 (300)	177 (390)
12-104-12	Assembly Bay	1.54 (0.96)	136 (300)	177 (390)
12-104-13	Assembly Bay	1.54 (0.96)	136 (300)	177 (390)
12-104-14	Assembly Bay	1.54 (0.96)	136 (300)	177 (390)
12-104-15	Assembly Bay	1.54 (0.96)	136 (300)	177 (390)
12-104-16	Assembly Bay	1.54 (0.96)	136 (300)	177 (390)
12-121	Explosives Machining Facility Bay 1 - Sawing Bay 2 - Staging Bay 3 - Mill/Turn Bay 4 - Staging Bay 5 - Milling Bay 6 - Subassembly/Gaging Bay 7 - Turning Bay 8 - Gaging Bay 9 - Milling Bay 10 - Waste Water Treatment Bay 11 - Turning Bay 13 - Density Bay 128 - IHE Machine Bay 145 - IHE Gaging Bay 146 - IHE Density Bay 147 - IHE Staging	1.54 (0.96)	 45.4 (100)[22] 125 (275)[22] 45.4 (100)[22] 125 (275)[22] 45.4 (100)[22] 125 (275)[22] 45.4 (100)[22] 125 (275)[22] 45.4 (100)[22] 125 (275)[22] 45.4 (100)[22] 68 (150)[22] -- -- -- -- -- --	 113 (250)[22] 227 (500)[22] 113 (250)[22] 227 (500)[22] 113 (250)[22] 227 (500)[22] 113 (250)[22] 227 (500)[22] 113 (250)[22] 125 (275)[22] 113 (250)[22] 136 (300)[22] No Limit No Limit No Limit No Limit -- --
FS-2	Storage	0.8 (0.5)	45.4 (100)	227 (500)
FS-4	Test Fire Facility	0.8 (0.5)	113.4 (250)[1,6]	147 (325)[1,6]
FS-5	Test Fire Facility	1.6 (1.0)	136 (300)[1,6]	177 (390)[1,6]
FS-10	Test Fire Facility	0.8 (0.5)	113.4 (250)[1,6]	147 (325)[1,6]
FS-11A	Shot Make-up, Bays 1-3	0.8 (0.5)	102 (225)[2]	132 (290)[3]
FS-16	Machining Facility: Hazard Class I Operations Hazard Class II Operations	2.08 (1.29)	 1.4 (3) 4.5 (10)	 -- --

TABLE B.5.—*Facility Limits and Approximate Site Boundary Distances For Chemical High Explosives (Continued)*

Building #	Building Use	Approximate Distance[a], km (mi)	HE Limits[b], kg (lb)	IHE Limits[c], kg (lb)
FS-21	Test Fire Facility	2.08 (1.29)	136 (300)[4,6]	177 (390)[4,6]
FS-21	Test Fire Storage Facility	2.08 (1.29)	17 (38)	22.7 (50)
FS-22	Test Fire Facility	1.6 (0.99)	136 (300)[5,6]	177 (390)[5,6]
FS-23	Test Fire Facility	0.8 (0.5)	5.1 (11.2)	--
FS-24	Trident Test Facility: Environment Room 0.91 kg (2-lb) Chamber 0.45 kg (1-lb) Chamber	0.8 (0.5)	 6.8 (15) 0.9 (2) 0.5 (1)	 8.9 (19.5) 1.2 (2.6) 0.6 (1.3)
BG-Pads	Explosive Scrap Burning	0.8 (0.5)	Each pad 680 (1,500) max	--
BG-3	Explosives Service Magazine	0.8 (0.5)	181 (400)	--
SST Trailer Pads		2.08 (1.29)	313 (690) per pad or 2,443 (5,385) when alternate pads are used	408 (900) per pad or 3,175 (7,000) when alternate pads are used
N. 15th Loading & Transfer Dock			1,361 (3,000)	1,814 (4,000)

* General comments for Table B.6.:
  - -All High Explosives limits shown on this drawing are HE weights. For Quantity Distance computations, all high explosives weights must be multiplied by 1.3 to convert to TNT equivalent weights. Insensitive High Explosives weights are equivalent to TNT weights for Quantity Distance calculations.
  - -For specific operating limits, see Building Standards.
  - -Whenever HE and IHE are both present, the HE limit will apply for the combined weight of HE and IHE.

Footnotes for columnar headings of Table B.6.:

[a] Distance of the facility in kilometers/miles from the Pantex site boundary.

[b] Explosive substances capable of mass detonation, and for which there is a significant probability of accidental initiation or transition from burning to detonation.

[c] Explosive substances that, although mass detonating, are so insensitive that there is negligible probability of accidental initiation or transition from burning to detonation.

Footnotes referenced throughout Table B.6.:

[1] Test shots shall be located so that the design capability, 100 lb explosives detonation at 10 ft from the front of the structure is not exceeded. Amounts of explosives may be varied, but at no time shall the pressure at the front of the structure wall exceed 325 psi (K=2).

[2] Allowable quantities are 225 lb (HE or He/IHE mix) per bay with a combined total of 400 lb.

[3] Allowable quantities are 290 lb (HE or He/IHE mix) per bay with a combined total of 520 lb.

[4] Test shots shall be located so that the design capability, 50 lb explosives detonation at 10 ft from the front of the structure is not exceeded. Amounts of explosives may be varied, but at no time shall the pressure at the front of the structure wall exceed 175 psi (=2.7).

[5] Test shots shall be located so that the design capability, 100 lb explosives detonation at 22 ft from the front of the structure is not exceeded. Amounts of explosives may be varied, but at no time shall the pressure at the front of the structure wall exceed 57 psi (=4.5).

[6] Tests involving fragmentating explosive configurations will provide exclusion distances equivalent to $D = 600*W^{(1/3)}$ (scaled distance K=600).

[7] As defined in the memorandum from J.W. Glover to Distribution, June 29, 1994: *Approved Usage of High Explosives Non-Propagating Storage Cabinets*, testing has demonstrated significant protective measures are provided with these cabinets if used correctly. The correct measures are:

-Orient the cabinets so that the back of the cabinet will be facing all explosive operations outside the cabinet.
-Allow no more than 1 lb of explosives in the adjacent operational explosives area, external to the cabinets.
-Store no more than 1 lb HE/IHE mixed in any single cubicle. (Note: There are no restrictions on quantities of IHE stored in these cubicles as long as there is no HE in the same cubicle. This is justified because IHE is not considered as an initiating event (donor) and the cabinet structure will provide accepter protection to a sizeable amount of contents contained within each cubicle.)

[8] If surrounding operations exceed 1 lb allowable limit, the entire contents of the storage cabinets must be counted in the bay limit.

[9] Pressing limit may be increased from 55 lb to 100 lb if Building 11-20 is totally evacuated except for two technicians and one supervisor in the remote control bunker during pressing and if temporary barricades are placed:

-across the ramp, north of 11-20,
-across the road, west of 11-21,
-across the entrance road, southwest of 11-20 parking area, and
-across the road, north of 11-20 and east of the ramp.

[10] See specific building standard for personnel limits for specific operations. The maximum operating limit is listed here.

[11] Up to 15 lb of unconsolidated power is authorized as TNT equivalent.

[12] 670 ft exclusion area distances in all directions.

[13] 2,000 (Special Program) as described in Building Standard.

[14] 28 ft exclusion area distance in all directions.

[15] 193 lb HE authorized during off-shift periods only

[16] For operations involving over 4 lb, special provisions for the evacuation of personnel in adjacent occupied areas will be applied. The limit for Bay 5 may be increased up to 30 lb per an approved PX 100-35 which specifies that administrative offices adjacent to Bay 5 be evacuated during operations with the increased limit. Contractor personnel limits will be increased to 61 ft.

[17] JTAs and NELAs only.

[18] When 12 lb is exceeded, special provisions will be applied to afford Class II levels of protection external to the bay.

[19] 20 lb IHE in each compartment on top of storage cabinets.

[20] Bays 15, 16, 17, 18, and 23 will be unoccupied during operations in Bay 27.

[21] Limit may be increased to 6 lb provided explosive and personnel limits in adjacent bays are reduced to zero.

[22] Explosive limits are not approved for 12-121 until ORR is completed.

TABLE B.6.—*Chemical High Explosives, Class Divisions, and Constituents*

Chemical High Explosive	UN Hazard/Class Division	Constituents
1,3,5-Trinitrobenzene	1.1	1,3,5-Trinitrobenzene
2,4-Dinitrotoluene	1.1	2,4-Dinitrotoluene
Ammonium perchlorate (NH_4ClO_4)	1.1	Ammonium perchlorate (NH4ClO4)
Baratol	1.1	TNT (24) Barium Nitrate (76)
Barium Nitrate [$Ba(NO_3)_2$]	1.1	Barium Nitrate [$Ba(NO_3)_2$]
Boracitol	1.1	Boric Acid (60) TNT (40)
Comp. B-3	1.1	TNT (40) RDX (60)
Comp. C-4	1.1	RDX (91) Polyisobutylene (2) Motor oil (1.6) Di-2-ethylhexylsebacate (15.3)
Comp. B	1.1	RDX (59.4) TNT (39.6) Wax (1)
Comp. A	1.1	RDX (91) Wax (9)
Cyclotol	1.1	TNT (25) RDX (75)
DATB (Diaminotrinitrobenzene)	1.1	DATB (Diaminotrinitrobenzene)
DATB-PBX	1.1	DATB (95) Epoxy 1007 (3) HET anhydride (2)
Extex	1.1	PETN (80) Sylgard 182 (20)
FEFO/SOL (Bis-2-fluoro-z,2-dinitroethyl formal in ethyl acetate)	1.1	FEFO/SOL (Bis-2-fluoro-z,2-dinitroethyl formal in ethyl acetate)
HMX (Cyclotetramethylene tetranitramine)	1.1	HMX (Cyclotetramethylene tetranitramine)
HNAB (2,2',4,4',6,6'-Hexanitroazobenzene)	1.1	HNAB (2,2',4,4',6,6'-Hexanitroazobenzene)
HNS I and II (Hexanitrostilbene)	1.1	HNS I and II (Hexanitrostilbene)
Lead Styphnate	1.1	Lead Styphnate

TABLE B.6.—*Chemical High Explosives, Class Divisions, and Constituents, Continued*

Chemical High Explosive	UN Hazard/Class Division	Constituents
Lead Azide	1.1	Lead Azide
LM-04-0	1.1	Cyanuric Acid (59.7) Melamine (23.5) Viton (16.8)
LX-03-0	1.1	HMX (70) DATB (20) Viton (10)
LX-02-0 (EL-506)	1.1	PETN Binder Dibutylicitrate Carbosil Red Dye
LX-02-1 (EL-506-L-3)	1.1	PETN (73) Binder (26) Carbosil (1)
LX-04-0	1.1	HMX (85) Viton (15)
LX-04-1	1.1	HMX (85) Viton (15)
LX-07-0	1.1	HMX (90) Viton (10)
LX-08	1.1	PETN (64) Sylgard 182 (26-35) Cab-O-Sil M5 (1.5-10) Phthalocyanine Blue (100 ppm)
LX-10 and LX-10-2	1.1	HMX (94-95) Viton (5-6)
LX-10-0	1.1	HMX (95) Viton (5)
LX-10-1	1.1	HMX (94.5) Viton (4.5)
LX-11	1.1	HMX (80) Viton A (20)
LX-13	1.1	PETN (80) Sylgard 182 (20)
LX-14	1.1	HMX (95.5) Estane (4.5)

TABLE B.6.—*Chemical High Explosives, Class Divisions, and Constituents, Continued*

Chemical High Explosive	UN Hazard/Class Division	Constituents
LX-14-0	1.1	HMX (95.5) Estane (4.5)
LX-15	1.1	HNSI (95) Kel-F 800 (5)
LX-17	1.3	TATB (92.5) Kel-F 800 (7.5)
MDF (Mild Detonating Fuse)	1.1	Potassium Nitrate, Carbon, Sulfur
Mercury fulminate	1.1	Mercury fulminate
Nitocellulose	1.1	Nitocellulose
Nitroguanidine ($CH_4N_4O_2$)	1.1	Nitroguanidine ($CH_4N_4O_2$)
Octol	1.1	HMX (75) TNT (25)
PBDT	1.1	DATB (92) Teflon (8)
PBDTF	1.1	DATB (89.3) Teflon (10) Fiber (0.3)
PBHDK	1.1	HMX (69) DATB (23) Kel-F (8)
PBHDMT	1.1	HMX (27.5) DATB (9) HGO (58.9) Teflon (4.6)
PBHDT-1	1.1	HMX (46) DATB (46) Teflon (8)
PBHDT-3	1.1	HMX (69) DATB (23) Teflon (8)
PBHDV	1.1	HMX (69) DATB (23) Viton (8)
PBHE	1.1	HMX (94) Exon 461 (6)
PBHEF	1.1	HMX Exon 461 (94.5) Fiber (0.5)

TABLE B.6.—*Chemical High Explosives, Class Divisions, and Constituents, Continued*

Chemical High Explosive	UN Hazard/Class Division	Constituents
PBHKF	1.1	HMX (90) Kel-F (9.5) Dacron (0.5)
PBX-9404	1.1	HMX (94) CEF (3)
PBX-9007	1.1	RDX (91) Polystyrene (9.1) Dioctyl Phthalate (DOP) (0.5) Rosin (0.4)
PBX-9207	1.1	HMX (92) Kel-F (8)
PBX-9401	1.1	RDX (94.2) Polystyrene (3.6) TOF (2.2)
PBX-9204	1.1	RDX (92) Polystyrene (5) Trioctylphosphate (TOF) (3)
PBX-9010F	1.1	RDX (90) Kel-F (9.5) Fiber (0.5)
PBX-9502	1.3	TATB (95) Kel-F 800 (5)
PBX-9205	1.1	RDX (92) Polystyrene (6) Dioctyl Phthalate (DOP) (2)
PBX-9501	1.1	HMX (95) Estane (2.5) BDNPA (1.25) BDNPF (1.25)
PBX-9010	1.1	RDX (90) Kel-F (10)
PBX-9011	1.1	HMX (85) Estane (15)
PBX-9203	1.1	RDX (92) Polystyrene (6) Dioctyl Phthalate (DOP) (2)
PBX-9407	1.1	RDX (94) Exon 461 (6)

TABLE B.6.—*Chemical High Explosives, Class Divisions, and Constituents, Continued*

Chemical High Explosive	UN Hazard/Class Division	Constituents
PBX-9503	1.1	TATB (79.8) HMX (15) Kel-F 800 (5) Violet Dye (0.2)
PBX-N-2	1.1	HMX Nylon
PDNPA (Poly-2,2'-Dinitropropylacrylate)	1.1	PDNPA (Poly-2,2'-Dinitropropylacrylate)
Pentolite 50-50	1.1	PETN (50) TNT (50)
Pentolite 10-90	1.1	PETN (10) TNT (90)
PETN ($C_5H_8N_4O_{12}$)	1.1	PETN ($C_5H_8N_4O_{12}$)
RDX	1.1	RDX
RDX (Cyclotrimethylenetrinitramine)	1.1	RDX (Cyclotrimethylenetrinitramine)
RX-04-AQ	1.1	HMX (86.9) Exon 461 (12.6) Dioctyl Phthalate (DOP) (0.5)
RX-04-AH	1.1	HMX (85.8) Viton (14.2)
RX-04-AR	1.1	RDX (84.4) Viton (15.6)
RX-04-AB	1.1	HMX (84.4) Viton (15.6)
RX-03	1.1	TATB (97) Estane (3) or TATB (95) Kel-F (5) or TATB (95.5) Viton (4.5)
TACOT (Tetranitrodibenzo-1,3A,4,6A-Tetraaz apentalene)	1.1	TACOT (Tetranitrodibenzo-1,3A,4,6A-Tetraazapentalene)
TATB (Triamino-trinitrobenzene)	1.3	TATB (Triamino-trinitrobenzene)
TCTNB (Trichloro-trinitrobenzene)	1.1	TCTNB (Trichloro-trinitrobenzene)
TETRYL ($C_7H_5N_5O_8$)	1.1	TETRYL ($C_7H_5N_5O_8$)

TABLE B.6.—*Chemical High Explosives, Class Divisions, and Constituents, Continued*

Chemical High Explosive	UN Hazard/Class Division	Constituents
Tetrytol	1.1	Tetryl (70) TNT (30)
Trinitrotoluene (TNT)	1.1	Trinitrotoluene (TNT)
X-0298	1.1	HMX (97.5) Tufflo Process Oil 6026 (1.38) Kroton G1650 Thermoplastic Rubber
X-0407	1.1	TATB (69.8) KELl-F 800 (5.0) PETN (25.0) Linol Blue (0.2)
XTX 8004	1.1	RDX (80) Sylgard 182 (20)
Zirconium powder	1.3	Zirconium powder

TABLE B.7.—*Mock High Explosives and Constituents*

Mock High Explosives	Constituents
905-03-AC	Cyanuric Acid (60) Melamine (32) Nitrocellulose (4) Tris (2)-chloroethyl Phosphate (4)
Mock 90504	Cyanuric acid (65) Melamine (24) Kel-F (11) Red Dye (0.05)
Mock LM-04-0	Cyanuric acid (59.7) Melamine (23.5) Viton (16.8)
Mock 90010	Barium nitrate (46) Penetek (48) Nitrocellulose (2.8) CEF (3.2)
NAN	Nylon (74) Aluminum (20) Thermal 9404 (6)
RM-03-AC	Cyanuric Acid (61) TALC (24) Kel-F 800 (15) Polyester Red Dye (0.01)
RM-03-AD	Cyanuric Acid (92) Kel-F 800 (8) Eastman Red Dye (0.05)
RM-04-BG	Cyanuric Acid (70.5) Barium Nitrate (14.5) Viton (15.0)
RM-952-AG	Talc (43) Melamine (50) Kel-F 800 (7)
XTX	Pentaerythritol (80) Sylgard 182 (20)

REFERENCES

1. Mason & Hanger-Silas Mason Co., Inc., *Basis for Interim Operation for the Pantex Plant, Revision 3*, Amarillo, Texas, November 1995.

2. U.S. Code of Federal Regulations, Title 29, Labor. Part 1910.119, "Process Safety Management of Highly Hazardous Chemicals, Explosives, and Blasting Agents."

3. Jacobs Engineering Group, Inc., *Hazardous Materials Hazards Assessment for the Pantex Plant, Amarillo, Texas*, Prepared in conjunction with Ogden Environmental and Energy Services Co., November 1992.

4. U.S. Code of Federal Regulations, Title 40, Protection of Environment. Part 355, "Emergency Planning and Notification."

5. Jacobs Engineering Group, Inc., *Chemical High Explosives Hazards Assessment for the Pantex Plant, Amarillo, Texas*, Prepared in conjunction with Ogden Environmental and Energy Services Co., October 1993.

6. Mason & Hanger-Silas Mason Co., Inc., *Basis for Interim Operation for the Non-Nuclear Facilities*, Draft 3, Pantex Plant, Amarillo, Texas, September 1995.

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APPENDIX C
HAZARD CLASSIFICATION AND SAFETY DOCUMENTATION

Table C.1 lists the facility hazard classification and safety documentation that is currently available for facilities at Pantex Plant. The facility list is derived from the Risk Management Safety Documentation Database[1]. Safety documentation was compiled from surveys of the Battelle Pantex Risk Management Library and Battelle Columbus and Battelle Northwest Pantex-related documents. The listings also provide the dates of the latest revisions to the safety documents.

The entries in Table C.1 represent the facilities in Appendix D. The entries should not be interpreted as facilities because some facilities are entered more than once. For example, the Modified-Richmond magazines in Zone 4 are represented by four entries (4-19, 4-21, 4-25, and 4-30/44). Currently, 110 entries are Low and Moderate Hazard facilities with a "U" for unusual hazards. These 110 entries also represent additional facilities that have been added due to construction (such as Buildings 11-55 and 16-16). The description of the information in the columns is given as:

BUILDING: A unique identifier for each moderate or low risk facility at Pantex Plant.

DESCRIPTION: A description of the facility's function.

TYPE: A designation of the type of material handled in the facility. High explosive (HE), nuclear material (NM), nuclear explosives (NE), or support (SU).

FUNCTION: A designation of the function of the facility. Operations (OPS), processing (PRO), staging (STA), test and evaluation (T/E), shops(SHP), utility (UTL), security (SEC), or administration (ADM).

USE: A designation whether facility is a hazard commonly (C) encountered and accepted by the public or an hazard uncommonly (U) encountered.

1027 RANK: Facility risk code based upon "Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports"[2].

PNL RANK: Facility risk code based upon the PNL methodology.

PHA COMP: The date that the Preliminary Hazard Analysis (PX-1245 form) was completed.

PHA APPROVED: The date that the Preliminary Hazard Analysis (PX-1245 form) was reviewed and the Risk Code was determined.

ABDS APPROVED: Approved Authorization Basis Documentation Summary. The date the ABDS was reviewed and approved. An "SA" in this column indicates the existence of a safety assessment for the associated facility.

SAR APPROVED: Approved Safety Analysis Reports. The date that the SAR was reviewed and approved. An "SA" in this column indicates the existence of a safety assessment for the associated facility.

TABLE C.1.—*Facility Hazard Classification and Safety Documentation*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
04-002	BUS STOP	SU	ADM	C		4			921207	
04-004	DATA COLLECTION	SU	UTL	C		4				
04-019	MAG MOD RICH	NM	STA	U	2	2	921118	921118	931222	921221
04-020E	EQUIP BLDG	SU	UTL	C		4				
04-021	MAG MOD RICH	NM	STA	U	2	2	921118	921118	931222	921221
04-022-24	MAG STORAGE	SU	STA	C		4				
04-025	MAG MOD RICH	NM	STA	U	2	2	921118	921118	931222	921221
04-026	LOADING BLDG	NE	OPS	U	2	2	921118	921118	931222	
04-027	MAG STORAGE (JTA)	SU	STA	C		3	901119	940222		
04-028	MAG STORAGE	SU	SHP	U		2	921106	921118		
04-029	MAG STORAGE (JTA)			C			901115	940222		
04-030/44	MAG MOD RICH	NM	STA	U	2	2	921118	921118	931222	921221
04-045	SNL MAG STORAGE	HE	STA	U		2	921106	921119	921106	
04-046/75	MAG SAC	HE	STA	U		2	921106	921119	921106	
04-050	MAG STORAGE RAD.	HE	STA	U		2	921106	921119	921106	
04-056	MAG STORAGE RAD.	NM	STA	U		2	921106	921119	921106	
04-070	AMMUNITION STOR.	SU	UTL	C		4	921106	921119	921207	
04-101/142	MAG SAC	NE	STA	U	2	2	921119	921119	931222	921221

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
04-143	GRD TWR RED 3	SU	SEC	C		3	901227	940222		
04-144	GRD TWR RED 4	SU	SEC	C		3	901227	940222		
04-145	GRD STAT #30	SU	SEC	C		3	901227	940222		
04-145A	GRD STAT#30 ADD	SU	SEC	C		3	910125	940222		
04-146	RESTROOM	SU	ADM	C		4				
04-147	GENERATOR BLDG	SU	UTL	C		4				
04-148	ZONE-4 GARAGE	SU	STA	C		4				
FS-001A	OFFICES	SU	ADM	C		4				
FS-001P	EMER PWR	SU	UTL	C		4				
FS-002	MAG STORAGE	HE	STA	U		2	921106	921118	921104	
FS-003	MAG STORAGE	HE	STA	U		2	930512	940124	921203	
FS-004	EXP TEST FIRE FAC	HE	T/E	U		2	930512	940124	921203	
FS-004A	VAC BLDG	SU	UTL	C		4				
FS-005	TEST FIRE FAC.	HE	T/E	U		2			921203	
FS-005A	VAC BLDG	SU	UTL	C		4				
FS-008	MAG INERT STOR	SU	STA	C		4				
FS-010	FS	HE	T/E	U		2	921106	921118	921104	
FS-010A	SHOP	SU	SHP	C		4	921106	921109		

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
FS-010B	STORAGE BLDG	SU	STA	C		3	921106	921118	921112	
FS-010C	HELIUM STORAGE	SU	SHP	C		4	921106	921109		
FS-011	FABRICATION	HE	OPS	U		2				770900
FS-011A	SHOT MAKE-UP FAC	HE	OPS	U		2	930512	940124	921203	770900
FS-011S	RESTROOM AND HALL	SU	UTL	C						
FS-016	HI SPEED EXP MACH	HE	T/E	U		2	921106	921118	921104	
FS-018	FS ODTX TEST FAC	HE	T/E	U		3			921104	
FS-021	TEST FIRE SITE	HE	T/E	U		2	921106	921118	921106	810500
FS-021A	TEMP. FS STORAGE	HE	SHP	U		3	921106	921118		
FS-022	EXP TEST FIRE FAC	HE	T/E	U		2	930512	940124	921203	
FS-023	EXP TEST FIRE FAC	HE	T/E	U		2	901130		921203	830900
FS-023A	TOTAL CONTAINMENT FIRING CHAMBER	SU	OPS	C		3	930512	940124	921207	830900
FS-023B	OPR & CLEANING FAC	SU	OPS	C		3	901130	940222	921203	
FS-024	EXP TEST FIRE FAC	HE	T/E	U		2	930512	940124	921203	871100
08-008	STORAGE BLDG.	SU	STA	C		4	901115	940222		
09-002	COMPUTER TRAINING			C						
09-004	EXERCISE TRAILER	SU	SEC	C		4	921112	940124		
09-005	EXERCISE TRAILER	SU	SEC	C		4	921112	940124		
09-006	EXERCISE TRAILER	SU	SEC	C		4	921112	940124		

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
09-008	GRD TOWER BLUE 9	SU	SEC	C						
09-009	GRD TOWER RED 2	SU	SEC	C						
09-010	GRD TOWER BLUE 7	SU	SEC	C						
09-011	GRD TOWER BLUE 12	SU	SEC	C						
09-012	GRD TOWER BLUE 6	SU	SEC	C						
09-013	GRD TOWER BLUE 11	SU	SEC	C						
09-013G	GRD STA GATE BN5A	SU	SEC	C						
09-014	GRD TOWER BLUE 8	SU	SEC	C						
09-015	GRD STATION 88A	SU	SEC	C						
09-016	PORTABLE BLDG			C						
09-020	OFFICE SPACE			C						
09-021	SECURITY TRAINING	SU	ADM	C		4	921105	940124		
09-022	GRD STATION	SU	SEC	C						
09-023	GRD STATION	SU	SEC	C						
09-029	SWAT TRAILER	SU	SEC	C		3	901227	940222		
09-030	STRESS TRAINING	SU	OPS	C						
09-043	FD STORAGE TRAILER	SU	OPS	C						
09-044	FD STORAGE TRAILER	SU	OPS	C						
09-049	SECURITY TRAINING	SU	ADM	C		4	921105	940124		

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
10-002	SECURITY TRAINING	SU	SEC	C		4	901228	940222		
10-007	WAREHOUSE	SU	STA	C		4	901205	940222		
10-009	STORAGE	SU	STA	C		4	940221	940222		
10-038	YD STOR SLAB	SU	STA	C		4	910401	940222		
11-001	EMER OPR FAC.	SU	UTL	C		4				
11-002	OFFICE	SU	ADM	C		4				
11-002E	EQUIP RM	SU	UTL	C		4				
11-005	PHYS PROP	HE	T/E	U		2	930406	930406	921113	
11-007N	PROD STOR	SU	STA	C		3	901204	940222		
11-009	PAINT SHOP	SU	SHP	C		4				
11-009N	WASTE STORAGE	SU	STA	U		3	931122	940124		
11-009S	SANITIZATN. DEMIL.	NM	OPS	U		4	930113	930114		
11-010	OXID STOR	SU	STA	C		3	901127	940222	921112	
11-014	MACH OPNS	SU	PRO	C		4	921106	940124	921112	861100
11-014E	EQUIP RMS	SU	UTL	C		4				
11-014E1	MECHANICAL RM	SU	UTL	C		4				
11-014E2	MECHANICAL RM	SU	UTL	C		4				
11-015	OFFICES	SU	ADM	C		4	921029	940124	921112	
11-015A	OCC. TRANSIENT STOR	HE	PRO	U		4	901125	940222	921112	

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
11-015B	CONTROL ROOM	SU	ADM	C		4				
11-016	HE TEST FAC. (OVEN)	HE	T/E	U		2	921030	940124	921113	
11-017	CHEM LAB	HE	T/E	U		2	930310	940124	921106	
11-017A	HE STOR	HE	STA	U		3	930310	940124	921106	
11-018	EXPLOSIVES TESTING	HE	T/E	U		2	921106	921118	921112	
11-019	INERT STORAGE	SU	STA	C		4				
11-020	PRESS/MOLDING	HE	PRO	U		2	930224	940124	921111	750900
11-020E	EQUIP ROOM	SU	UTL	C		4				
11-020E1	MECHANICAL ROOM	SU	UTL	C		4				
11-020E2	MECHANICAL ROOM	SU	UTL	C		4				
11-021	EQUIP ROOM	SU	UTL	C		4				
11-021B	BOILER	SU	UTL	C		4				
11-022	PART CHAR	HE	T/E	U		3	921030	940124	921112	
11-023	HE STAG.-SYNTHESIS	HE	STA	U		2	930315	940124	921112	
11-024	EQUIP STORAGE	SU	STA	C		4				
11-025	MAG SERVICE	HE	STA	U		3	921030	940124	921113	
11-026	STORAGE	SU	STA	C		4				
11-027	OFFICES	SU	ADM	C		4				
11-028	EXPEDITERS OFFICE	SU	ADM	C		4				

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
11-029	PHOTO LAB	SU	ADM	C		4				
11-030	SEC SUPP	SU	ADM	C		4				
11-034	HE SYNTH/ACID STOR	SU	STA	C		3	930316	940124	921112	
11-036	HE SYNTH	HE	PRO	U		2	930315	940124	921112	751200
11-036B	STEAM BOILER	SU	UTL	C		4				
11-037	EXP STORAGE	HE	STA	U		2	930406	940124	921111	
11-038-1	PROJECTILE IMPACT	HE	T/E	U		2	921106	940124	921113	861100
11-038-2	EXP DEV	HE	T/E	U		2	921106	940124	921112	861100
11-038-3	EXP DEV	HE	OPS	U		2	940216		921112	861100
11-038/P	SOLVENT STOR. PAD	SU	SHP	C		3	921030	940124		
11-039	FLAM LIQ STOR	SU	STA	C		3	930315	940124	921112	
11-040	GRD STAT #3	SU	SEC	C		3	901227	940222		
11-041	COMPRESSOR STA	SU	UTL	C		4				
11-042	SERVICE MAG	HE	STA	U		2	921106	940124	921112	
11-043	BOILER	SU	UTL	C		4				
11-044	HE FILTER FAC	HE	OPS	C		4				
11-045	HE STORAGE FAC	HE	STA	U		3	921030	940124	921112	
11-046	STORAGE FAC	HE	STA	U		3	921106	921231	921112	

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
11-047	RESTROOM	SU	UTL	C		4				
11-048	SHOP BATT	SU	SHP	C		4				
11-049	RESTROOM	SU	UTL	C		4				
11-050	HE MACH	HE	PRO	U		2	920724	940124	921113	840800
11-051	ANALYTICAL LAB	HE	T/E	U		2	921030	940124	921112	820300
11-053	RESTROOM	SU	UTL	C		4				
11-054	OFFICES	SU	ADM	C		4				
11-054A	OFFICES	SU	ADM	C		4				
11-055	HE SYNTHESIS	HE	PRO	U		2				910400
12-001	CHG HSE/CU	SU	ADM	C		4				
12-001A	LAUNDRY	SU	OPS	C		4				
12-002	GUARD STATION	SU	ADM	C		4				
12-002A	INDUST. HYGIENE LAB	SU	T/E	C		3	940221	940222	921203	
12-002B	INDUST. HYGIENE OFF	SU	ADM	C		4				
12-003	OFFICES	SU	ADM	C		4	416.0000			
12-003P	GENERATOR	SU	UTL	C		4	404.1333			
12-004	BOILER HSE	SU	UTL	C		4	404.1231			

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
12-004S	ELECT SUB	SU	UTL	C		3		940222	921203	
12-005	WHSE	SU	STA	C		4				
12-005A	WHSE	SU	STA	C		4				
12-005B	WHSE	SU	STA	C		3	901127	940222		
12-005C	SHOPS	SU	SHP	C		4				
12-005E	EQUIP RM	SU	UTL	C		4				
12-005G	STOR SHEDS	SU	STA	C		4				
12-005G1	STORAGE SHED	SU	STA	C		4				
12-005G3	STORAGE SHED	SU	STA	C		4				
12-005G4	WHSE NONF STORAGE	SU	STA	C						
12-006	OFFICES	SU	ADM	C		4				
12-006A	OFFICES	SU	ADM	C		4				
12-006B	OFFICES	SU	ADM	C		4				
12-006BE	EQUIP RM	SU	UTL	C		4				
12-006S	ELECT SUB	SU	UTL	C		4				
12-007	OFFICES	SU	ADM	C		4				
12-008	CHEM LAB AN	HE	T/E	U		2	921105	930105	921203	
12-009	TESTER,GAGING AND MACHINING	SU	SHP	C		4				

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
12-009A	INERT MACH	SU	SHP	C		4				
12-009S	ELECT SUB	SU	UTL	C		4				
12-010	PAINT, CRAFT,DRY AIR	SU	UTL	C		4				
12-011	METROLOGY	SU	T/E	C		4				
12-011A	OFFICES	SU	ADM	C		4				
12-012	CLASS DOC	SU	STA	C		4				
12-013	INCINERATOR	SU	OPS	C		4				
12-014	OFFICES	SU	ADM	C		4				
12-015	T&TD	SU	ADM	C		4	921023	930329		
12-015A	TRAINING FACILITY	SU	ADM	C		4	921023	930329		
12-016	PLASTIC SHOP	SU	SHP	C		4				
12-016A	STORAGE	SU	STA	C		4				
12-016B	STORAGE	SU	STA	C		4				
12-017	HE OPS	HE	OPS	U		2	930416	940124	921203	
12-017A	PRESS BAY	HE	PRO	U		2	930416	940124	921203	
12-017B	PRESS BAY	HE	PRO	U		2	930416	940124	921203	
12-017C	CLNG TWR	SU	STA	C		4				
12-017E	EQUIP ROOM	SU	UTL	C		4				

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
12-017F	FAN ROOMS	SU	UTL	C		4				
12-017S	ELECT SUB	SU	UTL	C		4				
12-017-9	BAY 9 X-RAY	HE	T/E	U		3	921109	940124		
12-018	BATTERY CHG	SU	SHP	C		4				
12-019E	EQUIP ROOM	SU	UTL	C		4				
12-019EA	HE FORMULATION	HE	PRO	U		2	921030	940124	921112	
12-019F	FAN ROOMS	SU	UTL	C		4				
12-019P	STORAGE TANK FOR RECOVERED SOLV.	SU	STA	C		4	921030	940124		
12-019WE	MATERIAL COMPAT.	HE	T/E	U		3	921113	940124	921203	
12-020	EMER POWER	SU	UTL	C		4				
12-021	GAS LAB (NDE)	HE	T/E	U		2	921106	940124	921111	
12-021A	EQUIP ROOM (NDE)	SU	UTL	C		4				
12-021NDE	NON-DES. EVAL.	HE	T/E	U		2	921109	940124	921203	731000
12-022	BREAK ROOM	SU	ADM	C		4				
12-023	INERT STORES	SU	STA	C		4				
12-024A	PROD SUP (EXP MACH)	SU	STA	C		4				

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
12-024E	EQUIP RM (EXP MACH)	SU	UTL	C		4				
12-024NO	HE MACH	HE	PRO	U		3	921102	940124	921203	
12-024SO	PROD SUP (EXP MACH)	SU	OPS	U		3	940406	940413	921203	
12-025	SOLVENT STORAGE	SU	STA	C		3	921214	940124	921203	
12-026	ASSEMBLY BLDG. BAYS 27 & 28	NE	T/E	U	2	2	930402	931109	931112	
12-026	ASSEMBLY BLDG. BAYS 22 & 26	HE	T/E	U		3	921231	940124		
12-026E	EQUIP ROOM	SU	UTL	C		4				
12-026PV	PIT VAULT	NM	STA	U	2	3	921030	940124	931112	800100 SA
12-026S	ELECT SUB	SU	UTL	C		4				
12-026WH	TOOLING WHSE	SU	STA	C		4				
12-027	CONF. ROOM	SU	ADM	C		4				
12-028	OFFICES	SU	ADM	C		4				
12-030	BREAK ROOM	SU	ADM	C		4				
12-031	HE SUB ASSY FAC.	HE	OPS	U		2	930929	940124	921203	
12-032	HE SUB ASSY FAC	SU	OPS	U		3	930928	940124	921203	741100
12-033	HE SUB ASSY FAC	HE	OPS	U		3			921203	

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
12-034	FLAMMABLE STORAGE	SU	STA	C		3	940221	940222		
12-035	MAINT SHOP	SU	SHP	C		4				
12-035A	OIL STOR BLDG	SU	STA	C		3	940221	940222		
12-035P	GENERATOR	SU	UTL	C		4				
12-036	OFFICES	SU	ADM	C		4				
12-036A	EOC	SU	ADM	C		4			921203	
12-036P	GENERATOR	SU	UTL	C		4				
12-036S	GENERATOR	SU	UTL	C		4				
12-037	CNTRL COMPUTER FAC	SU	ADM	C		4				
12-037A	CNTRL COMPUTER FAC	SU	ADM	C		4				
12-037E	CNTRL COMPUTER FAC	SU	ADM	C		4				
12-037EQ	CNTRL COMPUTER FAC	SU	UTL	C		4				
12-038	SOLV STOR	SU	STA	C		4				
12-039	FIRE STATION	SU	OPS	C		3			921111	
12-039A	FIRE STATION	SU	OPS	C		3			921111	
12-041	PAINT SHOP	NE	OPS	U		2	930519	931109	931112	
12-041A	COMP. PROC. FAC	SU	STA	C		4	921209	940124	921203	
12-042	BUY BACK OPERATION	SU	STA	C		3	901204	940222		

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
12-042A	SANDIA	HE	T/E	U		3			921203	
12-042B	SANDIA PARA RMS	SU	T/E	U		3			921203	
12-042C	SANDIA BOOM RM	HE	T/E	U		3			921203	
12-042F	SANDIA CENTRI	SU	T/E	U		3			921203	
12-042NV	NORTH VAULT RTG	NM	STA	U	2	3	921030	921111	921112	
12-042SV	SOUTH VAULT SRO	NM	STA	U	2	2	921030	921123	931112	860800
12-042CO M	COMPACTION FAC.	NM	STA	U		3	921028	940124		
12-043	HE PROC. WAT. FILTER	HE	OPS	U		3	921102	940124	921203	
12-043A	STORAGE	SU	STA	C		4				
12-044	ASSEMBLY CELLS 1-6	NE	OPS	U	2	2	921104	940124	931112	810300
12-044E	OFFICE	SU	ADM	C		4				
12-044EA	EQUIP ROOM	SU	UTL	C		4				
12-044-8	SNM STAGING CELL 8	NM	STA	U	2	3	921105	940124	931112	950228
12-045	STORAGE	SU	STA	C		4				
12-046	RESTROOMS	SU	ADM	C		4				
12-047	STORAGE BLDG (MISC)	SU	STA	C		3	901203	940222	921203	
12-048	MAINT. REPAIR & STO.	SU	STA	C		4				
12-049	MAINT FAC	SU	SHP	C		4				
12-050	SEP TEST FAC	HE	T/E	U	2	2	921029	921123	931112	

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
12-050E	EQUIP ROOM	SU	UTL	C		4				
12-051	SOLVENT STORAGE	SU	STA	C		4				
12-052	METROLOGY LAB	SU	T/E	C		3	940221	940222		
12-052AE	EQUIP ROOM	SU	UTL	C		4				
12-052A&B	INERT GAUGING (MET)	SU	T/E	C		4				
12-052E	EQUIP ROOM	SU	UTL	C		4				
12-053	METROLOGY MAA LAB	SU	T/E	C		3	940216	940222		
12-053E	EQUIP RM	SU	UTL	C		4				
12-055	PROD STAGING	HE	STA	U		2	921109	940124	921203	
12-056	RADIOGRAPHY FAC	HE	T/E	U		3	940228	940302	921203	
12-056E	EQUIP ROOM	SU	UTL	C		4				
12-057	STORAGE	SU	STA	C		4				
12-058-1	MAG BAY 1 & 2	HE	STA	U		2	921030	931123	921203	860700
12-058-3	BAY 3	NM	T/E	U		2	921123	931123	921203	860700
12-058-4	BAYS 4-5	NM	STA	U	2	2	921030	931123	931112	860700
12-059	CHEM LAB	HE	T/E	U		3	921105	940124	921203	
12-059E	EQUIP RM	SU	UTL	C		4				
12-060	MASS PROP. FAC	HE	T/E	U	2	2	921029	931109	931112	

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
12-060E	VAULT RM (COMPUTER)	SU	UTL	C		4	921029	940124		
12-061	REC.,SHIP., & OFFICE	SU	STA	C		4				
12-062	PETN PROC	HE	PRO	U		3	930416	940124	921203	830300
12-063	PRESS HE	HE	PRO	U		2	930416	940124	921203	801200
12-063-2,3	PRESS HE	HE	PRO	U			930410	940124	921203	
12-064	ASSY BAY	NE	OPS	U	2	2	921105	931109	931112	
12-064A	OFFICE/RESTROOM	SU	UTL	C		4				
12-064E	EQUIP ROOM	SU	UTL	C		4				
12-065	MAG HE	HE	STA	U		2	921106	940124	921112	810200
12-066	WAREHOUSE	SU	STA	C		4				731100
12-067	PETRO STOR	SU	STA	C		3	901128	940222	921203	
12-068	TOOL SHOP	SU	SHP	C		3	901128	940222		
12-068A	MET TOOLING FAC	SU	T/E	C		4				
12-069	OFFICES	SU	ADM	C		4				
12-069E	EQUIP ROOM	SU	UTL	C		4				
12-070	CAFETERIA	SU	OPS	C		4				
12-071	EXP STOR & PACK	HE	OPS	C		3	921030	921231		840400
12-072	OFFICES	SU	ADM	C		4				

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
12-073	HE DECON	HE	OPS	U		2	921106	940124	921112	
12-074	GRD TWR BLU 3	SU	SEC	C		3	901227	940222		
12-075	SEC COM CENTER	SU	SEC	C		3	921106	940124	921203	
12-075A	SECURITY TRAINING	SU	ADM	C		4	921106	940124		
12-075B	SEC. COMM. EXPAN.	SU	SEC	C		4	931027	940124		
12-075G	GENERATOR BLDG	SU	UTL	C		4				
12-076	FUEL STORAGE TANK	SU	STA	C		3	940218	940222	921112	
12-076A	PUMP HOUSE	SU	UTL	C		3			921203	
12-078	HE DRILLING	HE	PRO	U		4	921110	940124	921203	840300
12-079	WAREHOUSE	SU	STA	C		4				
12-080	WAIT BLDG	SU	ADM	C		4				
12-081	BATTERY ROOM	SU	SHP	C		4				
12-082	WAREHOUSE E-BAY	SU	T/E	C		3	921105	940124		
12-083	MAG HE	HE	STA	U		2	921106	940124	921112	830600
12-084	ASSY BAY	NE	OPS	U	2	2	921106	940124	931112	840300
12-084A	ADDENDUM TO 12-084			U			921106	940124	931112	860100
12-084-1 4	BAY 14 LASER SAMP	NM	T/E	U		3	921109	940124		840300
12-084R AD	BAYS 1 & 10 RADIOG	NE	T/E	U		2	921109	940124		840300

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
12-085	ASSY CELL	NE	OPS	U	2	2	921105	940124	931112	840100
12-086	INERT ASSY	HE	OPS	U		2	921105	940124	921203	871200
12-086/10+	INERT PIT REUSE	SU	OPS	C		3	940331	940523		
12-087	GRD TWR BLU 5	SU	SEC	C		3				
12-088	GRD TWR BLU 4	SU	SEC	C		3	901227	940222		
12-089	GRD TWR BLU 2	SU	SEC	C		3	901227	940222		
12-090	GRD STATION #26	SU	SEC	C		3	910125	940222		
12-090A	GRD STN #26 ADD	SU	SEC	C		3	901126	940222		
12-091	DATA COLLECTN	SU	UTL	C		4				
12-092	HE SERVICE MAG	HE	STA	U		2	921105	940124	921203	840100
12-093	EQUIPMENT STORAGE	SU	STA	C		4	921113	940124	921113	
12-094	AGING WEAPONS	NE	T/E	U	2	2	921106	940124	931112	840300
12-095	CLASS C STO & PACK	HE	OPS	U		3	921030	921231	921203	830800
12-095-2	OFFICE	HE	STA	C		4				830800
12-096	ASSY CELL	NE	OPS	U	2	2	921105	940124	931112	840100
12-097ABC	OFFICES	SU	ADM	C		4				
12-098	ASSY CELLS	NE	OPS	U	2	2	921105	940124	931112	860400
12-098E1	EQUIP RM	SU	UTL	C		4				

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
12-111	CARPENTER	SU	SHP	C		4				
12-112	SEC SHOP	SU	SHP	C		4				
12-113	RAT OPS CENT	SU	ADM	C		4				
12-114	GRD S MAA PORTAL	SU	SEC	C		4				
12-115	GRD N MAA PORTAL	SU	SEC	C		3	901227	940222		
12-116	SNM STAGING	NM	STA	U		3				
12-116R	RADIOLOGY & RADMTR	HE	T/E	U		2				890400
12-117	WEAPON TRANSFR STN	NE	OPS	U		2				890400
12-118	WHSE	SU	STA	C		2				
12-119	GRD STAT #28	SU	SEC	C		4				
12-120	GRD STAT #20	SU	SEC	C		3	901227	940222		
12-120A	GRD STAT #20 ADD	SU	SEC	C		3	901227	940222		
12-121	HE MACHINING FAC	HE	PRO	U		3				
12-122	RAD MON/CALBRATION	SU	T/E	C		3	930326	940124		890100
12-124	GRD STAT #88	SU	SEC	C		3	930217	940124	921203	
12-126	ALT COMMAND POST	SU	SEC	C		3				
12-127	OFFICE BUILDING	SU	ADM	C		4	931026	940124		
13-041	CONTROL BLDG	SU	UTL	C		4	930201	930201		
13-042	CHLORINATG BLD	SU	UTL	C		4				

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
12-098E2	EQUIP BLDG	SU	UTL	C		4				
12-099	ASSY BAY	NE	OPS	U	2	2	921103	940124	931112	860300
12-099-9	BAY 9 ENVIR TEST	HE	T/E	U		3	921109	940124		
12-100	OFFICES	SU	ADM	C		4				
12-101	OFFICES	SU	ADM	C		4				
12-102	OFFICES	SU	ADM	C		4				
12-103	CAFETERIA	SU	OPS	C		4				
12-104	ASSEMBLY/DISASSE	NE	OPS	U	2	2	921105	921123	931115	880900
12-104A	SPEC PURPOSE BAYS	NE	OPS	U	2	2				880700
12-104P1	GENERATOR BLDG	SU	UTL	C		4				
12-104P2	GENERATOR BLDG	SU	UTL	C		4				
12-105	COND RTN	SU	UTL	C		4				
12-106	OFFICES	SU	ADM	C		4				
12-106A	OFFICES	SU	ADM	C		4				
12-107	OFFICES	SU	ADM	C		4				
12-108	GENERATOR	SU	UTL	C		3	901126	940222	921203	
12-109	EQUIP RM	SU	UTL	C		4				
12-110	PAINT SHOP	SU	SHP	C		4				

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
13-043	DIGESTER	SU	UTL	C		4				
13-044	PRIM CLARIFIER	SU	OPS	C		4				
13-045	FILTERS	SU	UTL	C		4				
13-046	FIN CLARIFIER	SU	UTL	C		4				
13-047	SEWER CONTROL	SU	UTL	C		4				
15-001	STORAGE	SU	STA	C		4				
15-006	WATER WELL BLD	SU	UTL	C		4				
15-012	PMP STAT#1/CHLOR	SU	UTL	C		4				
15-013	SEC TRAIN FAC	SU	SEC	C		4				
15-014	WATER RESVR #1	SU	UTL	C		4	921105	940124		
15-016	WATER WELL	SU	UTL	C		4				
15-017	WATER WELL	SU	UTL	C		4				
15-020	WATER WELL BLDG	SU	UTL	C		4				
15-021EA	WATER TNK #1	SU	UTL	C		4				
15-022W E	WATER TNK #2	SU	UTL	C		4				
15-024	FIRE WATER	SU	UTL	C		4	940217	940222	921111	
15-024A	FIRE PMP STA	SU	UTL	C		4	930412	940124	921111	
15-025	FIRE WATER	SU	UTL	C		4	940217	940222	921111	

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
15-025A	FIRE PMP STA	SU	UTL	C		4	930412	940124	921111	
15-026	WATER WELL BLDG	SU	UTL	C		4				
15-027	PUMP HOUSE	SU	UTL	C		4	930408	940124	921203	
15-028	WATER RESVOR	SU	UTL	C		4				
15-029	CHLOR BLDG	SU	UTL	C		4				
16-001	VEH MAINT FAC	SU	OPS	C		4				
16-002	OPER FAC	SU	SEC	C		3				
16-003	GRD STAT #7	SU	SEC	C		3	901227	940222		
16-004	BLAST/PAINT BLD	SU	SHP	C		4				
16-005	TOOLING STORAGE	SU	UTL	C		4	930310	930311		
16-006	PANTEX TST RNG	SU	T/E	C		4				
16-007	RANGE 1	SU	SEC	C		3	921103	930308		
16-008	FIRE TST/TRNG	SU	T/E	C		4				
16-009	GRD E STAT #9	SU	SEC	C		3	901227	940222		
16-010	VEH WASH BLDG	SU	OPS	C		4				
16-010A	RR STORAGE	SU	STA	C		4				
16-010E	VEH WASH EQUIP	SU	OPS	C		4				
16-011	GRD W STA #6	SU	SEC	C		3	901227	940222		

TABLE C.1.—*Facility Hazard Classification and Safety Documentation (Continued)*

BLDG	DESCRIPTION	TYPE	FUNC	USE	1027 RANK	PNL RANK	PHA COMP	PHA APPVD	ABDS APPVD	SAR APPVD
16-012	SERVICES FAC	SU	ADM	C		4				
16-013	BOILER FAC	SU	UTL	C		4				
16-014	YARD STORAGE	SU	STA	C		4				
16-015	VMF/COF BOILER	SU	UTL	C		4	940219	940222		
16-016	RCRA HW STO FAC	SU	STA	U		3	931122	940124		940304
16-018	STORAGE	SU	SEC	C						
16-019	CENT. SHIP. & REC.	SU	SHP	C		3	921106	921203		
16-020	PESTICIDE WASHDOWN	SU	UTL	C		3				
16-021	AMMUNITION STORAGE	SU	SEC	C		3				
16-022	RADIO SHOP	SU	T/E	C						
16-023	BULK STORAGE WHSE	SU	STA	C						
16-024A -F	WEAP. TAC. & TRAIN	SU	SEC	C		3	930520	940124		

REFERENCES

1. *Pantex Risk Management Safety Documentation Database*, Pantex Plant, Amarillo, Texas.

2. DOE, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, DOE-STD-1027-92, U.S. Department of Energy, December 31, 1992.

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APPENDIX D
SUMMARY INFORMATION ON PANTEX FACILITIES

Appendix D provides a brief description of each current and planned facility at Pantex Plant.

Zone 4

Bus Stop - Empty Shed, 4-2

This is a 1.8 m (6 ft) by 3.1 m (10 ft) enclosed aluminum shed that is empty. No PX-1245 is required.

Data Collection Building, 4-4

The facility houses equipment for the collection of data related to security activities in Zone 4.

Magazines - Storage, 4-19, 21, 25, 30 - 44, & 101 - 142

The modified-Richmond magazines (4-19, 4-21, 4-25, 4-30 to 4-44) are used for staging of pits, secondaries, weapon assemblies, containerized weapons components, reservoirs, and cases. The 4-21 facility is currently being used as a training facility for the Stage Right project. Only empty pit cans and steel pallets are used in the facility. The Steel Arch Construction (SACs) (4-101 to 4-142) magazines are used for staging of weapon assemblies, containerized weapons components, pits, ORO components, reservoirs, and cases. Now that the Zone 4 EA is approved and the ORR/ORE process is completed, the other magazines will be identical to the 4-21 magazine.

Equipment Room, 4-20E

The facility houses equipment for heating and cooling of adjacent facilities in Zone 4. There are small quantities of water treatment chemicals, but otherwise no uncommon hazards are present.

Magazine - Ammunition Storage, 4-22, 23 & 24

The 4-22 magazine is used for the storage of ammunition for security forces. All material is Class C. The 4-23 magazine is used for the storage of dunnage for the Safe Secure Trailers. The 4-24 magazine is being used for inert storage of shipping materials (pallets). There are no uncommon hazards associated with this material.

Loading Building, 4-26

The facility is used for safeguards verification (radiometric inspection) of units being moved and the loading of railcars. The facility may have up to 20 kg (44.1 lb) of SNM and 907 kg (2,000 lb) of HE at any one time.

Magazine - Storage, 4-27 & 29

The 4-27 and 4-29 magazines is used for the storage of operating material. There are no uncommon hazards associated with this material.

Magazine - Storage, 4-28

The facility is being used for the storage of security material and PCB oil.

Magazine - Storage, 4-45

The facility is operated by SNL and used for the storage of special purpose test equipment not currently in use. There are no uncommon hazards associated with this use.

Magazines - Storage, 4-46 - 49, 51 - 55, 57 - 69, & 71 -75

The magazines are used for the storage of explosives (HE and IHE). Quantities of HE may vary with upper limits being 22,680 to 36,288 kg (50,000 to 80,000 lb) depending upon the magazine used. IHE limits are 90,720 kg (200,000 lb) for all magazines listed.

Magazine - Storage, 4-50

This facility is used for receiving, staging or interim storage, retrieving, and shipment of hazardous/mixed wastes offsite for treatment/disposal. Additionally, inspection, inventory, and recordkeeping activities are performed periodically.

Magazine - Storage, 4-56

This facility is used for receiving, staging or interim storage, retrieving, and shipment of low-level radioactive wastes for offsite treatment/disposal. Additionally, inspection, inventory, and recordkeeping activities are performed periodically.

Magazine - Ammunition Storage, 4-70

The facility is used for the storage of ammunition for security forces. All material is Class C.

Red 3 Tower, 4-143

Because there are weapons present (sidearms and rifles) there is a potential for worker death in the event of an accident.

Red 4 Tower, 4-144

Because there are weapons present (sidearms and rifles) there is a potential for worker death in the event of an accident.

Guard Station 30, 4-145 & 145A

The facility provides protection from the weather and potential hostile activity and controls access to Zone 4. There are firearms present (rifles and sidearms) and thus there is a potential for worker death in the event of an accident.

Restroom, 4-146

The facility may contain small amounts of cleaners required for maintenance, but there are no uncommon hazards.

Generator Building, 4-147

The facility houses an 800 kW emergency power generator (V-12 diesel) with up to 9,841 liters (2,600 gal) of fuel in the day tank.

Zone 4 Garage, 4-148

The facility is used for storage of vehicles and equipment. There are no uncommon hazards associated with this operation.

Zone 5

Test Fire Administration & Support Facility, FS-1A

The facility is used to provide administrative services to the test fire operations and limited fabrication shop support. The usual cleaners, copier supplies, and other equipment, associated with the administrative activities are present. The support activities require hand power tools and calibration equipment, but there are no uncommon hazards associated with the activities.

Emergency Power, FS-1P

This facility contains a generator to provide area security lighting. It poses no unique hazards.

Storage Magazine for Material, FS-2

The facility is used to store up to 45.4 kg (100 lb) of high explosives (227 kg or 500 lb IHE) for test fire operations.

Detonator Storage, FS-3

The facility is used to store detonators for use at the test fire facility. The materials are all Class C (1.4) stored in non-propagating containers.

Explosive Test Fire Facility, FS-4

The facility may handle up to 113 kg (250 lb) HE or 147 kg (325 lb) IHE during firing operations.

Vacuum Pump Building for Hydro Firing, FS-4A

The facility contains vacuum pumps and motors and methane supplies for test operations.

Test Fire Facility, FS-5

The facility is not in service.

Vacuum and Methane Building, FS-5A

The facility is not in service.

Storage Building, FS-8

The facility is used only for storage of inert material used in test fire operations.

Firing Bunker, FS-10

The facility is used for test fire operations and may have up to 113 kg (250 lb) HE or 147 kg IHE (325 lb).

Storage and Workshop, FS-10A

The facility is used to build test stands and other non-explosive items for test fire operations.

Storage Building, FS-10B

The flammable storage facility is used to store paints, solvents, and lubricants used in test fire operations.

Helium Storage, FS-10C

This facility provides storage of high pressure helium cylinders for use with high-speed cameras. This facility poses no unique hazards.

Fabricator, FS-11

This facility consists of three earth-covered bays used for test fire assembly and staging. The maximum explosive limits are 181 kg (400 lb) for all three bays and 102 kg (225 lb) for each bay.

Explosive Test Fire Processing Facility, FS-11A

The facility is used for test fire shot preparations (i.e., detonator installation, gaging, application of light enhancing material). It may have up to 102 kg (225 lb) HE (132 kg [290 lb] IHE) per bay or a combined total of 181 kg (400 lb) HE (236 kg [520 lb] IHE).

Restroom and Hall, FS-11S

The facility may contain small amounts of cleaners required for maintenance, but there are no uncommon hazards.

High Speed Machining of Explosives, FS-16

The facility is used for machining of explosives under worst case conditions, i.e., dry overspeed, overly high feed rates, etc. These operations are conducted by remote control from FS-21.

Firing Site ODTX Test Facility, FS-18

This facility is used for ODTX (one dimensional timed explosive) testing of explosives by the process of heating the explosive charges to the point of detonation. The presence of HE and heat sources are potential hazards.

Test Fire Site, FS-21

The facility is used for testing explosive components and as the remote control point for FS-16. However, the site may have up to 17 kg (38 lb) HE (23 kg [50 lb] IHE) present at any given time.

Temporary Firing Site Storage, FS-21A

This facility is used for storage of test fires (explosive devices) during operating hours only.

Explosive Test Fire Facility, FS-22

The facility is used for testing explosive components and may have up to 136 kg (300 lb) HE (177 kg [390 lb] IHE) present at any given time.

Explosive Test Fire Facility, FS-23

The facility is used for test firings requiring total containment of the blast and detonation products. The facility includes the firing chamber and an operations and cleanup area. There may be up to 5.1 kg (11.2 lb) of HE present on FS-23.

Total Containment Firing Chamber, FS-23A

This facility provides total containment of test shot residue from test fires. Test fire assemblies are detonated within the chamber. The performance is monitored and recorded. After the test shot, gravel, wood, and other debris are removed and packaged for special processing. Test fire residue may contain heavy metals.

Operations and Cleaning Facility, FS-23B

This facility provides a closed environment for FS-23A clean-up operations after a test shot. It also provides support for shot preparation, setup operations, and inert storage of support material. Test fire residue may contain heavy metals.

Explosive Test Fire Facility, FS-24

The facility is used as a special test facility. There may be 6.8 kg (15 lb) HE (8.9 kg [19.5 lb] IHE) in the environment room and 0.5 to 0.9 kg (1 to 2 lb) HE or 0.6 to 1.2 Kg (1.3 to 2.6 lb) of IHE in the chambers.

Zone 8

Storage Building, 8-8

The facility is used for the storage of empty boxes and museum pieces. There are no uncommon hazards associated with this operation.

Zone 9

Computer Training, 9-2

The facility is used for training in computer operations. Cleaners and copiers supplies normally associated with administrative functions are present, but present no uncommon hazards.

Physical Fitness Training, 9-4

The facility is used for physical fitness training. There are no hazards beyond those normally associated with such training, including the use of weight machines, and other equipment.

Physical Fitness Training, 9-5

The facility is used for physical fitness training. There are no hazards beyond those normally associated with such training, including the use of weight machines, and other equipment.

Physical Fitness Training, 9-6

The facility is used for physical fitness training. There are no hazards beyond those normally associated with such training, including the use of weight machines, and other equipment.

Blue 9 Tower, 9-8

Because there are weapons present (sidearms and rifles) there is a potential for worker death in the event of an accident.

Red 2 Tower, 9-9

Because there are weapons present (sidearms and rifles) there is a potential for worker death in the event of an accident.

Blue 7 Tower, 9-10

This tower is not normally manned. When it is manned, the presence of weapons (sidearms and rifles) raises a potential for worker death in the event of an accident.

Blue 12 Tower, 9-11

This tower is not normally manned. When it is manned, the presence of weapons (sidearms and rifles) raises a potential for worker death in the event of an accident.

Blue 6 Tower, 9-12

This tower is not normally manned. When it is manned, the presence of weapons (sidearms and rifles) raises a potential for worker death in the event of an accident.

Guard Station Gate BN5A, 9-13G

The facility provides protection from the weather and potential hostile activity. There are firearms present (rifles and sidearms) and thus there is a potential for worker death in the event of an accident.

Blue 11 Tower, 9-13

This tower is not normally manned. When it is manned, the presence of weapons (sidearms and rifles) raises a potential for worker death in the event of an accident.

Blue 8 Tower, 9-14

This tower is not normally manned. When it is manned, the presence of weapons (sidearms and rifles) raises a potential for worker death in the event of an accident.

Guard Station 88A, 9-15

The facility provides protection from the weather. There are firearms present (rifles and sidearms) and thus there is a potential for worker death in the event of an accident.

Portable Building, 9-16

The facility is used as a waiting station (weather protection) for employees waiting for car pool rides.

Offices, 9-20

The facility houses administrative functions for line support training, TSD training, and staff support. There are no hazards beyond those associated with administrative activities.

Security Training, 9-21

This facility is dedicated for classroom instruction for security training classes.

Guard Station 88, 9-22

The facility provides protection from the weather. There are firearms present (rifles and sidearms) and thus there is a potential for worker death in the event of an accident.

Guard Station, 9-23

Although the station is normally manned only when access is required, when it is manned, the presence of weapons (sidearms and rifles) raises a potential for worker death in the event of an accident.

SWAT Trailer, 9-29

The facility is used for storage and provides space for a classroom and SWAT planning activities. There are no uncommon hazards associated with these activities.

Stress Training, 9-30

The facility houses equipment (stress computer, projector) used in security related stress training.

Fire Department Storage Trailer, 9-43

The facility is used for storage of protective gear and uniforms. There are no uncommon hazards associated with this activity.

Fire Department Storage Trailer, 9-44

The facility is used to store protective gear, bulk quantities of AFFF fire fighting foam, and fire extinguishers.

Security Training, 9-49

The facility is dedicated to use of the security training and evaluation shooting system by the security forces department.

Zone 10

Security Training, 10-2

The facility is used for force-on-force training of security personnel. There is a potential for injury due to the nature of the training and the presence and use of blank ammunition.

Warehouse, 10-7

The facility is used for warehousing of weapon parts. There are no uncommon hazards associated with these operations.

Storage, 10-9

The facility is used for short and long term storage of miscellaneous materials. There are no uncommon hazards associated with the operation.

Building Material Storage, 10-38

This storage pad is dedicated to gravel and other construction material.

Zone 11

Emergency Operator Facility, 11-1

This facility is no longer used except for a small office that houses U.S. Army Corps of Engineers personnel. The facility poses no unique hazards.

Office, Library, Change House, 11-2

The facility houses the administrative offices, library, and change house for Zone 11. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Equipment Room, 11-2E

The facility houses air handling equipment (chillers, dryers, air conditioner) for heating and cooling of 11-2. The hazards are those normally associated with mechanical equipment rooms, especially rotating machinery.

Physical Property Testing, 11-5

This multi-bay facility is used to determine the physical properties of high explosives. Bay 2 is used for mechanical shock testing of materials.

There are adhesives, cleaners, and epoxies present in various quantities.

Storage Pad, 11-7N

The storage pad is an above grade permitted concrete facility used to repackage and stage wastes pending offsite disposition.

Shop, 11-9

The shop is used for reprocessing of roadables, thus there are limited quantities of paints and solvents present.

Sanitization Demilitarization Facility, 11-9S

The facility is used to sanitize classified weapon components and tooling prior to disposal. Solidification of mixed waste prior to disposal may also take place here. Chemical and radioactive hazards include cadmium, chromium, lead, tritium, cobalt-60, nickel-63, krypton-85, asbestos, and beryllium.

Waste Staging Pads, 11-9N

The facility is used for the receipt, staging, and retrieval of hazardous materials that have been designated as waste. No flammable storage will be performed in this facility. Any of the solid wastes listed in the Notice of Registration can be stored at this facility and all liquid wastes in storage have secondary containment.

Mock Powder Storage - Oxidizer Storage, 11-10

The facility is used for intermediate (production) storage of materials. This includes oxidizers and mock powder; the latter is potentially carcinogenic.

Vacuum Technology, 11-14

The facility houses vacuum technology equipment for the Materials Technology Department of the Applied Technology Division.

Equipment Room, 11-14E

The 11-14E facility houses equipment for the use in the pressing operation in 11-14. There are no hazards beyond those normally associated with such equipment. The facility is currently inactive.

Mechanical Room, 11-14E1

The 11-14E1 facility houses air handling equipment (pumps, air conditioners) for heating and cooling of 11-14. There are no hazards beyond those normally associated with such equipment. This facility is currently inactive.

Mechanical Room, 11-14E2

The 11-14E2 facility houses equipment (pumps, water treatment) for heating and cooling of 11-14. There are no hazards beyond those normally associated with such equipment. This facility is currently inactive.

Offices, 11-15

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Occasional Transient Storage, 11-15A

The facility is currently inactive.

Remote Control Room/Offices, 11-15B

The facility is designed for pressing. The operations are controlled remotely from 11-15B. Although the facility is currently inactive, it is maintained in a standby condition and could be used at any time. It is currently used for administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

HE Test Facility (Oven Facility), 11-16

The facility is used for aging studies on explosives and may contain up to 35 kg (77 lb) of HE or 45 kg (100 lb) of IHE.

Chemical Synthesis and Analysis, 11-17 & 17A

The facility is used for laboratory-scale synthesis of explosive material. The whole facility may contain no more than 4 kg (9 lb) of HE.

Explosives Testing, 11-18

The facility is used for test firing of small quantities of explosives.

Inert Storage, 11-19

The facility is used for inert storage to support Applied Technology Division operations.

Pressing/Molding, 11-20

The facility is used for pressing and testing of explosives. Although there may be HE in staging, pressing operations are much more limited. Other limits may apply under special conditions.

Equipment Room, 11-20E

The 11-20E facility houses equipment for use in the pressing operation in 11-20. There are no hazards beyond those normally associated with such equipment.

Mechanical Room, 11-20E1

The 11-20E1 facility houses equipment (air handling, pumps, air conditioners) for heating and cooling of 11-20. There are no hazards beyond those normally associated with such equipment.

Mechanical Room, 11-20E2

The 11-20E2 facility houses equipment for support of 11-20 (hydraulic pump, vacuum pump). There are no hazards beyond those normally associated with such equipment.

Equipment Room, 11-21

This facility houses equipment for heating and cooling of adjacent facilities. There are no hazards beyond those normally associated with such equipment. The facility provides restroom facilities for workers in the area. It has the usual varieties of cleaners for such facilities, but no uncommon hazards.

Steam Boiler, 11-21B

This boiler facility is currently out of service.

Particle Characterization Laboratory, 11-22

The facility is used for morphology of bulk formulated and compacted powders. It may contain up to 1.4 kg (3 lb) of HE, and it also has a variety of organic solvents.

HE Staging - HE Synthesis, 11-23

The facility is used for staging of high explosives. There may be 244 kg (538 lb) of HE in the facility, or up to 1,361 kg (3,000 lb) of IHE.

Equipment Storage, 11-24

There are no chemicals or other hazardous material stored in the facility.

Service Magazine, 11-25

The facility serves as a storage magazine for all types of explosives (e.g., PBX, tetryl, TNT, octol, etc.) and may contain up to 105 kg (231 lb).

Inert Storage, 11-26

The facility has no chemicals or radiation sources. The only hazards are those associated with warehousing and operation of forklifts.

Offices, 11-27

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Office, 11-28

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Photographic Laboratory, 11-29

There are no hazards beyond those normally associated with a photo lab. Up to 45 kg (100 lb) of photographic chemicals (e.g., developers, fixers, etc.) may be present.

Offices, 11-30

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

HE Synthesis Facility Acid Storage, 11-34

The facility provides storage of acids used in high-explosive synthesis (Building 11-36). Although the facility may contain some acids (e.g., 246 liters [65 gal] battery acid and 227 liters [60 gal] oakite), most of the stored acids (nitric, sulfuric, and hydrochloric) are in less than 19 liter (5 gal) quantities.

High Explosive Synthesis, 11-36

The facility houses equipment for explosive synthesis operations and may contain up to 68 kg (150 lb) of HE and a number of other chemicals.

Steam Boilers, 11-36B

The 11-36B facility is an "Out of Service" boiler facility. Principal concern may be some residual asbestos on steam pipe insulation. There are no unique hazards associated with this facility.

Explosive Storage, 11-37

The facility houses explosives in support of process development (Building 11-20) including HE and IHE. Total amount of explosives can be 172 kg (380 lb) of HE and 227 kg (500 lb) of IHE in Bay 1, and 105 kg (231 lb) of HE and 136 kg (300 lb) of IHE in Bay 2. Other hazards are those associated with a storage facility.

Explosive Development Bays, 11-38 Bays 1, 2, 3 & 38P Solvent Storage Pad

11-38 Bay 1 is used for a variety of tests on small quantities of explosives - HE/IHE, detonators - (typically less than 450 g/mo [1.0 lb/mo]). The facility also contains a 300 kV flash x-ray machine (fully interlocked). 11-38 Bay 2 is used to conduct test firings on small amounts of explosives (typically less than 454 gm). The facility also contains a 5 W laser, and high voltage capacitor system (8-40 kV, 40-300 kA). 11-38 Bay 3 is used for testing friction HE and linear charges. The solvent storage pad is used for storing solvents in 208 liter (55-gal) drums. These include toluene, freon T.F., ethanol, isobutyl acetate, dimethyl formamide, and acetone.

Flammable Liquid Storage, 11-39

The facility is used to store a broad range of liquid chemicals in support of development work. This includes, but is not limited to, dinitropropyl alcohol, chloroform, perfluro alcohols, xylene, cyclohexane, heptane, acetone, toluene, and others, in amounts up to 208 liter (55-gal).

Guard Station 3, 11-40

Because there are weapons present (rifles and sidearms) there is a potential for worker death in the event of an accident.

Compressor Building, 11-41

There are no uncommon hazards associated with this facility beyond the normal industrial hazards relating to large rotating machinery.

Storage and Issue of Development Material (Explosive), 11-42

This is a multiple bay magazine facility that can house HE and IHE.

Boiler House, 11-43

This is an active boiler facility.

High Explosive Filter Facility, 11-44

The facility is only used as a water pumping facility throughout Zone 11. No hazardous material is allowed in the facility, including explosive wastewater. This facility formerly housed a high-explosives reclamation facility.

HE Storage Facility, 11-45

The facility is used for the storage of Group A explosives, i.e., a maximum of 23 kg (50 lb) HE.

Storage Facility, 11-46

The facility is used for storage of Class C (1.4s) detonators in non-propagating containers.

Restrooms, 11-47

The facility provides restroom facilities for workers in the area. It has the usual varieties of cleaners for such facilities, but no uncommon hazards.

Maintenance Shop, 11-48

The facility houses the shop for repair and maintenance of plant equipment in Zone 11. It has a variety of compressed gases (e.g., oxygen, acetylene), acids, and solvents.

Restrooms, 11-49

The facility provides restroom facilities for workers in the area. It has the usual varieties of cleaners for such facilities, but no uncommon hazards.

High Explosive Machining Facility, 11-50

The facility houses a variety of equipment for precision machining of explosives. The machining bays may have up to 45 kg (100 lb) of HE (113 kg [250 lb] IHE). Bay 5 may have up to 175 kg (385 lb) of HE (227 kg [500 lb] IHE) in-process or staging.

Analytical Laboratory, 11-51

The facility houses analytical laboratories for routine analysis of explosives. There may be up to 4.5 kg (10 lb) of HE in the staging bay for the laboratory. In addition, there are a range of organic solvents along with the full range of chemicals and reagents used for analytical chemistry.

Restrooms, 11-53

The facility provides restroom facilities for workers in the area. It has the usual varieties of cleaners for such facilities, but no uncommon hazards.

Offices, 11-54 & 54A

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

HE Synthesis, 11-55

The facility is used to develop new high explosives and new high explosive processes and to produce small quantities of specialty high explosives which are not available from commercial sources. This requires versatility since explosives synthesis is a multiple-phase procedure where chemicals are processed through a series of vessels, chemical reactors, and filters.

Zone 12

Change House/Classrooms, 12-1 & 1A

The facility has no uncommon hazards. There are some small amounts of cleaning supplies associated with normal maintenance. The only machinery is floor cleaning equipment. The facility includes the 12-1A Laundry and there are no uncommon hazards associated with the operation of the laundry. There are cleaners and detergents present and commercial size washers and dryers, but they present no special hazard.

Central Health and Safety Facility/Guard Station, 12-2

This facility houses the Plant medical facility, which presents hazards associated with typical medical facilities. This facility also has a security guard station which controls access for personnel and vehicles between the Zone 12 North and provides protection from weather and potential hostile activity. Because there are weapons present (sidearms and rifles) there is a potential for worker death in the event of an accident.

Industrial Hygiene Lab, 12-2A

This facility is used for analysis of industrial hygiene samples and maintains a significant chemical inventory and a variety of laboratory equipment and instruments.

Offices, 12-2B

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Offices, 12-3

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Generator, 12-3P

The facility previously contained a generator. The equipment has been removed and the facility is now empty.

Boiler House, 12-4

This facility has been almost completely demolished; however, it is also noted that treatment chemicals (caustic soda and sulfuric acid) along with diesel fuel (66,130 liters or 18,000 gal) are present. Only the actual steam boilers remain.

Electrical Substation, 12-4S

Standard electrical substation.

Warehouse/Nonflammable Storage/Receiving, 12-5, 5A,5B, 5C, 5E, 5G, 5G1, 5G3 & & 5G4

The warehouse contains paints, copier supplies, cleaners, deodorizers, photochemicals, and other materials. These are commercially supplied products and pose no uncommon hazards beyond those associated with warehousing operations (e.g., forklifts, etc.). This complex also includes the 12-5A warehouse for drum lots of dry guard, zeolites and desiccants and the Building 12-5B warehouse which contains a broad range of solvents and chemicals (e.g., acetone - 3,028 liter [800 gal], adeprene - 204 kg [450 lb], alumina 1,814 kg [4,000 lb]). The 12-5B warehouse also has over 2,722 kg (6,000 lb) of freon in storage along with paints, paint removers/thinners, and elastomers. There are numerous commercially available epoxy resin kits in storage.

The 12-5C Shops contain solvents (acetone, alcohols) along with acetylene gas. The facility also has acids and organic cleaners and may also contain beryllium metal powder. Because this is a shop facility there are power tools, both installed and hand held as well as welding and cutting tools. The 12-5E facility contains treatment chemicals for the heating and cooling equipment. Building 12-5G, 12-5G1 and 12-5G3 rooms are used for the storage of durable goods. There are no uncommon hazards in 12-5G3. The 12-5G4 facility provides storage space for lumber and high pressure oxygen bottles (~60 bottles).

Offices,12-6

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Office, 12-6A

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Office, 12-6B

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Equipment Room, 12-6BE

There are no hazards associated with this facility beyond those normally associated with a room housing air handling equipment.

Electrical Substation, 12-6S

Standard electrical substation.

Office, 12-7

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Chemical Lab Annex, 12-8

The facility conducts chemical and physical analysis on small amounts of explosives. Bottled gases (oxygen and acetylene) are also present in the laboratory.

Tester, Gaging and Machining, 12-9

The facility conducts minor repair on specialized test equipment in the Bay 4 Tester Shop. There are small quantities of cleaners (alcohols), paint, lacquer, and epoxy resins available in the shop, but a fume hood is available for vapor control. Bay 3 contains the equipment for physical gaging of inert components and dimensional gaging of mock HE, plastic, and small metal components are conducted here. There are small quantities of cleaners present (e.g., isopropyl alcohol), an overhead hoist and granite surface plates. None of these pose an uncommon hazard. Bay 4 houses the machining and cleaning of components operations. There are small quantities of cleaners and solvents (acetone, isopropyl alcohol) and commercial acids (hydrochloric, nitric) available in Bay 4. A fume hood is available for vapor control. The second floor area of 12-9 is used only for temporary staging of components and parts for the tester shop.

Bays 1 & 2, 12-9A

The facility is used for storage (and cleaning components) and contains freon (272 kg or 600 lb) and sylgard (363 kg or 800 lb) as well as an assortment of adhesives, resins, and cleaners in quantities up to a few tens of pounds each.

Electrical Substation, 12-9S

Standard electrical substation.

Painting - Craft Maintenance and Dry Air Facility, 12-10

The painting facility contains quantities (perhaps 379 to 757 liters [100 to 200 gal] per year) of plastic-based paints and lacquers along with thinners, reducers, and hardeners. There is also the potential for carbon monoxide fumes. The dry air facility contains gal quantities of paints, cleaners (acetone, alcohol) and commercial cleaners.

Offices, 12-11 & 11A

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Low Cost Storage for Classified Documents, 12-12

The facility is used for "dead" storage of classified documents. No other activities take place in the facility.

Incinerator Building, 12-13

The facility is used for the destruction of classified documents by burning in a gas fired incinerator.

Offices, 12-14

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Training Facility, 12-15 & 15A

The facility is used for "hands on" training in a variety of operations. The full range of materials used in the plant (with the exception of explosives) are available in the training facility (adhesives, solvents, cleaners, paints, lacquers, etc.) with the total quantity amounting to a few tens of gals in the aggregate. The facility also has hoists, handtools, and other equipment required for the training activity.

Plastic Shop, 12-16

The facility provides fabrication of plastic tooling and fixtures and thus contains a broad range of solvents, plastics, and paints. There are acrylics, isocyanates, and urethanes along with acetone, alcohol, MEK, methyl chloride, and toluene in unknown amounts. Unknown quantities of boron carbide are also available in the facility.

Storage, 12-16A

The 12-16A facility is used for storage of operating supplies including deicers, mold release, fluorocarbons, silastics, silicone, and tetrahydrafuran.

Storage (Chemicals and Flammable Liquids), 12-16B

The 12-16B facility is used for storage of a wide range of solvents and chemicals including acetone, adiprene, isopropyl alcohol, toluene and xylene along with adhesives, epoxy resins, urethane and other plastics.

Pressing of HE Compounds, 12-17, 17A & 17B

The facility is used for the preparation and pressing of a wide range of explosive components. This includes PBX-9404, 9501, and 9502 along with LX-17. The facility uses a wide range of organic solvents including acetone, alcohols, methanol, toluene, and trichlorethylene. The facility also has several high-pressure presses for component preparation and numerous high-capacity hoists and cranes.

Radiography Bay, 12-17-9

Bay 9 of 12-17 is used for radiography.

Cooling Tower foundation and Pump House, 12-17C

The 12-17C cooling tower foundation and pump house facility is used only for storage of inert material.

Basement Equipment Room, 12-17E

The 12-17E basement equipment room has no hazards beyond those normally associated with a room housing air handling equipment and the associated pumps and motors.

Fan Rooms, 12-17F

The 12-17F fan rooms generally contain no uncommon hazards except unspecified quantities of HE/IHE waste may be in the rotoclones in t exhaust air system.

Electrical Substation and MCC, 12-17S

12-17S is a standard electrical substation ar MCC.

Battery Charging, 12-18

The facility provides electrical power for chargin electric cart and forklift batteries. No othe activities are conducted and there are n uncommon hazards.

East Development Formulation Facility, 12-19E/

This facility (Bays 8 - 17 and second floor provides pilot activities for development of plasti bonded explosives (PBX) and similar materials The facility may have up to 45 kg (100 lb) of HE or 113 kg (250 lb) IHE per bay on the day shif (88 kg [193 lb] HE or 113 kg [250 lb] IHE on of shift) and quantities of organic solvents (e.g., hundreds of liters of acetone, MEK, MIBK, ethyl acetate, etc.). Some operations with HE are conducted as Class I remote operations.

West Materials Compatibility Facility, 12-19WE

The 12-19WE materials compatibility assurance facility houses test equipment used to perform accelerated aging studies on explosive core samples. The facility may contain no HE and 113 kg (250 lb) of IHE.

Basement Equipment Room, 12-19E

There are no hazards associated with the 12-19 basement equipment room facility beyond those normally associated with a room housing heating and cooling equipment (e.g., pumps, fans, motors). However, this facility has been identified as asbestos-contaminated and access is prohibited until clean-up has been accomplished.

Fan Rooms, 12-19F

The 12-19F fan rooms (F1-F4) generally contain no uncommon hazards except that there can be unspecified amounts of HE/IHE and mock waste in the rotoclones in exhaust air system.

Storage Tank for Recovered Solvent, 12-19P

The 12-19P storage tank for recovered solvent facility is used for temporary storage of recovered solvents. Although the total capacity is 946 liters (250 gal), the material is moved and handled in smaller quantities, generally no more than one 208 liter (55 gal) drum at a time.

Emergency Power, 12-20

This facility contains a generator to provide emergency lighting. It poses no unique hazards.

Nondestructive Evaluation (NDE) Laboratories, 12-21, 21A & 21NDE

These buildings represent a typical NDE environment. Various bays may contain up to 256 kg (565 lb) of IHE or 113 kg (250 lb) of HE. Numerous solvents are present, but typically in less than a few liter quantities. There may be up to 50 cylinders of compressed gas. This facility may also contain mercury for use in the analytical gas laboratory.

Break Room, 12-22

There are no uncommon hazards beyond those normally associated with inhabited general purpose buildings.

Inert Stores, 12-23

There are no uncommon hazards beyond those normally associated with warehousing general office supplies.

Explosives Machining, 12-24NO, 24A, 24E & 24SO

Building 12-24NO is used primarily for the production of IHE components. Demolition of this facility is pending DOE review and approval.

Solvent Storage for Line Operations, 12-25

This facility stores and issues a wide range of industrial solvents (e.g., ethyl alcohol, xylene, trichloroethane), 151 to 265 liters (40 to 70 gal) each.

Assembly Building, 12-26 Bays 22 & 26

Both bays are used for material compatibility studies and for extracting gas samples for analysis. Although the facility is currently experiencing only limited use, it may be used for assembly operations.

Assembly Building, 12-26 Bays 27 & 28

One bay is being used for in-process staging of some tritium bottles and another is being used for vacuum testing of complete units.

12-26E

The 12-26E equipment room has hazards associated with mechanical equipment rooms, i.e., rotating machinery such as pumps or fans.

Electrical Substation, 12-26S

The 12-26S electrical substation is a standard electrical substation.

Pit Vault, 12-26PV

This facility is by definition a nonreactor nuclear facility. There are no mechanisms identified that could cause release and dispersal of the stored SNM.

Tooling Warehouse Wing, 12-26WH

There is a potential for injury because tooling materials are stored on racks well above personnel heights. Motorized equipment is used for material handling.

Conference Room, 12-27

There are no uncommon hazards beyond those normally associated with inhabited, general purpose buildings.

Offices, 12-28

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Break Room, 12-30

There are no uncommon hazards beyond those normally associated with inhabited, general purpose buildings.

HE Subassembly Facility, 12-31

Although quantities of explosives present are limited in these facilities (~4 kg [~9 lb] HE/bay; 68 kg [150 lb] IHE some bays) there is a potential for worker fatality for those working directly with the material.

HE Subassembly Facility, 12-32

Demilitarization and sanitization of weapons components which consist of inert parts occurs here. The facility is used to perform granulation and disfigurement of plastic, foam, and rubber; parachute disassembly; shredding metal; cutting fins; and crushing lead.

HE Subassembly Facility, 12-33

No quantities of explosives are present in these facilities.

Flammable Storage, 12-34

Mixed solvent storage.

Craft Maintenance Shops - Utility Operations, 12-35

There are numerous types of solvents, industrial cleaners, oils, and fuels present in the facility. However, the quantities are such that only those individuals directly involved with the material are at risk of injury or illness.

Generator, 12-35P

The 12-35P generator is a standard generator. I poses no unique hazards.

Oil Storage Building, 12-35A

There are over 30 varieties of oils and hydraulic fluids stored in this facility in quantities from 3.8 to 208 liters (1 to 55 gal), thus there is a potentia for serious injury or major damage in the event o an accident.

Offices, 12-36

The facility houses administrative offices. Th usual range of cleaning and copier supplies fo such functions are present, but there are n uncommon hazards. This facility also has security guard station which controls personne access and provides protection from weather an potential hostile activity. Because there ar weapons present (sidearms and rifles) there is potential for worker death in the event of a accident.

Administrative (Emergency Operations Center), 12-36A

There are no uncommon hazards beyond those normally associated with inhabited office space.

Generator, 12-36P

This facility is a small brick building which previously housed a generator, which has subsequently been removed. It is unused, except for the presence of electrical switch boxes. It poses no unique hazards.

Electrical Substation, 12-36S

Standard electrical substation.

Central Computer Facility, 12-37 & 37A

These facilities house computer equipment. There are no uncommon hazards beyond those normally associated with inhabited office space.

Central Computer Facility 12-37E & 37EQ

The 12-37E and 12-37EQ facilities contain heating and ventilating equipment (air handling) for 12-37. The hazards are those normally associated with mechanical equipment rooms; especially rotating machinery.

Solvent Storage 12-38

The facility houses a wide range of solvents and organics.

Fire Department Training Room 12-39 & 39A

There are no uncommon hazards beyond those normally associated with inhabited spaces used as offices and other administrative activities.

Paint Facility 12-41

There are modest amounts of solvents and paints present in the facility (3.8 to 37.9 liter [1 to 10-gal] lots) several of which are carcinogens (e.g., alodine). In addition, there may be quantities of plutonium, uranium and tritium in the facility.

Component Process Facility 12-41A

The 12-41A component process facility is used to store modest amounts of solvents (pint quantities) used in preparing components for painting.

Buy Back Operations 12-42

There are no uncommon hazards beyond those associated with materials warehousing operations and the warehousing of shipping containers of various types and materials.

South Vault - Component Staging 12-42SV

The vault is used for in-process staging of tritium reservoirs. Because the tritium is a gas under high pressure, there is a potential for radiological exposure in the event of an accident.

North Vault - RTG Staging 12-42NV

The vault is used for staging of RTGs during assembly/disassembly operations. There are no special hazards anticipated with these encapsulated items.

SNL Facilities 12-42A, 42B, 42C & 42F

These facilities are being operated by SNL.

Compaction Facility 12-42-COM

The segregation and compaction of all waste for the Zone 12 MAA is done in this facility.

HE Process Water Filtering 12-43

There may be small amounts (< 2.3 kg or 5 lbs) of explosives present in the process streams.

Storage Building 12-43A

Included in this facility is the 12-43A storage building, which is empty and inactive. The only concern is past potential exposure to pesticides.

Office 12-44E

This facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Equipment Room 12-44EA

The hazards in this area are those usually associated with mechanical/electrical equipment rooms, such as rotating machinery (pumps, fans, etc.) and high voltages.

Assembly Cells (1 - 6) 12-44

These facilities are used for weapon assembly/disassembly operations. Both explosives and SNM are present in the cells, including pits, secondaries, initiators, and tritium reservoirs. There are also quantities of other hazardous materials, e.g., beryllium, alcohols and elastomers.

SNM Staging (Cell 8) 12-44-8

This cell is used for in-process staging of SNM (pits) to support weapon assembly/disassembly operations. Although there are no explosives, there is a significant quantity of SNM, i.e., tens of kilograms.

Storage Building (Misc.) 12-45

This small building is used only for storage and there are no chemicals or energy sources involved.

Restrooms 12-46

The facility may contain small amounts of cleaners required for maintenance, but there are no uncommon hazards.

Storage Building (Misc.) 12-47

This small building is used only for storage and there are no chemicals or energy sources involved.

Maintenance Repair and Storage 12-48

The facility has unspecified amounts of acrylic enamels, paint remover/thinner, and cleaners.

Maintenance Shop 12-49

The facility is used for maintenance activities and contains a broad spectrum of solvents, compressed gases, paints, and cleaners in unspecified quantities. This includes acetone, MEK, alcohols, battery fluids (acid and alkaline), acetylene, propane, oils, and gasoline. The facility also has six small radiation check sources (radium and cesium) and a small tritium cylinder. Because it is a maintenance shop there are power tools, hoist and lifts, forklifts in the facility. This complex also has a carpenter/locksmith shop. Although there are small quantities of adhesives and cleaners, there are no uncommon hazards beyond those normally associated with power tools and similar equipment.

Separation Test Facility 12-50

The facility conducts functional tests for the separation of weapons from carrier vehicles.

Equipment Room 12-50E

The 12-50E equipment room hazards are those normally associated with mechanical equipment rooms; especially with rotating machinery.

Solvent Storage 12-51

This facility was previously used for storage of pesticides and herbicides, but it is no longer used for this purpose. It is now used for storage of lawn mowers and poses no unique hazards.

Metrology - Laboratory 12-52, 52A & 52B

Buildings 12-52A, 12-52B, and 12-52 house mechanical and electrical metrology operations, providing calibration and some minor maintenance on selected items. There are modest amounts of solvents (< 3.8 liters [1 gal] in any location) in all laboratories. Freon is available as a cleaning agent in all laboratories. There are radiation calibration sources available in 12-52B (tritium, americium, plutonium [238 and 239], cesium, and thorium). Mercury is also available for use in calibration instrumentation. Building 12-52 also must dispose of approximately 600 alkaline, 50 mercury, and 25 lead-acid batteries per year. Other hazards present are those typical of a multi-use laboratory facility.

Equipment Rooms 12-52E & 52AE

The hazards in this area are those normally associated with mechanical equipment rooms for water cooling systems; especially rotating machinery, pumps, compressors, and fans. The facility also contains modest amounts of antifreeze and organic phosphate.

Metrology - MAA Calibration Laboratory 12-5

The facility provides calibration and minor maintenance on specialized test equipment. There are small amounts of solvents and paints (less than gal quantities) and epoxies. The facility also has alpha sources (15 with less than 1.1 microcurie each), beta sources (tritiated CH_4 in N_2), and gamma (3 with less that 0.01 microcurie each).

Equipment Room 12-53E

There are no hazards associated with the 12-53E mechanical room facility beyond those associated with a room housing air handling equipment and the associated pumps and motors.

Production Staging 12-55

The only significant hazard in the facility is the approximately 40 curie cobalt-60 source that is in storage.

Neutron Radiography Facility 12-56

This former 8 MeV Linac facility is now in standby and will be converted to a neutron radiography facility. Upon completion of the conversion, the hazard level assignment may be higher.

Equipment Room 12-56E

There are no hazards associated with the 12-56E Equipment Room facility beyond those associated with a room housing air handling equipment and the associated pumps and motors.

Storage Building for Equipment 12-57

This building is used only for storage and there are no chemicals or energy sources involved.

Bays 1, 2, and 3 12-58B1, 58B2 & 58B3

Bay 1 is used for receipt, storage, and issue of 1.1 (Class A) explosive component parts. Bay 2 is used for receipt, storage, and issue of 1.3 (Class B) explosives. Bay 3 is used for passive inspection of OR items. The allowable HE/kg limits are being reduced. The facility has two check sources of approximately 2 microcuries each.

Bays 4 and 5 12-58B4 & 58B5

The facility is used for staging SNM component parts and significant numbers of units may be in process at any one time.

Analytical Chem Lab 12-59

This facility is used to perform chemical analysis on high explosives, adhesives, paints, environmental samples, and other types of sampling.

Equipment Room 12-59

There are no hazards associated with the 12-59E equipment room facility beyond those associated with a room housing air handling equipment and the associated pumps and motors.

Mass Properties Facility 12-60

The facility does mass properties (weight and balance) testing on weapons.

Vault Room 12-60E

The 12-60E vault room facility is used for mass properties data reduction and computer operations. There are no uncommon hazards associated with its operation.

Receiving, Shipping and Offices 12-61

The facility provides receiving and shipping services for weapon components of all types (pits, reservoirs, cases, secondaries, etc.). The office portion provides the administrative support required for shipping and receiving activities. There are no hazards beyond those normally present in an office environment.

Process PETN to Extrudable Forms 12-62

The facility is used to combine PETN with appropriate elastomers to create extrudable explosives (e.g., LX-13). Individual bays my have from 4.5 to 87.5 kg (10 to 193 lbs) of explosives. In addition, there are quantities of solvents (e.g., acetone, isopropyl alcohol) used in the facility.

HE Press/Yoke Press 12-63 & 63-2,3

The facilities are used for the pressing of a variety of high explosive formulations (e.g., PBX 9404, 9501, 9407 and LX-04, LX-07). The individual bays may have 32 to 75 kg (70 to 85 lb) of HE so long as no plasticizer is present. Bays 2 and 3 may have 227 kg (500 lb) of IHE if there is no HE in either bay. The hazards in the 12-63E, 12-63E1 and 12-63E2 equipment rooms are those normally associated with mechanical equipment rooms; especially rotating machinery.

Weapon Assembly/Disassembly Bays 12-64

This facility is used for the assembly/disassembly of cased weapons and for interim staging of OR items. The facility may contain up to 104 kg (230 lb) of HE or 177 kg (390 lb) IHE per bay along with a variety of solvents and adhesives, although these are in relatively small quantities.

Equipment Room 12-64E

The hazards in the 12-64E equipment room are those normally associated with mechanical equipment rooms, especially rotating machinery.

Office/Restrooms/Breakroom 12-64A

DOE Operations, Quality Management 12-72

The facility houses a portion of the administrative offices for the DOE Area Office. The usual range of cleaning and copier supplies for such functions is present, but there are no uncommon hazards.

Decontamination of HE Contaminated Tooling, Equipment,Parts 12-73

The facility is used to clean and decontaminate tooling. Up to 2.3 kg (5 lb) of HE (TATB, PETN, PBX, etc.) may be present in the facility. Only very small quantities of solvents are used in the facility.

Blue 3 Tower 12-74

The tower is an elevated observation tower used for security operations. Because there are weapons present (sidearms and rifles) there is a potential for worker death in the event of an accident.

Security Command Center 12-75

Building 12-75 is used for the communications center and administrative offices of the security force. Several rooms in Building 12-75 are used as weapons armories for firearms storage and repair and for the storage of ammunition and riot control agents (CS agents). The presence of significant numbers of weapons and quantities of ammunition provide a potential for worker death in the event of an accident.

Security Training Branch 12-75A, 75B

The 12-75A facility is used for the preparation and conduct of security training classes. There are cleaners and copier supplies normally associated with administrative operations.

Emergency Generator 12-75G

The 12-75G emergency generator facility houses a 90-kW emergency diesel generator to support emergency operations of the security and fire departments. There are no uncommon hazards beyond those normally associated with such facilities.

Fuel Storage and Pump House, 12-76 & 76A

The facility is a 2.2 million-liter (581,240-gal) storage tank for diesel fuel. There is a potential for significant damage and worker injury in the event of an accident.

Remote Hole Drilling Facility, 12-78

This facility is inactive and equipment has been removed. The facility was used for remote drilling of holes in explosives (PBX, LX and mock).

Warehouse 12-79

The facility is used for the storage and packaging of limited life items such as Class C (UNO Class 1.4) detonators in non-propagating containers.

Drivers Shack 12-80

The facility is used as a waiting room for uncleared drivers making deliveries to the site.

Battery Room 12-81

The facility provides electrical power for battery charging on forklifts, carts, and sweepers and space for preventive maintenance activities. No other activities are conducted in the facility and there are no uncommon hazards.

Warehouse E-Bay, 12-82

The facility is used for rework acceptance of parts, i.e., electrical/mechanical reacceptance. The facility may have Class C (UNO Class 1.4s) material in non-propagating containers.

Magazine - HE 12-83

This facility is an explosives magazine. It is used for temporary staging of HE and IHE parts/

materials. Bay 1 may contain up to 2,268 kg (5,000 lbs) of HE or 2,948 kg (6,500 lbs) of IHE.

Assembly Bays (1-20) 12-84, 84A

The facility is used for assembly and inspection of cased weapons. Bay 3 is an x-ray facility. Any bay (with the exception of 14) may have up to 136 kg (300 lb) of HE or 177 kg (390 lb) of IHE.

Radiography 12-84-RAD

Bays 1 and 10 are Linatron radiograph facilities.

Laser Sampling 12-84-14

Bay 14 houses the laser sampling project including laser drilling and welding, small volume gas sampling, helium leak testing, and microfocus radiography.

Assembly/Disassembly Cell 12-85

The cell is used for the assembly/disassembly of weapons and may contain up to 192 kg (423 lb) of HE or 249 kg (550 lb) of IHE.

Inert Assembly 12-86

The facility is used for inert assembly and test operations on NELAs. Bays in this facility may have 0.11 kg (0.25 lb) of HE (Bay 4 may have 5.2 kg [11.5 lb] of IHE, Class 1.3). The facility contains telemetry testers and their associated power supplies.

Inert Pit Reuse 12-86 Bays 10 to 12

Operations at this facility (Bays 10-12) will involve encasing inert mock pits with 304 SST shells and vanadium shells. Processes located in Bays 10 through 12 involve laser welding and associated cleaning and handling activities. Operations will support preliminary process checkout, training development, and maintenance implementation evaluations.

Blue 5 Tower 12-87

The tower is an elevated observation tower used for security operations. Because there are weapons present (sidearms and rifles) there is a potential for worker death in the event of an accident.

Blue 4 Tower 12-88

The tower is an elevated observation tower used for security operations. Because there are weapons present (sidearms and rifles) there is potential for worker death in event of an accident.

Blue 2 Tower 12-89

The tower is an elevated observation tower used for security operations. Because there are weapons present (sidearms and rifles) there is a potential for worker death in the event of an accident.

Security Access Control Station 26 12-90 & 90 A

The facility provides protection from weather and potential hostile activity and controls plant access. There are firearms present (sidearms and rifles) and thus there is a potential for worker death in the event of an accident.

Data Collection Building (Zone 12 S) 12-91

The facility houses the data collection for the PIDAS alarm system. There are no uncommon hazards associated with this administrative activity.

HE Service Magazine 12-92

The facility is used to wrap and seal components in special packaging. It may contain up to 136 kg (300 lb) of HE or 177 kg (390 lb) of IHE.

Equipment Storage 12-93

This facility provides equipment storage such as air hoses, small portable compressors, empty buckets, etc. There are no unique hazards associated with this facility.

Aging Weapons 12-94

This facility is used to perform compatibility testing on weapons and weapon-related parts. This testing includes leak checking, volume determination, backfilling, sampling, and thermal cycling of containers and weapons. Aging studies can involve complete nuclear weapons, explosive core samples, weapon components, and weapons-like assemblies. The core samples are HE specimens encapsulated in a compatibility container. Time periods for exposure vary from a few months to two years or more, depending on the Design Agency specifications. Weapons programs under test are identified as accelerated aging units, oven test units, or special test. The facility may contain special nuclear material of 25 kg (55 lb), as well as bottled tritium.

1.4 (Class C) Explosive Storage and Packaging Facility 12-95

The facility is used for the receipt, storage, and issue of Class 1.4 material packaged in non-propagating containers.

Office 12-95-2

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Assembly/Disassembly Cell 12-96

The cell is used for the assembly/disassembly of weapons and may contain up to 192 kg (423 lb) of HE or 249 kg (550 lb) of IHE.

Metal Trailers - Offices and Administrative Building 12-97A, 97B & 97C

The trailers provide office administrative office space for various departments. There is also the 12-97C administrative building. There are the usual cleaners and copier supplies associated with the offices, but no uncommon hazards.

Assembly/Disassembly Cells (1-4) 12-98

The cells are used for the assembly/disassembly of weapons and may contain up to 192 kg (423 lb) of HE or 249 kg (550 lb) of IHE. Cell 4 is dedicated to electrical testing of PAL/CAP controllers on completed weapons (i.e., cased explosive, no assembly/disassembly).

Equipment Room 12-98E1 & 98E2

This facility includes 12-98E1 and 12-98E2 equipment buildings which house the mechanical equipment required to service 12-98. There are no hazards beyond those normally associated with mechanical equipment rooms, especially rotating machinery.

Assembly/Disassembly Bays 12-99

The bays are used for the assembly/disassembly of weapons and may contain up to 136 kg (300 lb) of HE or 177 kg (390 lb) of IHE.

Environmental Testing 12-99-9

Bay 9 is dedicated to temperature and vibration testing of components, but it may also contain explosives.

Offices 12-100

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Offices 12-101

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Offices 12-102

The facility houses Quality Operations (Audit) and Tester Design Engineering. There are cleaners and copier supplies normally associated with administrative activities and solder/cleaners associated with electronics laboratory operations, but no uncommon hazards.

Cafeteria/Change House 12-103

The facility houses the cafeteria and change house that serve the south end of Zone 12. The facility has the cleaners and bleaches associated with commercial laundry and kitchen operations, but no uncommon hazards.

Weapon Assembly/Disassembly Bays 12-104

This facility is used for partial assembly/disassembly of nuclear explosives containing HE and complete assembly/disassembly of nuclear explosives containing IHE, vacuum testing operations, and staging of nuclear explosives or nuclear explosive components. The inert pit reuse operations will be transferred to this building in the future.

Special Purpose Bays 12-104A

The facility consists of three radiography bays where x-raying of weapons and components is done, one paint bay, one weapons aging bay where age testing is done, one vacuum chamber bay where vacuum testing is done, and two staging bays.

Generator Building - East Equipment Room 12-104P1 & 104P2

These facilities each house a 75-kW emergency generator that provides backup power for fire alarms, radiation alarms, and emergency lighting. The hazard associated with these operations are those normally associated with diesel powered generators, including fuel storage for limited operation. However, there are no uncommon hazards.

Condensate Return Building 12-105

The facility houses the tanks and pumps required to collect and return steam line condensate to the boiler facility. The hazards associated with this operation are those normally associated with commercial heating operations.

Offices 12-106 & 106A

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Offices 12-107

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

General Building 12-108

The facility houses three 1000-kW diesel generators for emergency power. The facility has fuel for the operation of the diesels and the associated electrical distribution gear. However, there are no uncommon hazards beyond those normally associated with such facilities in commercial service.

Mechanical Equipment Room 12-109

The facility houses the mechanical equipment (pumps, motors, chillers, tankage) associated with providing heating and cooling to industrial-type facilities. However, there are no uncommon hazards beyond those normally associated with such activities.

Paint Shop 12-110

This facility serves as a general purpose paint shop. It contains equipment for sandblasting and painting. Chemical sources such as paint and paint thinners are also present. The facility poses no unique hazards.

Carpenter Shop 12-111

This facility is dedicated to general carpentry. Equipment includes table saws, radial arm saws, band saws, jointer, shaper, belt sander, planer, and drill presses. Lumber, lock and door parts are stored at this facility. Protective equipment is required for personnel entering the facility.

Security Maintenance Shop 12-112

This facility provides for maintenance of security alarm systems and ancillary equipment. The facility houses spare alarm equipment and test equipment.

RAT Operations Center 12-113

This facility provides offices for the Emergency Management Department. It also seconds as a duty station for the Radiological Assistance Team (RAT) in the event of an emergency. The facility contains high pressure tanks and check sources for radiation monitoring equipment.

Guard Station South MAA Portal 12-114

This facility is a security guard station which controls access for personnel and vehicles between the Zone 12 South MAA from the south and provides protection from weather and potential hostile activity. There are firearms present (sidearms and rifles) and thus there is a potential for worker death in the event of an accident.

Guard Station North MAA Portal 12-115

This facility is a security guard station which controls access for personnel and vehicles between the Zone 12 South MAA and Zone 12 North. There are firearms present and thus there is a potential for worker death in the event of an accident.

SNM Component Staging Facility 12-116

The facility will be used for staging of SNM components, and therefore has potential hazards common to nuclear material staging areas.

Radiography Bay 12-116R

There is one bay used for radiography.

Weapon Transfer Station 12-117

The facility is an all weather enclosed loading station for loading and unloading weapons and components for offsite and onsite transportation.

Bulk Storage Warehouse 12-118

The facility provides space for storage of nonflammable bulk materials (cleaners, detergents, etc.). There are no uncommon hazards associated with facility beyond those associated with warehousing operations.

Guard Station 28, 12-119

The facility controls access for personnel and vehicles between Zone 12 South MAA from the north, and provides protection from weather and potential hostile activity. There are firearms present (sidearms and rifles) and thus there is a potential for worker death in the event of an accident.

Guard Station 20, 12-120 & 120A

The facility controls access for personnel and vehicles between Zone 12 South MAA from the south and provides protection from weather and potential hostile activity. There are firearms present (sidearms and rifles) and thus there is a potential for worker death in the event of an accident.

High Explosives Machining Facility 12-121

The facility is used for machining, gaging, and staging explosive and inert weapon components. Explosive limits have not been approved pending completion of ORR.

Personnel Radiation Monitoring and Calibration 12-122

This facility provides office space for Radiation Safety personnel as well as the external and internal dosimetry laboratory. This facility may contain radiation sources. Services within the laboratory include sample counting, dosimetry, internal dose assessment, spectroscopy/spectrometry, and TLD calibration.

Guard Station 88, 12-124

This facility controls access for personnel and vehicles to the protected area and provides protection from weather and potential hostile activity. There are firearms present and thus there is a potential for worker death in the event of an accident.

Alternate Command Post 12-126

The facility will be a duplicate of the current command center (12-75). The facility does not exist yet.

Offices, 12-127

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Offices, 12-132

The facility houses administrative offices. The usual range of cleaning and copier supplies for such functions are present, but there are no uncommon hazards.

Zone 13

Control Building 13-41

This facility provides support operations for the old wastewater facility. There is mechanical equipment present, but there are no uncommon hazards beyond those associated with pumps and motors.

Chlorine Building 13-42

The facility did provide chlorination of wastewater being processed for irrigation purposes. However, it is currently out of service.

Digester 13-43

The facility was the digester for raw sewage as part of the old wastewater treatment facility. However, it is currently out of service.

Primary Clarifier 13-44

The facility was the primary wastewater clarifier for the old wastewater treatment facility. However, it is currently out of service.

Filters 13-45

The facility provided the filtering of raw sewage for the old wastewater treatment facility. However, it is currently out of service.

Final Clarifier 13-46

The facility holds and pumps irrigation wastewater and catches and pumps tailwater to Playa 1. No uncommon hazards exist within this facility.

Sewer Control Building 13-47

The facility serves as the chlorinator for wastewater for the Pantex Plant. There may be up to 454 kg (1,000 lb) of chlorine in cylinders stored inside the facility.

Zone 15

Storage Building 15-1

Facility is in standby status.

Water Well Building 15-6

Facility houses well and pump for the site fresh water system.

Pumping Station and Chlorinator 15-12

The facility pumps and provides treated potable water for the site.

Security Training 15-13

There are no uncommon hazards associated with this facility beyond those associated with classroom demonstration instruction. Blank ammunition and crowd control gases are used in the training process.

Water Reservoir 15-14

The facility is a 8.3 million liter (2.2 million gal) storage tank for water.

Water Well 15-16

The facility pumps potable water for the site.

Water Well 15-17

The facility pumps potable water for the site.

Water Well Building 15-20

The facility pumps fresh water from a well for Pantex Plant. The only hazards are those normally associated with an engine driven pump.

Elevated Storage Tank 15-21EA

The facility provides water storage (and distribution head) for fresh water for Pantex Plant. There are no uncommon hazards.

Elevated Storage Tank 15-22WE

The facility provides water storage (and distribution head) for fresh water for Pantex Plant. There are no uncommon hazards.

Fire Protection Water Pump Station and Water Reservoir 15-24 & 24A

The combined facility consists of a 1.5 million-liter (400,000-gal) surface storage tank for water and the pump station for the high-pressure fire loop. There are no uncommon hazards beyond those normally associated with engine- and motor-driven pumps operating at modest pressures (70,310 to 105,465 kg/m^2 or 100 to 150 psi).

Fire Protection Water Pump Station and Water Reservoir 15-25 & 25A

The combined facility consists of a surface storage tank for water and the pump station for the high-pressure fire loop. There are no uncommon hazards beyond those normally associated with engine- and motor-driven pumps operating at modest pressures (70,310 to 105,465 kg/m² or 100 to 150 psi).

Water Well Building 15-26

The facility pumps fresh water from a well for Pantex Plant. The only hazards are those normally associated with an engine-driven pump.

Pump House 15-27

The pump house is used to pump fresh water to Pantex Plant water distribution system. Principal equipment includes water pumps, fire pumps, and a sump pump.

Water Reservoir 15-28

The facility is a 9.4 million liter (2.5 million gal) water storage tank for the Pantex Plant water system. There are no uncommon hazards associated with this facility.

Chlorine Building 15-29

The facility provides the chlorination required for the Pantex Plant water system. There are no uncommon hazards beyond those normally associated with similar large capacity systems. However, there may be up to 454 kg (1,000 lb) of chlorine stored inside the facility.

Zone 16

Vehicle Maintenance Facility 16-1

The facility contains parts and supplies for repair and maintenance of the plant vehicle fleet. This includes cylinders of acetylene, oxygen, and other compressed gases and a 18,925 liter (5,000 gal) tank for gas and fuel oil.

Operations Facility 16-2

This facility provides offices and standby housing for the Courier Section. There are firearms present and thus there is a potential for worker death in the event of an accident.

Guard Station 7, 16-3

This facility is a security guard station which controls access for personnel and vehicles and provides protection from weather and potential hostile activity. There are firearms present (sidearms and rifles) and thus there is a potential for worker death in the event of an accident.

Vehicle Maintenance Facility Blast/Paint Building, 16-4

This facility is used to clean and paint equipment, cars, trucks, trailers and railcars. Steel grit is used for blast cleaning, and spray painting is done in the paint booth. A variety of equipment such as compressors and spray guns are used. Chemical sources such as paint and paint thinners are also present.

Tooling Storage 16-5

This facility is used for storage of special tooling and equipment (inert material only). There are no unique hazards associated with this facility.

Test Range 16-6

The building is being used for the storage of empty cases and similar shipping material.

Control Range 1 (Security) 16-7

This firing range facility is designed for firearms training and qualification of security personnel.

Because there are live weapons and ammunition present, there is a potential for worker death in the event of an accident.

Fire Department Drill/Training Tower 16-8

This facility is designed for training of Fire Department personnel. Storage of up to 7,570 liters (2,000 gal) of unleaded automotive fuel is provided. Activities such as pit fire training, rope rappel training and rope rescue training may be conducted at the facility. Outdoor burning, as an element of the training, has been approved by the Texas Air Control Board.

Guard Station 9 16-9

This facility is a security guard station which controls access for personnel and vehicles and provides protection from weather and potential hostile activity. There are firearms present (sidearms and rifles) and thus there is a potential for worker death in the event of an accident.

Vehicle Wash Facility 16-10, 10A & 10E

This facility provides washing capabilities for GSA, DOE and TSD vehicles, trucks, truck tractors, trailers and rail cars. Equipment used includes an automatic brush washing assembly which uses high-pressure water. There are no unique hazards associated with this facility. Building 16-10A is for storage of supplies and Building 16-10E is the equipment room.

West Entrance Guard Station 16-11

This facility is a security guard station which controls access for personnel and vehicles at the west entrance to the Plant site. There are firearms present and thus there is a potential for worker death in the event of an accident.

Services Facility 16-12

The facility provides space for administrative and clerical activities. There are cleaners and copier supplies normally associated with such functions, but no uncommon hazards.

Boiler House 16-13

This facility provides steam for heating and process activities for the entire Pantex Plant. Although there are no uncommon hazards beyond those normally associated with such large scale plants, there is a potential for worker injury or onsite damage in the event of an accident involving the boiler plant.

Yard Storage 16-14

This facility provides storage for all yard tools and supplies.

VMF/COF Boiler 16-15

This is an active boiler facility to supply heating and compressed air for Zone 16 buildings.

RCRA Hazardous Waste Storage 16-16

The facility will be used for the receipt, staging, and retrieval of hazardous materials that has been designated as waste. No flammable storage will be performed in this facility. The types of waste include, but are not limited to, acids (or organic acids), bases (or organic bases), cyanides, oxidizers, heavy metals (solids), LLW and MW.

Storage 16-18

The facility is currently used for storage of targets for Range 3.

Central Shipping & Receiving 16-19

This facility will be dedicated to shipping and receiving material for general stores. Class C explosives and a variety of chemicals which are received into or shipped from the Plant will be staged at this facility. Containers are not to be opened at the staging area. An x-ray machine will be used for inspecting packages. Compressed gas containers will also be staged at this facility.

Pesticide Washdown 16-20

The facility is used for mixing plant-approved pesticides. Equipment used to disperse pesticides is also cleaned here after use. Hazards consist largely of pesticides.

Ammunition Storage 16-21

This facility is used for the storage of ammunition for the security forces.

Radio Shop 16-22

Operations in the facility include the installation, removal, repair, maintenance, and testing of communication equipment utilized in vehicles. This includes an RF booth, battery charging station, and various test equipment for the operations.

Bulk Storage Warehouse 16-23

The facility provides interior and exterior storage for large, low usage items and oxygen, nitrogen, and acetylene cylinders which are used by the VMF.

Weapons Tactics & Training 16-24 A to F

The facility is used to train the security forces and DOE transportation safeguard division in tactics for neutralizing hostile forces.

Texas Tech University Property

Killgore Center, 18-1

The facility is leased from Texas Tech University and houses the technical sampling and analysis section which does environmental sampling and testing. Coordination and dissemination of results are also done here. This facility is also the alternate Emergency Operations Center.

Bull Barn, 18-2

This facility is an old arena and as such is not currently used.

Range - Large Bore, 18-3

This facility is designed for firearms training and qualification of personnel. The use of weapons with live ammunition poses a potential hazard for personnel injury.

Burning Ground

Storage Building, BG-1

The facility is used for storage to support burning ground operations and may have several hundred gal of diesel fuel in storage.

Bunker and Control Building for BG Operations, BG-2

The facility houses the control activities for the burning ground. No hazardous materials are kept in the building.

HE Service Magazine (Storage), BG-3

The facility is used as a storage point for Class A explosives (up to 181 kg or 400 lb of HE).

Squib Service Magazine (Storage), BG-4

The facility is used for storage of Class 1.4 material only in non-propagating containers.

Other

Live Firing Range, Range 2

The facility is used to conduct live fire training for duty sidearms, submachine guns, and shotguns.

Hazardous Waste Treatment Processing Facility, HWTPF

This facility will be located in Zone 16 and will replace the 11-9N facility. Waste from 16-16 will be sent to this facility for onsite processing.

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APPENDIX E
SUMMARY OF SAFETY ANALYSIS REPORTS

This appendix presents a brief summary of accident/hazards analysis results for all Hazard Category 2 and 3 or moderate and low facilities that currently have approved final SARs or SAs completed. The accident analysis summary includes only the accident scenarios that were examined, those found to be credible, and those with potential for on site and/or off site consequences. Accident analyses summaries extracted from these documents were based upon the best and most recent available information. In instances where the accident analyses summaries were obtained from approved final SARs, the document has been referenced.

Zone 4, Modified Richmond Magazines and Steel Arch Construction Magazines

The accident initiating events evaluated in this assessment include operational accidents, internal and external events, accidents in nearby facilities, and natural phenomena[1]. Over 40 potential initiating events were originally considered in this analysis. Eight types of credible accident scenarios were identified and analyzed. The potential effects of these events are discussed below.

Aircraft Crash: An analysis of the conditional probabilities and consequences of an aircraft crash into a magazine showed that those aircraft crashes sufficient to cause damage and potential release of radioactive material were found to be incredible. Crashes that could credibly occur have negligible consequences. This analysis will be updated when the results of current studies of the frequency of aircraft flights near and over the Pantex Plant are completed.

Earthquakes: An analysis of the effects caused by a beyond design basis earthquake of ~333 cm/sec^2 (0.33 g_0) revealed that only minimal damage to the magazines could occur. Static and dynamic earthquake analyses indicated that the magazines would not fail and their contents would not be damaged from these events.

External Explosions: An analysis of the potential for a maximum credible explosion occurring adjacent to any magazine indicated that the magazine would survive the blast without significant damage. However, minor Plant personnel injuries are possible.

External Fires: The analysis showed that only minimal damage to the magazine exterior would be expected. No damage would occur to the magazine contents.

Internal Fires: No damage to the magazine contents would be expected from this event.

Missiles: An analysis of the effects caused by tornado- and blast-generated missiles indicated that the magazine security barriers could not be penetrated. Although personnel could be injured from these events, no damage to the magazine contents would occur.

Operational Accidents: An analysis of the effects of a worst-case accident involving the puncture of a pit by a forklift showed that the whole body 50-year equivalent dose received by the workers present would be less than 7 rem.

Tornados: An analysis of effects of a local tornado with a wind speed of up to 354 km/hr (220 mph) revealed that only minimal damage to the magazines could occur. The analysis indicated that the magazines would not fail and their contents would not be damaged by tornado effects.

Building 11-16, HE Test Facility (Oven Facility)

The single hazard of facility operation is the detonation of the high explosives contained in the building. The accident scenario for the building is accidental detonation. Potential causes arise from both operational events and natural phenomena. The risk of this postulated accident is greatly reduced by the design of safety related equipment, use of administrative controls, and implementation of safe operating practices.

The postulated detonation in the facility does not release any hazardous or radioactive material either onsite or offsite. Consequences of the worst case accident are destruction of the facility with potential injury to workers in or near the building. Since this facility is a normally unoccupied facility, injuries to personnel are highly unlikely.

Building 11-20, HE Pressing/Molding

The accident analysis evaluated each credible accident scenario in terms of its likelihood and its potential effects on the general public, the Plant workers, and the environment[2]. No radioactive materials are allowed in this building, so radiation hazards are not a concern. Accidental detonation has the most severe consequences of all the potential accidents in this facility.

The facility and operations are designed such that internal explosions in any one of the bays will not cause injury to personnel in other bay areas of the facility or result in damage to occupied areas sufficient to cause additional explosions. The effects of accidental detonation would be a considerable physical damage to the facility; however, any effect on the public or the environment is expected to be negligible. The potential for fire scenarios resulting in the release of toxic materials, beyond the typical products of building fires, is negligible.

The effects on the public, Plant workers, and the environment would be negligible as a result of any internal flooding. The static analyses (at ~ 100 cm/sec^2 or 0.1 g_0) indicate that minimal structural displacement of the facility would be expected from this event. Depending on the magnitude of the tornado, severe damage to the facility structure is expected.

Building 11-36, HE Synthesis

The accident scenarios evaluated include natural phenomena (excluding earthquake, flood, and hurricane), fire, and explosion[3]. The potential hazards and accidents are evaluated with respect to causes, effects, and consequences. A summary of the accidents scenarios is provided as follows.

Tornado: In the event of tornado, the facility structure would be seriously damaged and/or destroyed (worst case scenario).

External Explosions: Blast pressures generated from an accidental detonation of maximum amount of explosives in an adjacent facility would have no effect on this facility.

Internal Explosions: Based on the maximum allowable amount of explosive in the facility, partial damage to the facility structure is expected. However, no serious personnel injuries are expected.

Fires: Fire related accidents are likely to occur in Building 11-36 due to the quantities of highly flammable materials used in the processes. The effects of fires are not as serious as an HE detonation accident. No effects to the general public or the environment are expected from this event.

Building 11-38, Explosive Development Bays

The accident scenarios evaluated include natural phenomena, fire, explosion, and high pressure vessel failure[4]. The potential hazards and accidents are evaluated with respect to causes, effects, and consequences. A summary of the accidents scenarios is provided as follows.

Earthquake: Earthquakes as large as ~333 cm/sec² (0.33 g_0) were analyzed. The analysis showed that minor damage to the facility would occur.

Explosion: Based upon the maximum allowable amounts of explosives for the nearby facilities containing significant amount of high explosives, the most stressing blast was analyzed. This event presents no significant risks to the public or the environment. Personnel injuries may be expected in the bay of occurrence.

Tornado: The analysis showed that Building 11-38 would be vulnerable to a moderate tornado or high speed winds. A hazardous material release is unlikely, since a very small quantity of HE is maintained in the facility.

Flooding: Flooding occurring near or into Building 11-38 is very remote and will not have a significant impact on the environment, public, or workers.

Maximum Credible Vessel Failure: Due to the design of the high pressure gas system, it is unlikely that a failure will occur. However, if a failure would occur, it is expected to be in the form of a split with little or no fragmentation. If fragmentation did occur, the gun room wall would contain such fragments and no significant personnel injuries would be expected.

Building 11-50, High Explosive Machining Facility

The accident initiating events evaluated in this assessment include operational accidents, internal and external events, accident in nearby facilities, and natural phenomena[5]. Over 40 potential initiating events were originally considered in this analysis. Eight types of credible accident scenarios were identified and analyzed. The potential effects of these events are discussed below.

Earthquakes: An analysis of the effects of an earthquake [~333 cm/sec² (0.33 g_0)] revealed that only minimal damage to the bays would be expected. However, the secondary effects of an earthquake could result in the loss of human life, the total loss of a respective bay, and no damage to the environment.

External Explosions: The effects on each bay of an explosion occurring in an adjacent facility were determined to be low. The construction of the bays is sufficient to withstand the blast pressures with only minor damage.

Internal Explosions: Although the bay roofs are not expected to fail given the maximum loadings, some partial failure is anticipated. However, no effects on the general public and only marginal consequences to the environment (e.g., release of hazardous material) are expected from such internal explosions.

Internal Fires: An analysis of the potential for fire in Building 11-50 included examinations of two fire scenarios for the bays and the connecting rampways. One of the scenarios is not considered to be either serious or capable of serious consequences because of the fire protection system installed throughout the building and the lack of continuity of combustibles. However, a fire involving explosive material being machined in a machining bay could lead to a detonation if the event were not properly controlled. However, this event was considered extremely unlikely; if it occurred, the consequences of this fire are considered equivalent to those presented for an internal explosion (see above).

Internal Floods: This event is not expected to cause a release of hazardous material to the environment or lead to an accidental detonation.

Missiles: An analysis of the effects of missiles generated by a tornado or other external sources indicated that the walls or doors of the bays would not be penetrated.

Tornados: An analysis of the effects of a tornado (wind speed 354 km/hr or 220 mph) indicated that only minimal damage to the bays would occur.

Operational Accidents: Operational accidents presented a moderate level of risk to the Plant workers; however, no significant effects to the general public or the environment are expected.

Building 11-51, Weapon Materials Analytical Laboratory

The Weapons Materials Analytical Laboratory is capable of sustaining credible, exterior, and interior accidental HE explosions and still maintaining its structural integrity[6]. The accident analysis showed that the effects of accident initiating events and the operations within the laboratory present no significant risks to the environment or to the public. The effects of any accident events will be limited to the interior of the facility.

Building 11-55, High Explosives Synthesis Facility

The accident initiators evaluated for the accident analysis include operational accidents, external events, and natural phenomena[7]. The preliminary accident analysis showed that the worst accident postulated would be one which occurred while Class I or II operations (68 kg or 150 lbs TNT equivalent) were being performed. Proper administrative procedures and operator training, conscientious performance of assigned duties with proper supervision, and adequate equipment to perform a mission will greatly reduce the probability of such occurrences.

In the remote probability of an accidental detonation, the public or environment would suffer minor or negligible consequences.

Building 12-17, Pressing of HE Compounds

Over 36 potential initiating events were originally considered in this analysis. Of the 36 accidents considered, eight types of credible accident scenarios were identified. A brief discussion of these events is provided in the following paragraphs.

Aircraft Crashes: The potential consequences of aircraft crash into Building 12-17 could include the complete loss of the facilities and the operating personnel. However, because Building 12-17 contains no radioactive material, the effects of such an event would be limited to the area immediately surrounding the crash site, and no effects on the general public are expected. This analysis will be updated when the results of current studies of the frequency of aircraft flights near and over the Pantex Plant are completed.

Earthquakes: No effects to the general public; an environment exposure and/or major structural failure of the facility are expected under the most pessimistic conditions.

External Explosion: The facility structure is not expected to experience complete failure as a result of an external explosion, and damage to internal contents would be limited.

Class I and II Internal Explosion: The bay roofs are expected to fail and collapse down into the bays given the maximum loadings from an internal explosion. Plant personnel could experience serious injury from blast pressures and from primary and secondary fragments; however, no effect on the general public is expected.

Internal Fires: Impacts associated with credible fire scenarios are considered to be minor due to the lack of combustibles in the facility. No significant consequences to the general public or the environment are expected from any internal fire scenario.

Internal Flood: No effect upon Plant personnel, the public, or the environment is expected because a release of hazardous material or an accidental detonation is not anticipated.

Tornado- and Explosion-Driven Missiles: Tornado- and explosion-driven missiles are not expected to initiate a detonation within the facility; therefore, no effects on the general public or the environment are expected from missile impact. Plant personnel are required by procedures to evacuate to shelters during severe weather. These missiles do not pose a credible threat to Plant personnel. The consequences of explosion-driven missiles are highly dependent on the location of Plant personnel at the time of the event; nevertheless, minor effects on the Plant personnel are expected.

Tornado: Widespread damage to the facility including the destruction of equipment is expected from this event. No effects on the general public are expected, although some minor effect on the environment may be anticipated due to the dispersal of explosive material and solvents.

Building 12-21, Nondestructive Evaluation (NDE) Laboratories

The accident scenarios evaluated include natural phenomena (excluding earthquake, flood and hurricane), fire, and explosion[8]. The potential hazards and accidents are evaluated with respect to causes, effects, and consequences. A summary of the accident scenarios is provided as follows.

Tornado: In the event of tornado, the equipment room and interlock should remain intact and would provide maximum protection to operating personnel and material.

External Explosions: Based on the analysis, major structural damage to the modified area of Building 12-21 is expected from the blast pressures generated from an accidental detonation of maximum amount of explosives in an adjacent facility.

Internal Explosions: Based on the maximum allowable amount of explosives in the facility, partial damage to the facility structure is expected. Release of radioactive material is a possible outcome of the worst case scenario. No serious effects to the general public or the environment are expected.

Fires: Because of the fire protection system in this facility, there should be no immediate hazard to personnel in the event of fire in the facility.

Building 12-24NO, Explosives Machining

A quantitative assessment and an estimate of the effects of all credible accident scenarios were performed. A summary of the six credible accidents is as follows.

Extreme Wind: Building 12-24NO is designed to withstand relatively minor structural damage while maintaining the capacity to function. The greatest potential for damage occurs with the local failure of the roof decking at its attachment to the nailers at roof purloins, due to outward pressures. This event would have negligible consequences.

Earthquakes: The principal effect of the seismic event will be to induce additional lateral and vertical loads. The seismic resistance of the structure is sufficient to provide safety and guarantee reusability after a seismic event.

Lightning: A direct lightning strike to the overhead ground wire lightning protection system would be expected to cause negligible consequences and no consequences to the general public.

Internal Explosions: The consequences of a 5.4 kg (12 lb) HE explosion in a Class I bay are minimal outside of the bay. Personnel in nearby bays may be subject to partial roof collapse or injury from a dislodged light. An explosion of 88 kg (193 lb) of HE in a Class II bay would result in catastrophic destruction of the incident bay, the adjacent bays, and the adjacent corridors, with the associated damage to equipment and personnel.

External Explosions: Explosions in neighboring facilities would have a negligible consequence to operations or personnel in Building 12-24NO.

Fire: A fire in Building 12-24NO would result in marginal consequences to the public and the environment.

Building 12-26, Pit Vault

A quantitative assessment and an estimate of the effects of all credible accident scenarios were performed[9]. A summary of the five credible accidents is as follows.

Earthquake: The effects of earthquakes as large as ~333 cm/sec^2 (0.33 g_0) were analyzed. The analysis showed that only minimal damage to the vault would occur.

External Explosion: Based upon the maximum allowable amounts of explosives for the nearby facilities containing significant amounts of high explosives, the most stressing blast was analyzed. The vault construction is sufficient to withstand blast pressures with only a minimal amount of damage to the vault exterior.

Missiles: The effect of missiles driven by tornado indicated that the vault walls or doors could not be penetrated.

Tornado: The analysis showed that a tornado with a wind speed of 354 km/hr (220 mph) will cause minimal damage to the vault.

Structural Interactions: An analysis of the effects of the collapse of Building 12-26 onto the vault revealed that only minimal, cosmetic damage could occur. The vault roof would not fail and the pits and RTGs would not be damaged by these events.

Building 12-42, North Vault

The identification of accidents and initiating events was supported by screening assessments of over 40 potential initiating events. No postulated credible accident or design basis accident was found to breach the protective systems associated with the facility and to challenge the ability of the RTG to prevent the release of hazardous materials. A summary of accidents and their effects on the facility safety systems appears below.

Aircraft Crash: Aircraft crash is a credible event for the general area in which the vault is located; however, the small size of the vault reduces the probability of this accident to an incredible event. This analysis will be updated when the results of current studies of the frequency of aircraft flights near and over the Pantex Plant are completed.

Criticality: Criticality is not a credible event, since more than 20 kg (44 lbs) of plutonium oxide would be required to approach criticality. Only 18 kg (40 lbs) maximum loading is expected in the vault.

Earthquake: The effects of earthquakes as large as ~333 cm/sec^2 (0.33 g_0) were analyzed. The analysis showed that the vault structure will withstand the effects without failure.

External Explosion: Based upon the maximum allowable amounts of explosives for the nearby facilities containing significant amount of high explosives, the most stressing blast was analyzed. The vault structure was shown to withstand the blast effects without failure.

External Fire: The analysis showed that the vault structure and facility fire protection features, as well as the building fire detection and fire protection systems, provide sufficient margin against all credible external fires.

Missiles: The vault structure will withstand the effect of missiles driven by tornado without failure.

Tornado: The analysis showed that a tornado with wind speed of 354 km/hr (220 mph) will not cause the vault structure to fail.

Building 12-42, South Vault

The accident analysis considered 26 potential initiating events. Eight types of credible accident scenarios were identified and analyzed[10]. The potential effects of these events are as follows.

Earthquakes: An analysis of the effects of beyond design basis earthquake ~333 cm/sec² (0.33 g_0) revealed that this event not would produce the structural failure of the South Vault. The steel cabinets containing the majority of tritium reservoirs staged in the vault are bolted to the walls of the South Vault and would not be toppled by the event. The analysis also indicated that internal systems (fire protection, air conditioning) are not expected to fail as a result of this event.

Explosions: The results of the analysis show that the South Vault is sufficiently sturdy to withstand the forces of explosive detonations in nearby facilities with a considerable margin of safety.

Internal Fires: Due to a lack of combustible materials inside the South Vault, a fire originating inside the vault would produce only minor smoke damage and no damage to the contents staged inside the vault.

Internal Floods: Floods internal to the vault (caused by the inadvertent actuation of the sprinkler system) were judged to present a negligible hazard to the facility workers, co-located workers, the public, or the environment.

Missiles: Deterministic analysis of the effects caused by tornado-driven missiles indicated that the vault walls or door could not be penetrated. No damage to the tritium reservoirs would occur from this event. Qualitative analysis indicated that blast-driven missiles would not damage the South Vault.

Operational Accidents: An analysis of potential operational accidents in the South Vault revealed that a tritium reservoir mishandling accident could lead to a release of tritium gas. The potential consequences of an accidental release of tritium from a single reservoir in the South Vault are marginal for the facility workers. The radiological dose to the public and the level of environmental contamination from the release would be negligible, even if the release was in the form of tritiated water.

Structural Interactions: An analysis of the effects of the collapse of Building 12-42 onto the South Vault revealed that the vault would survive with only minor damage. The analysis indicated that the vault roof would remain intact and the tritium reservoirs inside the vault would not be damaged.

Tornado: Deterministic analysis of the strength of the South Vault indicated that the effects of a tornado (a beyond design basis event) could be withstood by the South Vault with only minor exterior damage.

Buildings 12-44 (Cells 1-6), 12-85, 12-96, and 12-98 Assembly/Disassembly Cells

The accident analyses included an evaluation of potential process-related, natural phenomena, and external hazards that can affect the public, workers, and the environment[11,12,13]. A brief summary of the accident analyses is given in the following few paragraphs.

Earthquakes: The analyses show that there is adequate steel reinforcement at the foundation wall interface to prevent damage to the cell structure during an earthquake.

Tornado: Because of the features of the facility design, the cells are not vulnerable to tornado and high winds.

Missiles: The analysis show that tornado-driven missile will penetrate the covering of the facility corridors but will not penetrate blast doors, concrete walls or roofs of cells and other occupied areas.

Flooding: Accumulation of standing water was incredible given the location of the facility.

External Explosion: The analysis showed that steel fragments resulting from accidental explosion of the nearby facilities containing explosives and hitting the earth-covered reinforced concrete walls of the occupied areas would not penetrate or cause spalling of inside surfaces.

Lightning Strike: The cells are protected by an integral lightning protection system.

Operational Accidents:

Pit Breach with Plutonium Release: The overall consequences to the workers and the facility from this postulated accident are judged to be small. The dose to facility workers would be within the range of normal operational doses and the doses to the public would be negligible. The probability of the pit drop accident is assessed to be unlikely.

Tritium Release Accident: The potential consequences of an accidental tritium release in one of the cells are small. The estimated dose to the facility workers is within the range of normal occupational exposures. The dose at the site boundary is considerably less than the 5 rem limit for unlikely accidents.

Fire: Stringent measures have been taken to limit the amount of flammable and combustible materials present in the cells, which greatly minimizes potential ignition sources in the cells. The cells are equipped with a highly reliable fire protection system. The likelihood of fires in the cells is much smaller as a result of these measures. Plutoniumdispersal due to internal fires was examined and found to be incredible.

Internal Explosion: The probability of an internal explosion in the cells is extremely unlikely. Such an event would have catastrophic consequences for any workers present in the cell and the structure itself. However, the unique features of the cells including the gravel roof provide significant mitigation of the consequences outside the cell.

Internal Flooding: The analysis showed that the potential consequences of an internal flood caused by inadvertent actuation of a single sprinkler head could range from negligible to marginal. The marginal consequences are primarily due to the costs of water damage to equipment and materials and programmatic interruption if radioactive material is not present. Negligible consequences would result if radioactive materials are present; however, they would not be more severe than a pit handling/drop accident.

Aircraft Crash: The probability of an aircraft crash into any one of the cells was found to be credible. However, the analysis showed that penetration of the cell structure by the type of aircraft that dominated the crash probability was not possible. Thus the probability of an aircraft crash leading to the dispersal of plutonium was found to be incredible. This analysis will be updated when the results of current studies of the frequency of aircraft flights near and over the Pantex Plant are completed.

Building 12-44, Cell 8

The accident analysis identified several types of credible accident scenarios[14]. The potential effects of each of these events are discussed below:

Earthquakes: The potential consequences of the DBE or MCE on Cell 8 or its contents could range from negligible to marginal. Because of the design of the facility, no damage to the pit containers is expected. Consequently, no effects on the general public, the plant workers, or the environment are expected from either the DBE or MCE. Minor damage to Cell 8 such as cracking or spalling of the concrete walls or roof might occur or some of its process or utility systems may receive minor damage as well, but dollar loss would be relatively small.

External Explosions: The potential consequences of the blast overpressures from the maximum adjacent explosion on Cell 8 or its contents are considered negligible. Because of the design of the facility, damage would be minimal. Consequently, no effects on the general public, the plant workers, or the environment are expected from a blast. Minor damage to the Cell 8 outer blast door may occur, but the dollar loss would most likely be relatively small.

Internal Fires: The analysis shows that fire would not lead to any release of radioactive material, thus there is no radiological threat to the public, the environment, or the workers. The consequences to the public, the plant worker, and the environment are negligible. Marginal consequences would result in equipment damage from smoke and/or water.

Tornado-Driven Missiles: The potential consequences of tornado-driven missiles on Cell 8 and the possible consequences to the contents are considered negligible. Consequently, no effects on the general public, the plant workers, or the environment are expected from the missile types considered. Minor damage to the blast door may occur from the partial penetration of the missiles, resulting in relatively small dollar losses for repairs. No program interruptions are anticipated due to tornado-driven missiles.

Explosion-Generated Missiles: The potential consequences of blast-driven missiles on the contents of Cell 8 are considered marginal. The effects on the public are marginal (an expected dose of 6.3 mrem, which is well below DOE criteria). The effects on plant workers are also considered to be marginal. The effect on the environment is considered negligible. Damage to the Cell 8 door and the AL-R8 containers, as well as to one pit, would result in a marginal dollar loss, including the decontamination that would take place. Only a minor program interruption would be expected while minor decontamination of the vicinity immediately surrounding the entrance to Cell 8 occurred.

Operational Accidents: The operational accidents identified in this analysis and their effects on the general public and the environment would be negligible. However, the effects on Cell 8 personnel and operations would be marginal due to exposure to radioactive material. The radiological dose received by workers in a worst-case scenario is significantly less than the 5 rem annual dose limit established by DOE for occupational workers.

Internal Floods: The analysis showed that the potential consequences of a credible flooding scenario (one in which no radioactive material is involved) is considered negligible. Consequently, no effects on the public, the plant workers, or the environment are expected. Water damage to equipment could result in a marginal dollar loss, but no program interruptions are anticipated.

Tornado: The potential consequences of tornados on the cell or its contents could range from negligible to marginal. Because of the massive construction features of Cell 8, no injury to personnel inside the cell or damage to the pit containers is expected. Consequently, no effects on the general public, the plant workers, or the environment are expected from either the Design Basis Tornado (241 km/hr or 150 mph) or the Maximum Credible Tornado (354 km/hr or 220 mph). Exterior damage to the cell may occur to the Gunite cap and some gravel may be removed but the dollar loss would most likely be modest.

Building 12-56, Radiography Facility

The preliminary accident analysis evaluated internal, external, and natural phenomena events, with regard to potential consequences to the public, workers, and the environment. The results are as follows.

External Fires: The most likely components to be damaged by this event would be the corridor leading to the building and the roof on the radiography bay. The secondary impacts from the roof destruction would be minimal since the building's internal component would be protected by the sprinkler system.

Internal Fires: If this event occurred, possible exposure to workers within the building would be expected. However, no effects on the general public or the environment would be expected.

Flooding: The possibility of water accumulation in the building is minimal. The analysis indicated that no significant damage to the structure of the facility or the internal components is unexpected.

Tornado: The effects on the facility and associated occupied areas would be negligible in the event of a tornado (354 km/hr or 220 mph wind speed).

Missiles: Tornado generated missiles would likely penetrate only the west side and the roof of this building.

Earthquake: The analysis showed that the design and the strength of the facility structure would prevent significant damage to this building during an earthquake.

Explosions: The consequences as a result of this event would be low to moderate. However, the frequency of this event would be extremely unlikely based on the operating procedures, administrative controls, and the design of the mechanical systems used in the operations.

Building 12-58, Magazine Bays

The accident initiating events evaluated include operational accidents, internal and external events, accidents in nearby facilities, and natural phenomena[15]. Accidents that were analyzed and determined to be incredible included aircraft crashes, criticality events, and external and internal fires. Six types of credible accidents scenarios were identified and analyzed. The potential effect of these events are discussed below.

Earthquakes: The analysis showed that the effects caused by a design basis earthquakes [$\sim$100 cm/sec^2 (0.10 g_0)] and a maximum credible earthquake [$\sim$300 cm/sec^2 (0.30 g_0)] will result in minimal damage to the bays. However, the ceiling mounted HVAC unit is expected to fail during the maximum credible earthquake. The potential effects of this could produce substantial consequences, principally due to the level of local decontamination that would be required and the moderate radiological exposure to the workers involved in decontamination and cleanup activities. The radiological dose to the public and the level of environmental contamination from this operational accident would be minimal.

External Explosions: The effects on the bays of an explosion occurring in an adjacent facility were determined to be minimal. No damage to the ORO items would occur from this event.

Internal Floods: Floods internal to the bays were judged to present a negligible hazard to the Plant workers, the public, or the environment.

Missile: An analysis of the effects caused by tornado-generated missiles indicated that the bays' wall or doors could not be penetrated.

Tornado: An analysis of the effects caused by a tornado with wind speed of 354 km/hr (220 mph) revealed that only minimal damage to the bays could occur.

Operational Accidents: An analysis of potential accidents in the bays showed that a mishandling accident involving ORO items could not lead to a release of hazardous and/or radioactive materials.

Building 12-62, PETN Processing Facility

The accident initiating events evaluated in this assessment include operational accidents, internal and external events, accident in nearby facilities, and natural phenomena[16]. Over 40 potential initiating events were originally considered in this analysis. Seven types of credible accident scenarios were identified and analyzed. The potential effects of these events are discussed below.

Earthquakes: An analysis of the effects of an earthquake [$\sim$333 cm/sec^2 (0.33 g_0)] revealed that only minimal damage to the facility would be expected. The loss of human life, the loss of the use of the facility, and damage to the environment are not expected.

External Explosions: The effects of an explosion occurring in an adjacent facility were determined to be relatively minimal. The construction of the facility is sufficient to withstand the blast pressures with only marginal damage.

Internal Explosions: Although the facility is not expected to fail given the maximum loadings, some partial failure is anticipated. However, no effects on the general public and only marginal consequences to the environment (e.g., release of hazardous material) are expected from such internal explosions.

Internal Fires: Because of the fire protection system installed in the facility, including the solvent storage area, the consequences of this fire are considered relatively insignificant.

Internal Floods: The potential consequences of an internal flood within a bay in Building 12-62 are expected to be relatively insignificant. Although this event could cause a very small release of hazardous material to the environment, it is not expected to lead to a detonation.

Missiles: An analysis of the effects of missiles generated by a tornado or other external sources indicated that the cemesto walls, frangible panels, and the roof of Bay 6 would be penetrated. No further damage to the building contents is expected.

Tornado: An analysis of the effects of a tornado (wind speed 354 km/hr or 220 mph) indicated that only minimal damage to the facility would occur.

Building 12-63, HE Pressing Facility

The accident initiating events evaluated in this assessment include operational accidents, internal and external events, accident in nearby facilities, and natural phenomena[17]. Over 40 potential initiating events were originally considered in this analysis. Seven types of credible accident scenarios were identified and analyzed. The potential effects of these events are discussed below.

Earthquakes: An analysis of the effects caused by earthquake [$\sim$333 cm/sec^2 (0.33 g_0)] revealed that only minimal damage to Bays 1, 2, and 3 would be expected. Static earthquake analyses indicate that Bays 1, 2, and 3 would not fail during earthquake.

External Explosions: The effects on each bay of an explosion occurring in an adjacent building or other bay within Building 12-63 were determined to be moderate. The construction of the bays is sufficient to withstand the blast pressures without structural failure or collapse. However, individuals located near the bays during an extreme explosion could be severely injured as a result of these blast forces.

Internal Explosions: The bay roofs are expected to fail as a result of this event. No effects on the general public and only marginal consequences to the environment, i.e., release of hazardous material, are expected from any type of internal explosion.

Internal Fires: A fire involving HE material in process on the Syntron table (Bay 3) could lead to a detonation if the event were not properly controlled. Although this event was considered extremely unlikely, the consequences of this fire are considered equivalent to those presented for an internal explosion (see above).

Internal Floods: This accident scenario is not expected to cause a release of hazardous material or lead to an accidental detonation and, therefore, would not affect the general public, the Plant workers, or the environment.

Missiles: An analysis of the effects caused by missiles generated by a tornado or other external sources indicated that the walls or doors of the bays would not be penetrated.

Tornado: An analysis of the effects caused by a tornado (wind speed 354 km/hr or 220 mph) reveals that only minimal damage to the bays would occur.

Buildings 12-64, 12-84, 12-99 and 12-104, Assembly/Disassembly Bays

The accident analysis identified and evaluated eight accident initiating events that have the potential for significant consequences[18,19,20,21]. Of these initiating events, the operations that occur within the bays have the potential for severe consequences. A brief summary of these events is given below.

Operational Accidents:

Pit Breach with Plutonium Release: The overall consequences to the workers and facility from this event were judged to be marginal. The effects on the public and the environment are considered to be negligible.

Tritium Release Accident: The potential consequences of an accidental tritium release in one of the bays are negligible for the workers in bays given proper PPE utilization during the operational stages. The analysis showed that the dose at the site boundary is expected to be less than the annual exposure of the average individual from all sources of radiation.

Explosion or Combustion of High Explosives with Plutonium Dispersal: The accident analysis showed that the explosive dispersal of plutonium and burning dispersal of plutonium are incredible events.

Radiographic Overexposure: The radiation overexposure hazard does not involve the release of radioactive or toxic materials.

Fires: The analysis showed that the annual probability of fires in the bay was assessed to be unlikely or extremely unlikely and the consequences of these events would be negligible. The worst case scenario would result in the detonation or combustion of high explosives and the dispersal of plutonium; however, this event is judged to be incredible.

Internal Explosions: If an explosion were to occur in one bay, the personnel and the contents located in adjacent bays in the facility would be protected.

The operational accident resulting in the detonation of high explosive was examined and found to be an incredible event.

External Explosions: The analyses show that the reinforced concrete walls of the bays would not be penetrated from the explosion in the nearby facilities.

Accidental Criticality: Accidental criticality as an operational event was found to be incredible.

Internal Floods: The probability of flooding was judged to be a likely event, but the consequences were expected to be negligible.

Earthquake: The static analyses indicate that each facility would survive this event with minimal structural displacements and effects. The analyses show that earthquake induced detonation and accident criticality are incredible events.

Tornado: Because of the features of the facility design, occupied areas would sustain no structural damage. The covering over unoccupied areas is expected to fail.

Missiles: Bays facilities are not considered vulnerable to tornado-generated missiles. A missile would not only have to penetrate the walls of the bays, but also would have to hit and damage a weapon assembly for release of radioactive material. The combination of these events was considered to be incredible.

Aircraft Crash: A likelihood of an aircraft hitting one of the bays was examined and found to be an incredible event. An aircraft crash into one of the bays together with penetration of bay walls as a result, was considered to be incredible. A subsequent impact from an aircraft crash would have the potential to ignite the explosives in a weapon leading to dispersal of the radioactive contents; however this event was found to be incredible. This analysis will be updated when the results of current studies of the frequency of aircraft flights near and over the Pantex Plant are completed.

Building 12-65 and 12-83, Service Magazine

The accident analysis evaluated potential hazards that can have significant impact on operating personnel, the environment, and the general public[22,23]. A brief summary of the credible accident scenarios is given below.

Flood: Because the Plant is located in an historically low flooding area, flooding from local streams, or any other source, was assessed to be incredible.

Earthquake: The analyses indicate that the concrete masonry and the pre-engineered metal building portion of the building are structurally adequate under seismic loading.

Lightning: The integrated lightning system in this building will limit and localize damage to facilities, and ensure that the effects on personnel and hazardous materials are negligible.

Tornado: The analyses of a tornado event on this building revealed that the effects of pressure created by high winds are negligible.

Missiles: The analysis show that tornado-generated missiles will penetrate the fabricated metal exterior wall of the ramp area. However, missiles will produce no structural damage to the concrete wall of the building or the doors.

Explosions: The most severe credible accident which would affect the facility would be an explosion inside the facility; however, this postulated accident would be unlikely with the limited quantity of explosive in the facility.

Fires: Due to limited amount of flammable/ combustible material, this event was examined and found to be unlikely.

Building 12-71 and 12-95, Class C Magazine

The accident analysis evaluated potential hazards that can have significant impact on operating personnel, the environment, and the general public[24,25]. A brief summary of the credible accident scenarios is given below.

Flood: Because the Plant is located in an historically low flooding area, flooding from local streams, or any other source, was assessed to be incredible.

Earthquake: The analyses indicate that these buildings are structurally adequate under seismic loading.

Lightning: The integrated lightning system in this building will limit and localize damage to facilities, and ensure that the effects on personnel and hazardous materials are negligible.

Tornado: The analyses of a tornado event on this building revealed that the building structure would be vulnerable to tornado and high winds.

Missiles: The analysis shows that tornado-generated missiles will penetrate the building structure; however, no significant effects on personnel, the public, or the environment would be expected.

Explosions: Both external and internal accidents would affect the integrity of the facility structure; however, this postulated accident would be unlikely considering the limited quantity of explosive within the facility.

Fires: Due to the limited amount of flammable/combustible materials, this event was examined and found to be unlikely. If a fire accident occurred, personnel injuries are likely but it would not impact the public or the environment.

Building 12-78, Remote Hole Drilling Facility

Consideration was given to natural phenomena events and operational accidents that may cause facility damage or personnel injury either as a result of direct action of the event or as a primary initiated mechanism[26]. Events analyzed are summarized below.

Lightning: Lightning was the only natural phenomenon considered for this facility. The likelihood of occurrence was considered occasional with a negligible consequence.

Explosion: An explosion in or adjacent to the facility was analyzed. The likelihood of this event was considered remote with a catastrophic consequence.

Fire: Two scenarios involving a facility fire were analyzed. A fire event with a functional fire suppression system was assigned an occasional likelihood of occurrence. A fire event with no functional fire suppression system was assigned a remote possibility of occurrence. In both scenarios the consequence of the event was considered critical.

Building 12-86, Inert Assembly Test Facility

The evaluation of the facility's safety was accomplished by analysis of the response of the facility to potential hazards and postulated malfunctions or failure of equipment and material[27]. Events analyzed are summarized below.

Lightning: The probability of lightning striking the facility was categorized as occasional. The consequence of this event was negligible.

Explosions: An explosion event may occur either internal to the facility or external in an adjacent facility. The likelihood of this event occurring was considered extremely improbable. The consequence associated with an explosion in an adjacent facility was considered marginal. An internal explosion would result in a catastrophic event.

Fire: Due to limited quantities of combustible and flammable materials and the control of ignition sources, the probability level of fire in this facility was considered remote. A fire event would correlate to a marginal consequence category.

Toxic Material Release: The probability of this event, based on review of existing Pantex Industrial Hygiene Exposure Records, may be conservatively considered to be reasonably probable. Consequences of this event were categorized as marginal.

Building 12-94, Weapons Aging Facility

The accident initiating events evaluated in this assessment include operational accidents, internal fires, external explosions, accidents in nearby facilities, and natural phenomena[28]. The potential effects of each of the analyzed events are discussed below.

Aircraft Crash: The analysis showed that aircraft crash is incredible; therefore, this accident was not further analyzed. This analysis will be updated when the results of current studies of the frequency of aircraft flights near and over the Pantex Plant are completed.

Earthquakes: An analysis of the effects of a design basis earthquake revealed that only minimal damage to the facility could occur. Analyses indicate that the structure would not fail, and its contents would not be damaged from such an event.

External Explosions: The results of the analysis show that the building is sufficiently sturdy to withstand the forces of such detonations with a considerable margin of safety. The contents of the bays would be unaffected by the worst-case external explosion. Plutonium dispersal from an explosion in a nearby assembly cell facility was considered extremely unlikely.

Internal Fires: A fire hazards analysis revealed that there are insufficient combustible materials within the facility to produce large, long-lasting fires even if the fire protection system fails. The high explosive in test assemblies is well protected from a fire by the environmental chambers and by the outer casing of the assembly.

Operational Accidents: An operational accident has been analyzed involving release of the contents of a tritium reservoir to the atmosphere of the Aging Bay. The potential for such an event was assessed to be incredible and was based on operating experience at Pantex and the Mound Laboratory, rather than on the identification of a specific mechanistic cause for actuation, such as an electro-static discharge.

Tornado: Deterministic analysis of the strength of Building 12-94 indicated that the effects of the tornado could be withstood by the facility with some minor exterior damage. The contents of the facility would be unaffected.

Building 12-104A, Weapons Special Purpose Bays Replacement Complex

Consideration was given to natural phenomena and operational accident events that may cause facility damage or personal injury either as a result of direct action of the event or as a primary initiating mechanism[29]. The events considered are summarized below.

Earthquake: Based on analysis, the probability of an earthquake was considered either unlikely or extremely unlikely and the consequences of this event range from negligible to marginal.

Tornado: Analysis indicated that occurrence of this event was extremely unlikely with negligible consequences.

External Explosion: Analysis indicated that the probability of the external explosion event was extremely unlikely and the consequences are negligible.

Operational Accident: Two scenarios were evaluated for this event; a bare pit drop during handling, and a tritium release accident. The probability of occurrence ranged from unlikely to extremely unlikely. Both event scenarios resulted in a marginal consequence.

Building 12-116, SNM Component Staging Facility

The accident analyses included aircraft crashes, earthquakes, external explosions, missiles, internal fires, internal floods, tornados, and operational accidents[30]. A brief summary of these events follows.

Pit Breach with Plutonium Release: The probability of this accident category was unlikely. The overall consequences to workers and the facility from this postulated accident were marginal. The effects on the public and the environment were considered to be negligible.

Tritium Release Accident: The potential consequences of an accidental tritium release were negligible for the workers in the bay. The analysis showed that the dose at the site boundary was well below established limits.

Fires: The annual probability of fires in this facility was unlikely or extremely unlikely, and the consequences would be negligible.

Aircraft Crash: An aircraft crash into this facility could present a threat to the contents due to impact, puncture, fragments, fire, etc. However, the probability of an aircraft crash into the facility was incredible. This analysis will be updated when the results of current studies of the frequency of aircraft flights near and over the Pantex Plant are completed.

Internal Flooding: The overall probability of internal flooding in the building was extremely unlikely.

Radiation Overexposure: Radiation overexposure incidents involving the radiography equipment resulting in significant doses were unlikely. The potential for a lethal dose of radiation was in the extremely unlikely category.

Accidental Criticality: This event was found to be incredible.

Earthquake: The static analyses indicate that the facility would survive both a design basis earthquake and a maximum credible earthquake with minimal structural displacements and effects. Furthermore, earthquake-induced criticality was incredible.

Tornado: A tornado with a wind speed as high as 354 km/hr (220 mph) would result in no structural damage. Damage to walls, doors, or ceilings, would be limited to external roof coverings and ducting. The covering over unoccupied areas (ramps and corridors) was expected to fail, along with water-repellant roof coverings, including those over the bays.

Missiles: The analysis showed that missiles would penetrate the covering of the facility corridors, but would not penetrate blast doors, concrete walls or roofs of occupied areas. Missile penetration into concrete walls or ceilings would be minimal and would not result in cracking or spalling of the inner wall surface.

External Explosions: The analysis showed that steel fragments hitting the 45.7-cm (18-in.) thick reinforced concrete walls of occupied areas would not penetrate or cause spalling of inside surfaces. The effects on personnel, the public, and the environment would be negligible.

Building 12-121, High Explosive Machining Facility

The evaluation of the safety of the facility was accomplished by analyzing the response of the facility to potential hazards and postulated malfunctions or failure of equipment and material[31].

Earthquakes: A design basis earthquake event was considered extremely unlikely at this facility. Since the seismic resistances of the structure are sufficient to provide safety and guarantee reusability after the seismic event, the consequence category associated with the earthquake event was negligible.

Tornado: Based on reported tornado frequency, it is extremely unlikely that this event would occur at Building 12-121. The facility was designed to accommodate the design basis tornado event. Thus, tornadic effects on the structure are considered to be negligible in terms of personnel safety and public protection.

Lightning: Based on National Weather Service information, this event was likely to occur frequently in the general area of the facility. However, a direct lightning strike to the facility was unlikely. A lightning strike may damage the lightning protection system and mounting structure, but the consequence of this event was considered negligible.

Explosion: The effects of an explosion on the High Explosives Machining Facility were considered in the facility design. Analysis of the activities that could result in an explosion indicate that the occurrence of this event would be extremely unlikely. The consequence of this event was considered catastrophic.

Fire: Due to the limited quantities of combustible and flammable materials and the control of ignition sources, it is extremely unlikely that a fire would occur in this facility. A design basis fire would result in a consequence ranging from marginal to critical.

Building 16-16, RCRA Hazardous Waste Staging Facility

Buildings 16-16 is being designed to withstand a variety of internal and external situations. Each situation considered in designing the facility is summarized in the following paragraphs[32].

Earthquakes: Based on analysis, the building anchorage to its foundation can withstand accelerations well beyond the suggested design basis event. The probability of this event was extremely unlikely. The consequence category for this event was in the critical range.

Tornados/Winds: Based on analysis, the probability of Building 16-16 being struck by straight line winds greater than 125.5 km/hr (78 mph) (design basis) or a tornado falls in the likely category. Analysis of the tornado/wind event resulted in a consequence category of critical.

Airplane Crashes: The probability of an airplane striking the facility was investigated and categorized as incredible, with a consequence category of critical. Therefore, this initiating event need not be considered further.

Chemical/Toxic Gas Releases: An event involving the release of a toxic gas resulting from mixing incompatible chemicals was evaluated. The probability of this event occurring is in the incredible range. Note that it is difficult to specify in detail the types of waste that might be staged in Building 16-16. The accident could become credible if significant quantities of concentrated acid are handled in the building and incompatible compounds such as cyanide wastes were also handled.

External Explosions: The closest facilities that contain high explosives are Buildings 12-104A and 12-121. Both are over 610 m (2,000 ft) away.

An explosion at one of these facilities will not result in blast pressures or fragments that could damage Building 16-16.

Internal Fires/Explosions: Based on analysis, the probability of a fire or explosion is expected to be in the extremely unlikely category. The consequence of such a fire or explosion has been classified as critical.

Internal Floods: The only significant source of water in the facility is the dry pipe sprinkler system. The probability of inadvertent actuation of this system was extremely unlikely.

Missiles: No facilities are close enough in which explosions could generate missiles that would threaten Building 16-16.

Operating Incidents: Since the facility handles hazardous and radioactive materials, operator-initiated accidents have the potential for initiating an accident sequence. The probability of a handling error resulting in a significant event was in the incredible category with consequences categorized as marginal.

Building FS-2, Firing Site 2

The safety of the facility was evaluated by analyzing the response of the facility to potential hazards and postulated malfunctions or failure of equipment. Events analyzed are summarized in the following paragraphs.

Earthquakes: Based on a maximum credible seismic event, the frequency of occurrence of an earthquake was expected to be either remote or extremely improbable. The seismic resistance of the structure was sufficient to provide both safety during and reusability after the seismic event.

High Winds: Facilities in which HE is staged or processed are required to resist winds that have a 100-yr mean recurrence level (148 km/hr or 92 mph). Therefore, the concrete structure would not be affected by the 148 km/hr (92 mph) high wind event. A likelihood of reasonably probable was assigned to this event.

Lightning: This event is likely to occur frequently in the area of the facility. The facility is equipped with a complete lightning protection system to limit and localize damage and ensure that effects to personnel and hazardous materials are negligible.

Snow, Ice, and Hail: These events are likely to occur frequently at the facility; however, the structure will not be damaged.

Explosion within FS-2: Given the occasional use of this facility, the limited operations conducted therein, and Plant HE safety rules and regulations that govern the operations conducted, the probability of an HE detonation within this facility was considered to be extremely improbable. An accidental detonation in FS-2 could completely destroy the facility and result in the death of all persons working within the structure.

Explosion in an Adjacent Facility: The probability of this event was extremely improbable. An accidental detonation of the HE in a test fire bay in a nearby facility would result in an exposure of FS-2 to overpressures in the range of 2,812 kg/m² (4 psi).

Fire: Due to the limited quantities of combustible materials, limited use of the facility, and the control of ignition sources, there was a remote probability for a fire in the facility. Consequences of this event were assumed to be negligible.

Building FS-11 and FS-11A, Addition to FS-11

Renovation of Building FS-11 (Fabrication Facility) was accomplished as part of the construction project for Building FS-11A and is also covered in this section.

Accident analysis was discussed in the Final Safety Analysis Report for Addition to FS-11 and is summarized below[33].

Tornado: The old FS-11 and the FS-11A (Addition) were not designed to be tornado resistant and would be expected to be severely damaged or destroyed in a tornado event.

Earthquake, Flood, and Hurricane: These events were not taken into consideration in the accident analysis.

High Explosive Detonation in an Adjacent Facility: A high order detonation event in the nearest adjacent facility (FS-2) is expected to cause some damage to FS-11 and support facilities, but no damage to the assembly bays (FS-11A).

High Explosive Detonation an Assembly Bay (FS-11A): An accidental detonation in an assembly bay would likely result in the donor bay being destroyed or damaged beyond repair. Adjacent areas would be heavily damaged. However, adjacent assembly bays would sustain only minor damage, and equipment and materials housed in these bays would sustain no damage or, in a worst case, only very minor damage.

Fire: Significant loss due to a fire was considered to be very low and possibly non-credible.

Building FS-21, Test Firing Facility

Six postulated accident scenarios were identified and analyzed for Building FS-21[34]. A description of these scenarios is summarized below.

Earthquakes: Because no nuclear material or high explosives are housed within the confines of this structure, the requirements for seismic resistance imposed by DOE Appendix 6301, "Building and Facilities Design, Section C - High Explosives Facilities," March 1977, are met by conformance with the Uniform Building Code for which structures are routinely designed. The occurrence of a postulated earthquake event was considered extremely improbable and consequences from such an event would be negligible.

Tornado: Analysis of Building FS-21 indicated that the facility has an extremely low vulnerability to tornados. The tornado decompression and/or design based missile would have no effect on the integrity of this heavily reinforced firing site or associated magazine structure. The occurrence of the postulated tornado was considered remote and would result in critical consequences.

High Winds: The design basis extreme wind is assumed to have a maximum wind speed equal to that of the tornado event. Thus, a high wind event was adequately covered by the tornado event analysis. The likelihood of a high wind event was assigned a frequency of occasional and a consequence category of marginal.

Flood: Pantex Plant is not located in an area subject to flooding. Thus, flooding from local streams or any other source is not a credible accident and was assigned a likelihood category of impossible.

Explosion: The accidental detonation of HE at the facility was considered. An event of this type was considered remote with catastrophic consequences.

Fire: Due to the low fuel loading and the low continuity of combustibles in this facility there is a low probability for fire. For a fire event (with no HE detonation) the likelihood of occurrence was considered occasional with a critical consequence.

Building FS-23, Interim Total Containment Test Fire Facility

Consideration was given to natural phenomena and operational accidents that may cause facility damage or personnel injury, either as a result of direct action of the event or as a primary initiating mechanism[35]. The analysis of the impacts of natural phenomena and operational accidents are summarized below.

Earthquakes: Because no special nuclear material is housed within this structure, the requirements for seismic resistance imposed by DOE Order 6430 were met by conformance with the Uniform Building Code for which the structure was designed.

Tornado: Analysis of the effects of design basis tornado on the structure has been performed and indicated that the Containment Chamber will survive the design basis severe tornado intact.

High Winds: The facility was designed to withstand the required 148 km/hr (92 mph) design basis wind load of the Uniform Building Code, and tornado analysis indicated that it is capable of surviving greater than a 402 km/hr (250 mph) wind load.

Lightning: This facility is equipped with an approved lightning protection system; therefore, damage by lightning is not considered a credible accident.

Toxic Releases: Toxic releases are controlled by procedures, interlocks, and design safety factors; therefore, an unacceptable release of a toxic material was considered extremely improbable. Minor releases due to leakage or release from cleanup operations are considered to occur occasionally with negligible consequences.

Explosion: An explosion resulting in failure or breaching of the Containment Chamber was considered extremely improbable. The consequence of such an explosion was considered critical since major facility/operation damage may occur.

Fire: An operational accident involving fire was considered but was determined not to constitute a credible event.

Building FS-24, Explosives Test Fire Facility

The primary potential hazards for this facility are associated with fire, explosion, and lightning. The credible accident scenarios are summarized below[36].

Lightning: Analysis of a lightning strike occurrence indicates that this event was unlikely and would be of negligible consequence.

Operational Accidents: An accidental detonation of high explosives in either the Test Chamber Rooms prior to closure of the Chamber doors or in the Environmental Room friction oven was considered. An event of this type was considered extremely unlikely with catastrophic consequences.

Fire: The maximum credible fire (assuming the fire suppression system functions as designed) was postulated to be one in the Control Room involving the electric test equipment. The fire loading and continuity of combustibles would not be expected to support a fire that could extend beyond the room. This event was considered extremely unlikely and would result in consequences ranging from marginal to critical, dependent primarily on the extent of equipment damage.

REFERENCES

1. Mason & Hanger - Silas Mason Co., Inc., *Zone 4 Magazines, Final Safety Analysis Report*, UCNI, Pantex Plant, Amarillo, Texas, December 1992.

2. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Building 11-20, Development Support Facility*, Pantex Plant, Amarillo, Texas, September 1975.

3. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report Building 11-36,*

High Explosives Synthesis Facility, Pantex Plant, Amarillo, Texas, December 1975.

4. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Projectile Impact System and Modified Facility (11-38)*, Pantex Plant, Amarillo, Texas, November 1986.

5. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Building 11-50*, Pantex Plant, Amarillo, Texas, August 1984.

6. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Assessment Document, Weapon Materials Analytical Laboratory, Building 11-51*, Pantex Plant, Amarillo, Texas, March 1982.

7. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Safety Analysis Report, High Explosives Synthesis Facility, PSAR 11-55*, Pantex Plant, Amarillo, Texas, April 1991.

8. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Safety Analysis Report, High Explosives Synthesis Facility, PSAR 11-55*, Pantex Plant, Amarillo, Texas, April 1991.

9. Mason & Hanger - Silas Mason Co., Inc., *Safety Assessment Document (SAD), Pit Storage Vault*, Pantex Plant, Amarillo, Texas, January 1980.

10. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, 12-42 South Vault*, Revision 0, Pantex Plant, Amarillo, Texas, August 1986.

11. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Assembly Cells*, Pantex Plant, Amarillo, Texas, March 1981.

12. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, 2 Assembly Cells with Associated HE Service Magazine*, Pantex Plant, Amarillo, Texas, January 1984.

13. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Assembly Cell Complex*, Pantex Plant, Amarillo, Texas, April 1986.

14. Mason & Hanger - Silas Mason Co., Inc., *12-44 Cell 8, Safety Analysis Report*, Pantex Plant, Amarillo, Texas, February, 1995.

15. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Building 12-58*, Pantex Plant, Amarillo, Texas, July 1986.

16. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Building 12-6[illegible]*, Pantex Plant, Amarillo, Texas, March 198[illegible].

17. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Building [illegible] (High Explosive Pressing)*, Pantex Plant, Amarillo, Texas, December, [illegible].

18. Mason & Hanger - [illegible] *Final Safety Analysis [illegible] Facilities W[illegible] [illegible] Add-on*, Pantex Plant, [illegible] January 198[illegible].

19. Mason & Hanger [illegible] *Final Safety [illegible] Linear [illegible]* [illegible] Texas, [illegible]

20. [illegible]

21. [illegible]

22. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report for Building 12-65 Service Magazines*, Pantex Plant, Amarillo, Texas, February 1981.

23. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report: Production High Explosive Service Magazines (12-83)*, Pantex Plant, Amarillo, Texas, June 1983.Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report for Building 12-65 Service Magazines*, Pantex Plant, Amarillo, Texas, February 1981.

24. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report: Production High Explosive Service Magazines (12-83)*, Pantex Plant, Amarillo, Texas, June 1983. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report for Building 12-71 Class "C" Storage*, Pantex Plant, Amarillo, Texas, April 1984.

25. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report for Pantex Building 12-95 (Small Explosive Component Staging)*, Pantex Plant, Amarillo, Texas, August 1983.

26. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Building 12-78, "Remote Hole Drilling Facility*, Pantex Plant, Amarillo, Texas, March 1984.

27. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Building 12-86, Inert Assembly and Test Facility*, Pantex Plant, Amarillo, Texas, December 1987.

28. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Building 12-94*, Pantex Plant, Amarillo, Texas, March 1984.

29. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Safety Analysis Report, Weapons Special Purpose Bays Replacement Complex*, Pantex Plant, Amarillo, Texas, July 1988.

30. Mason & Hanger - Silas Mason Co., Inc., *Preliminary Safety Analysis Report, Special Nuclear Materials Component Staging Facility*, Pantex Plant, Amarillo, Texas, Rev. A, April 1989.

31. Mason & Hanger - Silas Mason Co., Inc., *Building 12-121, Preliminary Safety Analysis Report, High Explosives Machining Facility*, Pantex Plant, Amarillo, Texas, January 1989.

32. Mason & Hanger - Silas Mason Co., Inc., *Building 16-16 and 16-17, Preliminary Safety Analysis Report*, Pantex Plant, Amarillo, Texas, March 1994.

33. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Building FS-11A, Addition to FS-11*, Pantex Plant, Amarillo, Texas, September 1977.

34. Mason & Hanger - Silas Mason Co., Inc., *Building FS-021, Firing Site 21*, Pantex Plant, Amarillo, Texas, May 1981.

35. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Building FS-23, The Interim Total Containment Test Fire Facility*, Pantex Plant, Amarillo, Texas, September 1983.

36. Mason & Hanger - Silas Mason Co., Inc., *Final Safety Analysis Report, Building FS-24, Explosive Test Fire*, Pantex Plant, Amarillo, Texas, November 1987.

APPENDIX F
SCREENING POTENTIAL NATURAL PHENOMENA HAZARDS AND EXTERNAL EVENTS

This appendix presents the potential natural phenomena and external events that are considered in the hazards analyses, safety analysis reports (SAR), and other related documents. For this extensive list of events, a qualitative assessment was performed to eliminate from further consideration events that pose little or no hazard to facilities or their contents. Events that could not be eliminated in this initial screening process are analyzed more closely in Chapter 4.0, "Accident/Event Analysis."

Potential natural phenomena and external event hazards were identified by reviewing several prior risk and safety studies. The prior studies included environmental impact and safety analyses performed for the Pantex Plant site, current guidelines for performing DOE hazards assessments, recent risk and safety analyses of another DOE facility, and the recommended list of initiating events used to evaluate commercial nuclear power plant risks[1 through 9]. In addition, an attempt was made to identify any other potential external initiating events unique to the Pantex Plant site that had not been considered in previous studies.

Table F.1 presents the accident-initiating events that were considered for the Plant. The status column in Table F.1 indicates how each event was categorized in the screening process. The four criteria used in the screening process are as follows:

1. The event is impossible or improbable due to the size or location of the facility; the characteristics of the regional geology, topography, or hydrology; or the contents or the nature of the operations performed in the facility.

2. The event produces challenges that are similar to, or obviously less severe than, other events of higher likelihood already under consideration.

3. The event would not result in any potential for adverse consequences.

4. The event could not be eliminated from consideration. Quantitative analysis is required.

Many of the events listed in Table F.1 were eliminated from further consideration in this screening process. Four natural phenomena hazards and two external events were identified as requiring further analyses: aircraft impacts, earthquakes, external explosions, floods, lightning strikes, and tornados. The likelihood and/or consequences of these events are analyzed quantitatively in Chapter 4.0. All the events considered in this assessment, along with brief descriptions of their screening rationale, are listed below.

Aircraft Impacts

The probability of an aircraft impact on the operational portion of the Pantex Plant site has been analyzed numerous times in safety documentation and found to have a probability of extremely unlikely to even incredible. The event is considered in Section 4.3. The DOE, together with other agencies, is developing a standard methodology for aircraft crash analysis and collecting data on the frequency and types of

TABLE F.1.—*Potential Natural Phenomena Hazards and External Events*

Event	Status
Aircraft Impacts	4
Avalanches/Landslides	1
Coastal Erosion	1
Drought	3
Earthquakes	4
External Explosions	4
External Fires	Facility-specific
External Floods	4
Fog	3
Forest/Grass Fires	3
Frost	3
Hail	2
Ice	2
Industrial or Military Facility Accident	1,2
Internal Explosion	Facility-specific
Internal Fires	Facility-specific
Internal Floods	Facility-specific
Lightning Strikes	4
Loss of Offsite Power	3
Low Lake or River Water Level	1
Meteor Strikes	1
Pipeline Accidents	2,3
River Diversions	1
Sandstorms/Duststorms	3
Seiche	1
Snow	2
Straight Winds	2
Structural Interactions	1
Temperature Extremes	3
Tornados	4
Transportation Accidents	2
Tsunami	1
Volcanic Activity	1

Status Key

1 - Not possible or plausible at this site or facility.
2 - Less severe than other potential events.
3 - No potential for adverse consequences.
4 - Quantitative analysis required.

flights in the vicinity of Pantex Plant. This data will be presented when the methodology becomes available.

Avalanches and Landslides

Due to the flat terrain around Pantex Plant, avalanches and landslides are not credible events.

Coastal Erosion

Pantex Plant is not subject to coastal erosion because of its inland location.

Drought

Droughts are possible at the site, but there is no potential for adverse effects to the facilities or their contents.

Earthquakes

Seismic events could not be eliminated from consideration. The likelihood and effects of these events are considered in detail in Section 4.3.

External Explosions

Blast pressures and releases of radioactive materials caused by accidental explosions in nearby facilities could not be eliminated from consideration. The likelihood and effects of these events are considered in detail in Section 4.3.

External Fires

Information concerning external fires is discussed in facility-specific SARs.

External Floods

External flooding is an extremely remote possibility at Pantex Plant[11]. Even if temporary localized flooding occurred due to extremely heavy rainfall, the complex would not be damaged; and a release of radioactive or otherwise hazardous material would not occur. The likelihood and effects of these events are considered in detail in Section 4.3.

Fog

Fog presents no hazard to the Plant.

Forest and Grass Fires

Pantex Plant is located in an area of grassy plains, and while forest fires are not a concern, grass fires are a hazard. There are, however, plant functions and administrative policies which significantly reduce the threat of grass fire at Pantex Plant. These include a 24-hour, fully-staffed Fire Department onsite with special fire fighting equipment specifically designed for extinguishing grass fires. A fire brigade, which includes Fire Department personnel as well as trained plant personnel are available when necessary. Pantex Plant, in mutual agreement with four neighboring fire departments, has fire fighting support from other fire departments such as Carson Co. and Amarillo. There are also administrative procedures in place that require maintaining fire breaks and mowing weeds/grasses around facilities, thus decreasing the amount of combustibles and reducing the threat of fire[10]. The presence of smoke from a grass fire could reduce visibility at the site which could directly affect traffic at the plant by increasing the potential for vehicular accidents.

Frost

Frost presents no hazard to the Plant.

Hail

Any effects from hail can be considered less severe than other events (e.g., missiles) that are under consideration.

Ice

Any loadings created by ice can be considered less severe than other events (e.g., loads from tornados and earthquakes) that are under consideration.

Industrial or Military Facility Accidents

Because of the large restricted area around the material access area (MAA) and the remote location of Pantex Plant, industrial and military facility accidents are not credible threats. Furthermore, the hazards associated with military aircraft crashing into the facility are considered explicitly in Section 4.3. A railroad is located 3.1 km (1.9 mi) from an assembly facility at the closest point. Three chemicals (chlorine, hydrogen fluoride, and ammonia) could be shipped in sufficient quantity (e.g., 45,360 kg or 100,000 lbs) that could, in an accident, result in concentrations that are immediately dangerous to life and health at certain areas of the Plant. Section 4.3.9 considers this event in more detail. Sheltering in place as a protective action minimizes the risk of an even more severe accident.

Internal Explosions

Information concerning internal explosions is discussed in facility-specific SARs.

Internal Fires

Information concerning internal fires is discussed in facility-specific SARs.

Internal Floods

Information concerning internal floods is discussed in facility-specific SARs.

Lightning Strikes

All explosives facilities and most administrative and low hazard facilities are equipped with a lightning protection system. Also, surge suppressors are provided in the electrical distribution system to assure that, if a lightning strike were to occur, a large electric pulse in an electric line could not reach a weapon. The likelihood and effects of these events are considered in detail in Section 4.3.

Loss of Offsite Power

Diesel generators and the UPS ensure that loss of offsite power would cause no significant hazard from operations at the Plant.

Low Lake or River Water Level

This hazard is considered relevant only if offsite water sources are required for safety-related cooling purposes. No such cooling requirements exist for the operations conducted within these facilities.

Meteor Strike

Previous analyses of the likelihood of a meteor strike on structures the size of the facilities considered here indicated that this event is incredible[12].

Pipeline Accidents

The only pipelines in or near the complex are (1) low-pressure steam lines and chilled water lines for heating and cooling and (2) natural gas lines located outside the production area in Zone 12. Rupture of the steam or chilled water lines is not considered a significant threat unless other failures occur simultaneously. Natural gas pipeline failures leading to explosions are considered less severe than other external explosion events due to the distance between the gas lines and the facility (0.4 km or 0.25 mi).

Therefore, the effects of such explosions are subsumed in the consideration of explosions in adjacent facilities.

River Diversions

This potential hazard is only relevant for facilities that depend on near-site rivers for safety-related cooling purposes. Therefore, it is not relevant to these facilities.

Sandstorms and Duststorms

Sandstorms and duststorms would not represent a hazard for the Plant.

Seiche

Seiches are not a concern because no large shallow bodies of water are located near Pantex Plant.

Snow

Any loading effect from snow can be considered less severe than other events (e.g., loads from tornados and earthquakes) that are analyzed.

Straight Winds

Straight winds present less of a hazard to these buildings than tornados[13]. Any effects of straight winds are subsumed in the consideration of tornados.

Structural Interactions

No off-gas stacks, tall buildings, or other structures exist in the immediate vicinity of these buildings. Therefore, the potential for interactions with these adjacent structures is not credible.

Temperature Extremes

Seasonal temperature extremes do not represent a hazard to Plant operations. All structures, withstand temperatures well beyond those that might arise from natural causes.

Tornados

Tornados, including tornado-generated missiles, could not be eliminated from consideration. The likelihood and effects of tornados are considered in detail in Section 4.3.

Transportation Accidents

Onsite transportation accidents that could lead to significant chemical and toxic gas releases (except tritium) are not considered credible. Potential railroad accidents are discussed under "Industrial or Military Facility Accidents." Transportation accidents that could lead to fires, explosion, and tritium gas release would be subsumed by other events under consideration.

Tsunami

Due to the inland location of the site, hazards from the effects of tsunamis are not relevant to Pantex Plant.

Volcanic Activity

No potential for volcanic activity exists at or near Pantex Plant.