DOE/EIS–0225

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

Volume II–Appendixes

U.S. Department of Energy
1000 Independence Avenue
Washington, DC 20585

November 1996

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List of Acronyms and Abbreviations

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ACRONYMS AND ABBREVIATIONS

ADROIT	Analysis of Dispersal Risk Occurring in Transportation
AGV	Automated Guided Vehicle
AL	Albuquerque Operations Office
ALARA	As Low as Reasonably Achievable
AOC	Area of Concern
AQCR	Air Quality Control Region
ASER	Annual Site Environmental Report
AT&SF RR	Atchison, Topeka and Santa Fe Railroad
BG	Burning Ground
BGU	Burning Ground Upgrade
BNA	Block Numbering Area
BN&SF RR	Burlington Northern and Santa Fe Railroad
BOD	Biological Oxygen Demand
BRAC	Base Realignment and Closure
CAA	Clean Air Act
CAMS	Continuous Air Monitoring Systems
CDP	Census Designated Place
CDR	Conceptual Design Report
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant(s) of Concern
COD	Chemical Oxygen Demand
COE	U.S. Army Corps of Engineers
COPC	Contaminant(s) of Potential Concern
CRM	Cultural Resource Management
CRMP	Cultural Resource Management Plan
CSA	Canned Subassembly
CWA	Clean Water Act
CY	Calendar Year
DAF	Device Assembly Facility
DCG	Derived Concentration Guidelines
D&D	Decontamination and Decommissioning
DNL	Day-Night Average Sound Level
DOC	Department of Commerce

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IHE	Insensitive High Explosive
ILS	Instrument Landing System
IO	Isolated Occurrence
ISC	Industrial Source Complex
ISCLT2	Industrial Source Complex Long Term, Version 2
ISCST2	Industrial Source Complex Short Term, Version 2
JTA	Joint Test Assembly
KAFB	Kirtland Air Force Base
LANL	Los Alamos National Laboratory
LCF	Latent Cancer Fatality
LDR	Land Disposal Restrictions
L_{eq}	Equivalent Sound Level
LLNL	Lawrence Livermore National Laboratory
LLMW	Low-Level Mixed Waste
LLW	Low-Level Radioactive Waste
LWR	Light Water Reactor
MACCS	Melcor Accident Consequence Code System
MACT	Maximum Achievable Control Technology
MCAF	Materials Compatibility Assurance Facility
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MEOI	Maximally Exposed Offsite Individual
MOBILE 5a	Mobile Source Emission Factor Model, Version 5a
MOU	Memorandum of Understanding
MR	Modified Richmond
MSA	Metropolitan Statistical Area
MTU	Mobile Treatment Unit
NAAQS	National Ambient Air Quality Standards
NDEF	Nondestructive Evaluation Facility
NDRC	National Defense Research Committee
NE	Northeast
NEPA	National Environmental Policy Act
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NFA	No Further Action
NHPA	National Historic Preservation Act
NHW	Nonhazardous Waste
NIOSH	National Institute for Occupational Safety and Health

NLR	Noise Level Reduction
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NTS	Nevada Test Site
NW	Northwest
OB/OD	Open Burning/Open Detonation
O&I	Operations & Inspection
OMB	Office of Management and Budget
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
OSTP	Old Sewage Treatment Plant
OU	Operable Unit
PA	Programmatic Agreement
PBX	Plastic Bonded Explosives
PEIS	Progammatic Environmental Impact Statement
PIDAS	Perimeter Intrusion Detection and Alarm System
PL	Public Law
PPOA	Pollution Prevention Opportunity Assessment
PP/WM	Pollution Prevention/Waste Minimization
PRG	Preliminary Remediation Goal
PQL	Practical Quantification Limit
PSD	Prevention of Significant Deterioration
RAMS	Radar Aircraft Monitoring System
RBC	Risk Based Concentrations
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
ROD	Record of Decision
ROI	Region of Influence
RRS	Risk Reduction Standard
RTG	Radioisotopic Thermoelectric Generator
SAC	Steel Arch Construction
SAR	Safety Analysis Report
SARA	Superfund Amendments and Reauthorization Act
SCDHEC	South Carolina Department of Health and Environmental Control

SDWA	Safe Drinking Water Act
SF	Slope Factor
SHPO	State Historic Preservation Office
SNL	Sandia National Laboratories
SNM	Special Nuclear Material
SPF	Standard Project Flood
SRS	Savannah River Site
SST	Safe Secure Tractor Trailer
STAR	Stability Array
STP	Site Treatment Plan
SVOC	Semivolatile Organic Compound
SWDA	Solid Waste Disposal Act
SWMU	Solid Waste Management Unit
T&E	Threatened and Endangered
TAC	Texas Administrative Code
TACB	Texas Air Control Board
TBEG	Texas Bureau of Economic Geology
TDS	Total Dissolved Solids
TNRCC	Texas Natural Resources Conservation Commission
TOX	Total Organic Halogen
TRU	Transuranic
TSCA	Toxic Substances Control Act
TSD	Transportation Safeguards Division
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
TTU	Texas Tech University
UST	Underground Storage Tank
U.S.	United States
U.S.C.	United States Code
UTL	Upper Tolerance Limit
UTM	Universal Transverse Mercator
VOC	Volatile Organic Compound
VORTAC	Very High Frequency Omni-Directional Radio Range with Tactical Air Navigation
WAC	Waste Acceptance Criteria
WSA	Weapons Storage Area
WWTF	Wastewater Treatment Facility
WWTP	Wastewater Treatment Plant

CHEMICALS AND UNITS OF MEASURE

BGY	billion gallons per year
°C	degrees Celsius
Ci	Curie
CCl_4	carbon tetrachloride
CO	carbon monoxide
CFC	chlorofluorocarbons
CFC-12	dichlorodifluoromethane
CFC-113	trichlorotrifluoroethane
cm	centimeter
D	deuterium
d	day
dB	decibel
dBA	decibel A-weighted scale
dBC	decibel C-weighted scale
DCE	1, 2-dichloroethylene
DDT	dichlorodiphenyltrichloroethane
DU	depleted uranium
°F	degrees Fahrenheit
ft	feet
ft^2	square feet
ft^3	cubic feet
ft^3/s	cubic feet per second
g	gram
gal	gallon
gpd	gallons per day
g/sec	gram per second
HCFC-22	chlorodifluoromethane
HCl	hydrochloric acid
HEU	highly enriched uranium
HF	hydrogen fluoride
HMX	high melt explosive
hr	hour
Hz	Hertz
in	inch

K	kelvin
kg	kilogram
km	kilometer
km^2	square kilometers
km/hr	kilometers per hour
kV	kilovolt
kVA	kilovoltampere
kW	kilowatt
kWh	kilowatt hour
lb	pound
lb/hr	pounds per hour
lb/yr	pounds per year
L	Liter
Li	lithium
LX	press-moldable HMX
M	million
m	meter
m^2	square meters
m^3	cubic meters
mCi	millicurie (one-thousandth of a Curie)
mCi/g	millicurie per gram
mCi/ml	millicurie per milliliter
mg	milligram (one-thousandth of a gram)
mg/L	milligram per liter
MGD	million gallons per day
MGY	million gallons per year
mi	miles
ml	milliliter
MOX	mixed oxide
mph	miles per hour
mrem	millirem (one-thousandth of a rem)
mrem/yr	millirem per year
m/sec	meters per second
MVA	megavolt-ampere
MW	megawatt
MWe	megawatt electric
MWh	megawatthour

MWt	megawatt thermal
N	nitrogen
nCi	nanocurie (one-billionth of a Curie)
nCi/g	nanocuries per gram
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
O_3	ozone
P	phosphorous
Pb	lead
PBX	plastic-bonded explosives
PCB	polychlorinated biphenyl
pCi	picocurie (one-trillionth of a Curie)
pCi/g	picocuries per gram
pCi/L	picocuries per liter
PETN	pentaerythritoltetranitrate
pH	hydrogen-ion concentration
PM_{10}	particulate matter of aerodynamic diameter less than 10 micrometers
ppb	parts per billion
ppbv	parts per billion by volume
ppm	parts per million
psi	pounds per square inch
Pu	plutonium
qtr	quarter
RBC	risk based concentrations
RDX	research development explosive
rem	roentgen equivalent man
sec	second
SO_2	sulfur dioxide
SO_x	sulfur oxides
sq	square
T	tritium
TATB	triaminotrinitrobenzene
TCA	1, 1, 1-trichloroethane
TCE	trichloroethene
TNB	trinitrobenzene
TNT	trinitrotoluene

TOC	total organic compounds
TOX	total organic halogen
U	uranium
yd^3	cubic yards
yr	year
µCi	microcurie (one-millionth of a Curie)
µCi/g	microcuries per gram
µg	microgram (one-millionth of a gram)
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
µm	micron or micrometer (one-millionth of a meter)
µmhos/cm	microhms per centimeter

APPENDIX A

Methodology

NI
NC
NF
NP
NR
NR
NT
NW
OB
O&
OM
ORF
OSH
OST
OU
PA
PBX
PEIS
PIDA
PL
PPOA
PP/W
PRG
PQL
PSD
RAMS
RBC
RCRA
RFI
ROD
ROI
RRS
RTG
SAC
SAR
SARA
SCDHE

APPENDIX A
METHODOLOGY

Introduction

The environmental impact assessment methodologies discussed in this section address the full range of natural and human resources and issue areas pertinent to the continued operations at Pantex Plant. These methodologies are also applicable to the analysis of candidate sites considered for the potential interim storage of pits, as described in chapter 5 of this EIS.

Plant Facilities and Infrastructure

Changes to plant facilities and infrastructure are assessed by comparing the support requirements resulting from the changes in the activity levels at Pantex Plant to projected site infrastructure capacities. These assessments focus on transportation and infrastructure and utilities (including water, wastewater treatment, electricity, and natural gas). Projections of site development plans are used to project site infrastructure conditions. Tables are presented that depict the changes in infrastructure. Where needed, requirements generated by the Proposed Action and Alternatives and mitigation considerations are identified that could reduce impacts due to changes in infrastructure on a site-by-site basis.

Land Resources

Land use changes associated with the changes in the activity levels at Pantex Plant could occur on both the plant site and the surrounding region, and could affect both developed and undeveloped land. The analysis of land use also considers impacts that could result from the activities related to the environmental restoration program and modification of existing facilities or the construction of new facilities on Pantex Plant Site.

The degree to which the alternatives affect future use or development of land at Pantex Plant Site are considered. Land use impacts are assessed based on the extent and type of land that would be affected. The land use analysis also considers potential direct impacts resulting from the incompatibility of land use changes with special-status lands, such as prime and unique farmlands.

Geology and Soils

Geology. Impacts to the geological environment could occur from destruction of or damage to unique geological features and subsidence caused by groundwater withdrawal. The local geology that could affect Pantex Plant operations, including geomorphology, stratigraphy, structural attitude of rocks, and faults and seismicity, are described. The locations of capable faults are identified and an overview of the seismicity of Pantex Plant Site, including the history and significance of earthquakes, along with their intensity and ground acceleration, is presented.

Soils. Soil types at Pantex Plant Site are described. Analysis is provided qualitatively to summarize the potential contaminants of concern in soils at Pantex Plant Site. The analysis describes the potential for contaminating soils and sediments from changing activity levels at Pantex Plant and activities related to the environmental restoration.

Water Resources

The quality and quantity of surface water and groundwater resources are described using available data. Potential effects on surface water and groundwater availability and quality are assessed.

NLR
NOI
NPDE
NPL
NRC
NRHP
NTS
NW
OB/OI
O&I
OMB
ORR
OSHA
OSTP
OU
PA
PBX
PEIS
PIDAS
PL
PPOA
PP/WM
PRG
PQL
PSD
RAMS
RBC
RCRA
RFI
ROD
ROI
RRS
RTG
SAC
SAR
SARA
SCDHEC

Surface Water. Local surface water resources in the Pantex Plant region and their flow characteristics and relationships are used to describe current conditions. Data used for surface water impact assessments include rates of wastewater discharge from Pantex Plant operations.

The water quality of potentially affected surface water and groundwater is determined by reviewing current monitoring data. Focus is given to parameters that exceed applicable water quality criteria. Surface water quality data and effluent discharge data are compared to U.S. Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) permit and TNRCC Wastewater Discharge Permit limits and requirements for Pantex Plant. The performance of Pantex Plant in complying with the permit requirements is presented. The assessment of water quality impacts from wastewater (sanitary and process) and stormwater runoff qualitatively addresses potential impacts to the receiving waters' minimum or average flow, as available and appropriate.

Floodplains are identified to determine whether any of the continuing or proposed operations or facilities are located within a floodplain.

Groundwater. Groundwater resources are analyzed for effects on aquifers, groundwater usage, and groundwater quality within the Pantex Plant Region of Influence (ROI). The affected environment discussion includes a description of the potentially affected hydrogeologic units. The local aquifers are described in terms of the extent, thicknesses, geologic formations, hydraulic properties, and quality of the groundwater. Groundwater recharge areas are also noted. Total baseline groundwater use at the facility is compiled using the best available data.

Available data on existing groundwater quality conditions are compared to Federal and State groundwater quality standards and DOE-derived concentration guidelines for radionuclides and risk reduction standards. Impacts of groundwater withdrawals from activity levels at Pantex Plant are assessed. Impacts are assessed by the degree to which groundwater quality, drawdown of groundwater levels, and groundwater availability to other users would be affected. Impacts on groundwater quality are based on current and anticipated wastewater discharge rates and applicable permit requirements.

Air Quality

Potential effects on the environment associated with air pollutant emissions from normal operations are evaluated for the current activity levels at Pantex Plant. This is assumed to be equivalent to handling 2,000 weapons per year and includes Burning Ground Upgrade operations. The assessment of air quality impacts includes identification of applicable criteria for assessing impacts, the development of emission inventories, and the estimation of air pollutant concentrations.

The assessment of potential impacts to air quality is based on comparison of effects of the Proposed Action and Alternatives with applicable local, State, or National Ambient Air Quality Standards or the potential exceedance of Prevention of Significant Deterioration increments for PM_{10} (particulate matter of aerodynamic diameter less than 10 micrometers), sulfur dioxide, or nitrogen dioxide.

Assessment criteria for pollutants include the EPA primary and secondary ambient air quality standards for criteria pollutants and those established by the State of Texas. The more stringent of either the EPA or State standards serve as the assessment criteria. The assessment criteria for toxic pollutants include guidelines or standards adopted or proposed by the State of Texas.

Ambient air monitoring data are used to determine maximum background concentrations of pollutants for Pantex Plant Site. Baseline concentrations of pollutants are calculated by modeling site emissions during the baseline year. The baseline concentrations are a conservative estimate of pollutant concentrations at Pantex Plant Site during a period considered representative of recent site activity.

Changes in concentrations of pollutants from the changing activity levels at Pantex Plant are calculated by modeling projected site emissions on an annual basis. Those concentrations are then compared to applicable Federal and State standards for air pollutants to provide an estimate of the potential effects on air quality.

Modeling of site-specific emissions (using the EPA-recommended Industrial Source Complex Short–Term [ISCST2] Model and Long–Term [ISCLT2] Model) was performed in accordance with EPA's *Guideline on Air Quality Models* (EPA–450/2–78–027R).

Major source criteria and hazardous air pollutant emissions were modeled using actual source locations and stack parameters to determine environmental baseline and criteria pollutant concentrations. Onsite and/or representative National Weather Service meteorological data are used to define the dispersion characteristics of the site.

Acoustics

Acoustic impacts are assessed on the basis of potential degree of change in noise levels at sensitive receptors near the Pantex Plant Site boundary with respect to ambient conditions. The analysis uses available information on the potential types of noise sources and the location of Pantex Plant facilities relative to the site boundary and noise-sensitive locations. The potential for exposure of workers to noise and the measures taken to protect worker hearing are included. Quantitative analysis of blast noise from high explosives detonations is provided using an airblast prediction model called BLASTO.

Biotic Resources

Potential impacts to biotic resources are addressed for the following categories: terrestrial resources, wetlands, aquatic resources, and threatened and endangered species. Changing activity levels at Pantex Plant may affect biotic resources as a result of changes in land use and human disturbance and noise. In general, the potential impacts are assessed based on the degree to which various habitats or species could be affected by the changing activity levels at Pantex Plant. Where appropriate, impacts are evaluated with respect to Federal and State protection regulations and standards.

Terrestrial Resources. Potential impacts to terrestrial resources include loss and disturbance of plant and wildlife habitats. The loss of important or sensitive habitats is considered more important than the loss of a regionally abundant type. Impacts to wildlife are based to a large extent on plant community loss, which is closely associated with animal habitat. The disturbance, displacement, or loss of wildlife was also evaluated in accordance with wildlife protection laws such as the *Migratory Bird Treaty Act* and *Bald and Golden Eagle Protection Act*.

Very small concentrations of radionuclides are released to the atmosphere during operations at Pantex Plant. Results of biouptake of radionuclide levels have been identified from monitoring data.

Wetlands. Most impacts from continued operations at Pantex Plant are related to discharge of contaminants to the playas. Other impacts could potentially occur from construction activities conducted outside of wetland areas. No direct loss of wetlands resulting from construction and operation is

expected at Pantex Plant Site. Impacts resulting from changing levels of flows are evaluated based on a comparison of expected discharge rates with present stream flow rates.

Aquatic Resources. Aquatic resources could be impacted as a result of sedimentation, increased flows, effluent discharge, and the introduction of thermal or chemical effluents and radionuclides.

Threatened and Endangered Species. Impacts to threatened and endangered species of wildlife and plants, including critical habitat, State-listed species, and species proposed for listing, are determined. A list of species potentially present on Pantex Plant Site is developed using information obtained from the U.S. Fish and Wildlife Service and appropriate State agencies. Impacts are determined in a manner similar to that described for terrestrial and aquatic resources because the sources of potential impacts are similar.

Cultural and Paleontological Resources

Cultural and paleontological resources include prehistoric, historic, World War II, Cold War, Native American, and paleontological resources.

Prehistoric Resources. The affected environment section for prehistoric resources includes a brief overview of the number and types of prehistoric sites at Pantex Plant Site and their status on both the National Register of Historic Places (NRHP) and appropriate State registers. The overview consists of a summary of existing information about prehistoric resources within the site boundary and a discussion of types of sites that are likely to occur.

Impact assessments for prehistoric resources focus mainly on those properties likely to be eligible for the NRHP. Impacts are assessed by considering whether the Proposed Action and Alternatives could substantially add to existing disturbance of resources in the project areas, adversely affect NRHP-eligible resources, or cause loss of or destruction to important prehistoric resources.

Historic, World War II, and Cold War Resources. The affected environment section for historic resources includes a brief overview, the number and types of historic sites at Pantex Plant Site and their status on both the NRHP and appropriate State registers. Impact assessments for historic resources focus mainly on those properties likely to be eligible for the NRHP.

Native American Resources. Native American concerns have been identified through direct consultation with tribal representatives. Impacts to Native American resources are assessed by considering whether the continued operations at Pantex Plant have the potential to affect sites important for their position in the Native American physical universe or belief system.

Paleontological Resources. The affected environment section for paleontological resources includes a description of known paleontological localities and geological formations at Pantex Plant Site that may be fossil bearing. Impact assessments for paleontological resources are based on the numbers and kinds of resources that could be affected as well as the quality of fossil preservation in a given deposit, particularly in deposits with high research potential.

Socioeconomics

This section describes and assesses impacts on local and regional socioeconomic conditions and factors, including population, employment, and income. This EIS assesses the socioeconomic impacts of both changing levels of activity and potential loss of mission at Pantex Plant. Geographically, the potential for socioeconomic effects is greatest in those local jurisdictions that are the residential locations of the majority of Pantex Plant employees. An

ROI, comprised of those local jurisdictions likely to experience the greatest socioeconomic impacts, is defined for Pantex Plant. The evaluation of impacts is based on the degree to which changes in employment and population affect the local economy on an annual basis. The following sections discuss each of the socioeconomic conditions and factors considered.

Employment. The changing level of activities at Pantex Plant would affect employment at the plant. Changes in plant employment would, in turn, directly affect local and regional populations and income. Current employment at Pantex Plant is described as well as projected employment associated with changing levels of activity at the plant. Emphasis is placed on evaluating total direct and indirect employment changes and impacts associated with potential mission relocations.

Income. The regional economy surrounding Pantex Plant is characterized. Emphasis is placed on the measurement of the relative contribution and importance of Pantex Plant's employment payroll and purchases to the economy. Changes to local economic conditions are evaluated based on the changing activity levels at Pantex Plant.

Population. The demographic changes in the region surrounding Pantex Plant are described and assessed. Demographic characteristics are presented for the ROI to support the assessment of socioeconomic impacts. Cumulative population impacts include the population impacts of other DOE actions under consideration.

Intrasite Transportation

The focus of this analysis is on the intrasite transfer and handling of hazardous materials at Pantex Plant. The impact analysis emphasizes the radiological effects from the transportation of radioactive materials. This focus is consistent with *National Environmental Policy Act* guidance and requirements as follows:

- The performance of Pantex Plant-type operations does not require or produce risk-significant quantities in regards to transportation of nonradioactive hazardous materials; therefore, transportation activities involving hazardous materials are small-scale operations that do not have the potential of causing significant damage to the human environment.
- The radiological hazard, not chemical toxicity, is the dominant risk from Pantex Plant-related transportation activities.

The affected environment includes the discussion of frequency and type of movement of materials within the plant boundaries and handling and packaging of materials onsite.

Accidents involving the transportation and handling of radioactive and hazardous material have the potential to lead to human fatalities, excess cancer fatalities, and serious environmental contamination. Normal transport may expose personnel to ionizing radiation. Impact analysis is conducted using Pantex Plant historical records and Safety Analysis Reports. Radiological exposures and excess cancer fatalities are calculated for the workers handling the materials. Impacts to the public outside the Pantex Plant boundaries are not expected from intrasite transfer and handling of radioactive materials.

Waste Management

Wastes generated during the operation of Pantex Plant facilities consist of four primary types: low-level radioactive waste (LLW), low-level mixed waste (LLMW), hazardous waste (HW), and nonhazardous waste.

Pantex Plant provides for the short-term management and onsite storage of wastes, including the means to minimize waste generation, until DOE either disposes of the

wastes or places them in long-term storage. To provide a framework for addressing the impacts of waste management for continued operations at Pantex Plant, descriptive information is presented on waste management activities. The volumes of each waste type generated are estimated. These estimates, obtained from the plant, include consideration of concepts for waste minimization. The impact assessment addresses the waste types and waste volumes projected to be generated from the changing activity levels at Pantex Plant. Impacts are assessed in the context of site practices for treatment, storage, and disposal plus the applicable regulatory requirements.

Human Health

Pantex Plant uses a broad variety of processes involving both radioactive and chemical materials that can be hazardous to people who are exposed to them. The degree of hazard is directly related to the types and quantity of the particular radioactive or chemical material to which the person may be exposed. The health effects are determined for the operations at Pantex Plant by identifying the types and quantities of material to which one is exposed, estimating exposures, and calculating the resultant health effects.

The impacts on human health for workers and the public during normal operations and postulated accidents for the various alternatives are assessed. Computer codes are used to simulate the impacts on the health of workers and the public due to normal operations and postulated accidents. These computer codes include: the Melcor Accident Consequence Code System (MACCS) for airborne and liquid radioactive releases where no explosives were involved; and the Explosive Release Atmospheric Dispersion (ERAD) computer code where explosives were involved. Atmospheric dispersion modeling using the ISCST2 Model performed for the air quality analysis is also used in the evaluation of impacts to workers from radiological and hazardous chemicals.

Health Impacts on Plant Workers During Normal Operation. Because radiation workers are individually monitored, experience from past and current operations that are similar to future operations are used to estimate the radiological health impacts to workers. Health impacts from chemicals are discussed qualitatively. Chemical concentrations onsite are compared to published threshold limit values for chemical substances to determine potential human health impacts.

General Health Impacts on the Public During Normal Operation. Public health impacts could result from exposure to radioactive or hazardous chemical materials released during plant operations. The effect is the sum of internal exposure resulting from breathing air, eating food, drinking water, and of external exposure from standing on contaminated ground and being exposed to the air.

Modeling is used to estimate the type and amount of material released and the associated radiological and chemical doses. These doses are converted to health effects using appropriate health risk estimators.

Accident Analysis for Postulated Accident Scenarios. The relative consequences of postulated accidents in the evaluation of each alternative are considered. For the purpose of this assessment, risk is defined as the mathematical product of the probability and consequences of an accident. The specific accidents consider the types and location of facilities. Examples of accidents include those resulting from operator errors, spills, criticality, fire, explosions, common-cause failures, collocated facilities, severe weather, and earthquakes. Transportation and aircraft crash risks are described separately in this EIS.

A risk screening methodology was used to determine the accident scenarios that resulted in the highest combination of frequency and consequence. In all cases, public risk is dominated by the release and dispersion of radionuclides. In those scenarios that involved an explosion, the ERAD computer code was used to model the dispersion and resulting exposure to workers and the public. For nonexplosive scenarios, the MACCS code was used. Results from the computer modeling are radiological doses to the worker and the public. Worker risk is dominated by explosions without an accompanying release of radionuclides (i.e., the greatest risk to the worker is due to high explosive development, manufacture, and testing activities).

In summary, the radiological and hazardous chemical impact estimates presented in this document were obtained by:

- Using the best available data.
- Using state-of-the-art computational tools.
- Considering the processes, events, and accidents that are reasonably foreseeable for Pantex Plant operations.
- Making conservative assumptions when there is doubt about the exact nature of the processes and events taking place.

Aircraft Accidents

A unique and controversial scenario in the accident risk impact assessment is the potential for an aircraft-induced hazardous material dispersal accident. The likelihood and consequence of this accident scenario have been studied extensively since the start of nuclear explosive operations at Pantex Plant, and these studies continue to this day.

At Pantex Plant, data from a Radar Airspace Monitoring System (RAMS) have been utilized to determine the amount, type, and frequency of aircraft movement in proximity to Pantex Plant. The latest DOE Standard methodology (DOE 1996g) is utilized to estimate the likelihood of an aircraft impacting a Pantex Plant facility containing nuclear materials and causing a release (see appendix E). The estimated change in risk, both from the increased storage of components in Zone 4 and from any predicted changes in aircraft operations in proximity to Pantex Plant identified by the Overflight Working Group and committed to by DOE and the Federal Aviation Administration, is discussed.

Human health risks from aircraft-induced radiological releases are assessed using MACCS. The consequence assessment uses such site-dependent factors as meteorology, population distributions, and onsite facility location. The resulting doses are converted to a predicted number of excess cancer fatalities. Air dispersion of radionuclides following an accidental release not explosively initiated is modeled using MACCS, and air dispersion of radionuclides following an accidental release explosively initiated is modeled using the ERAD computer code package.

Intersite Transportation

The intersite transportation assessment focuses primarily on the transport of radioactive material. A transportation baseline, using historical and projected shipment information, is established for evaluating potential environmental impacts. The packaging required for the shipment of pits is described. Risks are calculated for transporting pits and other nuclear weapon components.

The potential environmental impacts of transporting pits and other nuclear weapon components are determined using existing health and accident risk data. For evaluating risk, the following elements are considered: transport mode, weight of material, curies, proximity dose rates (transport index), type of package, number of shipments, and distance.

The Analysis of Dispersal Risk Occurring in Transportation (ADROIT) code is used to evaluate the accident risk posed by the expected transfers of weapons, plutonium, weapons components, and tritium reservoirs. Developed by Sandia National Laboratories for the Defense Programs Transportation Risk Analysis study, the ADROIT code has unique abilities to evaluate the transportation risk from defense program material. This includes the ability to place ERAD data sets within the code for modeling explosively driven events.

Environmental Justice

The potential for disproportionately high and adverse human health or environmental effects on minority and low income populations are evaluated in accordance with Executive Order 12898, *Federal Action to Address Environmental Justice in Minority Populations and Low Income Populations.* The environmental justice analysis addresses selected demographic characteristics of the Pantex Plant ROI, defined as an 80-kilometer (50-mile) circle centered on Pantex Plant. Similar analyses have also been performed within the ROI for each of the alternate sites considered for interim storage of pits.

The analysis of environmental justice presented in this EIS is based on the definitions of minority and low income populations as contained in the notice for the EPA Office of Environmental Justice (59 FR 192). These definitions call for identification of Census Tracts where 25 percent or more of the persons in 1990 were either minority group members or below poverty level based on their income in 1989. For comparison purposes, definitions of minority and low income populations as provided by the Council on Environmental Quality (CEQ) in August 1995, and also reported in *Guidance for Incorporating Environmental Justice Concerns* in EPA's NEPA Compliance Analysis (EPA 1996a), are also applied to the 1990 Census data and results of both analysis are reported in the EIS.

Cumulative Impacts

Cumulative impacts include the impacts of continued operations at Pantex Plant combined with impacts associated with other reasonably foreseeable projects that could impact the environment at the plant or in the resource-specific ROIs. Although several DOE programs described in section 1.7 of this EIS have the potential to impact the Pantex Plant ROI, sufficient information for incorporation in this document is currently available for only three programs, the Waste Management (WM), Stockpile Stewardship and Management (SSM), and Storage and Disposition of Weapons-Usable Fissile Materials (S&D) programs. Programmatic EISs (PEISs) have been or are being prepared by DOE for each of these programs.

The WM PEIS examines the environmental impacts of managing radioactive and hazardous wastes at DOE Sites throughout the U.S. Pantex Plant was considered one of 17 "major" sites managing DOE wastes. For Pantex Plant, three types of waste were analyzed: LLMW, LLW, and HW. The WM PEIS analyzes the impacts associated with four management alternatives: No Action, Decentralized, Regionalized, and Centralized. The cumulative impacts of the WM program and the alternatives being considered for Pantex Plant operations in this EIS are discussed in each resource section to the extent information is available from the WM PEIS.

The SSM PEIS considered an alternative in which current Pantex Plant operations could be transferred to another site. This Pantex Plant EIS incorporates by reference and summarizes impacts of relocating operations as identified in the SSM PEIS. It is recognized that relocation of operations would involve a transition period during which relocation would occur in a systematic manner, and activities, such as decontamination and decommissioning and environmental restoration, would be accomplished to prepare the Pantex Plant

property for disposal. Because a definite schedule for these transition activities is not yet available, it can only be assumed that employment and consumption of utilities at the plant would decline over several years and no sudden impacts would occur.

The S&D PEIS considers activities that would result in storage of inventories of nonsurplus weapons-usable plutonium and highly enriched uranium (HEU); storage of inventories of surplus weapons-usable plutonium and HEU pending disposition; and disposition of surplus weapons-usable plutonium. For storage, the strategy for long-term storage of weapons-usable plutonium and HEU, as well as the storage site(s), would be decided. For disposition, the strategy and technologies for disposition of surplus weapons-usable plutonium would be decided.

The S&D PEIS is considering Pantex Plant for both storage and disposition alternatives. With the S&D PEIS collocation alternative, construction of new storage facilities would be required to store plutonium and HEU at Pantex Plant. For the disposition alternatives, the emphasis at this stage in the NEPA decision process is on choosing the strategy and technology mix rather than the actual site. The evolutionary Light Water Reactor was chosen for the purpose of analysis as the bounding alternative for disposition. Implementation of this disposition alternative may require the construction and operation of one or more light water reactors, a pit disassembly and conversion facility, a plutonium conversion facility, and a mixed oxide fuel fabrication facility. The bounding alternative also assumes that all of the facilities previously mentioned would be collocated at the same site (potentially Pantex Plant).

The collocation storage alternative and the evolutionary Light Water Reactor disposition alternative from the S&D PEIS are discussed in this Pantex Plant EIS, because those alternatives if they occurred at Pantex Plant, could potentially have the greatest impacts to the Pantex Plant Site. It is important to note that these are conservative bounding impacts. The final S&D PEIS will include an alternative that is a refinement of these storage alternatives. As discussed in sections 1.4 and 1.7.3 of volume 1 of this EIS, the final S&D PEIS will include an alternative under which pits from Rocky Flats Environmental Technology Site (RFETS) could be transferred to Pantex Plant for storage in Zone 4 as early as 1997. The impacts of this alternative are fully accounted for in this EIS because the pits from RFETS could not cause the total number of pits stored in Zone 4 to exceed the storage limit of 20,000 pits analyzed under the Proposed Action. Furthermore, RFETS pits that could come to Pantex Plant would have the same characteristics, as analyzed in the S&D PEIS, as pits currently or previously stored at Pantex Plant. For disposition, further site-specific tiered NEPA documentation may be required, as appropriate, before any specific site is selected. If different alternatives or a site other than Pantex Plant were selected in the Record of Decision (ROD) (and tiered RODs) for the S&D PEIS, then impacts to Pantex Plant from storage and disposition would be reduced and might not occur.

In addition to the DOE programs, information on other Federal, State, or local projects, including private developments, was sought through contacts with Federal and State regulatory agencies, the Amarillo Economic Development Corporation, the Panhandle Municipal Water Authority, and the City of Amarillo.

This effort yielded only one project (future closure of the Helium Plant) that would contribute to the cumulative impacts in the Pantex Plant ROI. The U.S. Bureau of Mines has been operating the Helium Plant in the Amarillo area since the early 1940s. The

Helium Privatization Act of 1996 directs Helium Operations to discontinue production and sale of refined helium by April 1998. The impacts of this action are analyzed in volume I, section 4.11.5, because cumulative impacts of closing or downsizing this facility would be limited to socioeconomic impacts.

APPENDIX B

Air Quality Analysis

APPENDIX B
AIR QUALITY ANALYSIS

B.1 INTRODUCTION

This appendix presents more detailed information on the assessment of the air quality at and in the vicinity of Pantex Plant and the potential impacts associated with the alternatives being evaluated in this EIS.

B.2 OBJECTIVES

The overall objective of the air quality impact analysis is to determine the impact of air pollutant emissions resulting from construction and operation activities under the Proposed Action and Alternatives at Pantex Plant. Local and regional receptors include human beings, vegetation, and materials.

The impact and significance of ambient pollutant concentrations resulting from Pantex Plant emissions were determined by comparing the predicted concentrations with the appropriate Federal or State ambient air quality standards or guidelines. Ambient air quality standards represent the allowable pollutant concentrations at which public health and welfare are protected with a reasonable margin of safety.

Specific objectives include the following:

- Selection of an appropriate air quality dispersion model.
- Use of the model to evaluate maximum pollutant concentrations at the Pantex Plant boundary and residences near the plant boundary resulting from existing emissions and from emissions related to the Proposed Action and Alternatives.
- Estimation of air quality impacts at the plant boundary and at nearby residences.

B.3 METHODOLOGY

B.3.1 Model Selection

Model selection required consideration of the characteristics of Pantex Plant emission sources, terrain in the vicinity of the plant, and land use classification. Because of the large number of sources (over 100) and 90 pollutants, it was determined that a screening model could not be used for this air quality analysis. Screening models are most appropriate for assessing the air quality impacts of a single source with continuous, constant emission rates. Therefore, it was determined that a refined dispersion model would be required. The following attributes are required in the model:

- Accommodate multiple point, area, or volume, and fugitive sources.
- Allow for a sophisticated treatment of building downwash for point sources.
- Predict concentrations for flat and rolling terrain.
- Predict impacts on urban and rural land use classifications.
- Allow input of time-varying emissions rates (e.g., emission rates may vary by season, month, or hour-of-day).

A review of Environmental Protection Agency (EPA)-preferred air quality models listed in the *Guidelines on Air Quality Models (Revised)* (40 CFR, Part 51, Appendix W) indicated that the only model that would meet the above requirements was the Industrial Source Complex Model (ISC2). The model operates in both short-term (ISCST2) and long-term (ISCLT2) modes. ISCST2 can produce short-term concentrations averaged over periods of 1, 2, 3, 4, 6, 8, 12, or 24 hours. ISCLT2 can produce long-term concentrations averaged

percentage of urban land-use within 3,000 meters (9,843 feet) was less than 5 percent (Radian 1993:3-1, 5-1). Since the percent of urban land use is less than 50 percent, rural dispersion coefficients were selected.

B.3.4 Meteorological Data

Meteorological data for the ISCST2 model consisted of hourly surface observations and mixing heights obtained from meteorological data recorded at the Amarillo International Airport for calendar year 1988. Meteorological data for the ISCLT2 model consisted of a joint frequency distribution of wind speed, wind direction, and stability class (STAR data). The STAR data were based on 1985 through 1989 surface observations recorded at the Amarillo International Airport. The meteorological data were obtained from TNRCC's bulletin board.

This set of meteorological data was selected because it was specified by TNRCC and was used by the Radian Corporation in modeling emissions from the Pantex Plant Burning Ground. Also, the use of these data would make the site-wide modeling performed for this EIS comparable with the Radian analysis from a meteorological standpoint (Radian 1994).

B.3.5 Emission Source Characteristics

Emission sources are located in several functional areas (some of these are referred to as numbered zones). These areas include a weapons assembly/disassembly zone (Zone 12), a weapons staging area (Zone 4), and an area for experimental explosives development (Zone 11), a drinking water treatment plant, a sanitary wastewater treatment facility, and a vehicle maintenance and administration area (see Figure B.3.5–1).

Other emission sources included an explosive test-firing facility, an open burning ground to burn high explosive(s) (HE) materials, and a Burning Ground Upgrade (BGU) facility for processing explosive-contaminated materials or components. Emission sources also included welding and cutting operations, standby diesel and gasoline engines, and the container storage area where drum sampling and bulk handling of chemicals are performed.

Most of the emissions from Pantex Plant are fugitive emissions, except emissions from Building 16–13. This building was a point source (stack) with the following parameters:

- Height of stack: 19.81 meters (65.0 feet).
- Diameter of the stack: 0.91 meters (3.0 feet).
- Exit Speed: 5.03 meters per second (16.5 feet per second).
- Exit Temperature: 418.76 °K (294.1 °F).

Building 16–13 was the only source at Pantex Plant that required the application of building downwash effects.

As indicated in Tables B.3.6–1 through B.3.6–9, facilities from which fugitive emissions were emitted were treated as volume sources (all tables are presented at the end of this appendix). The emission rates were expressed in grams per second. The release height of the emissions was assumed to be located at one half the building height. Groups of point sources with small emission rates were treated as an area source.

The Burning Ground is an onsite facility used to demilitarize and sanitize explosives components and treat materials contaminated with explosives. The Burning Ground covers approximately 23.5 hectares (58 acres) in the north-central portion of Pantex Plant (see Figure B.3.5–1), and currently includes the firing sites, nine burn trays, three burn pans, two burn cages, and three burn pits. There are no structures at the Burning Ground that could affect the normal dispersion of air pollutants during burning operations (Radian 1993:6-1).

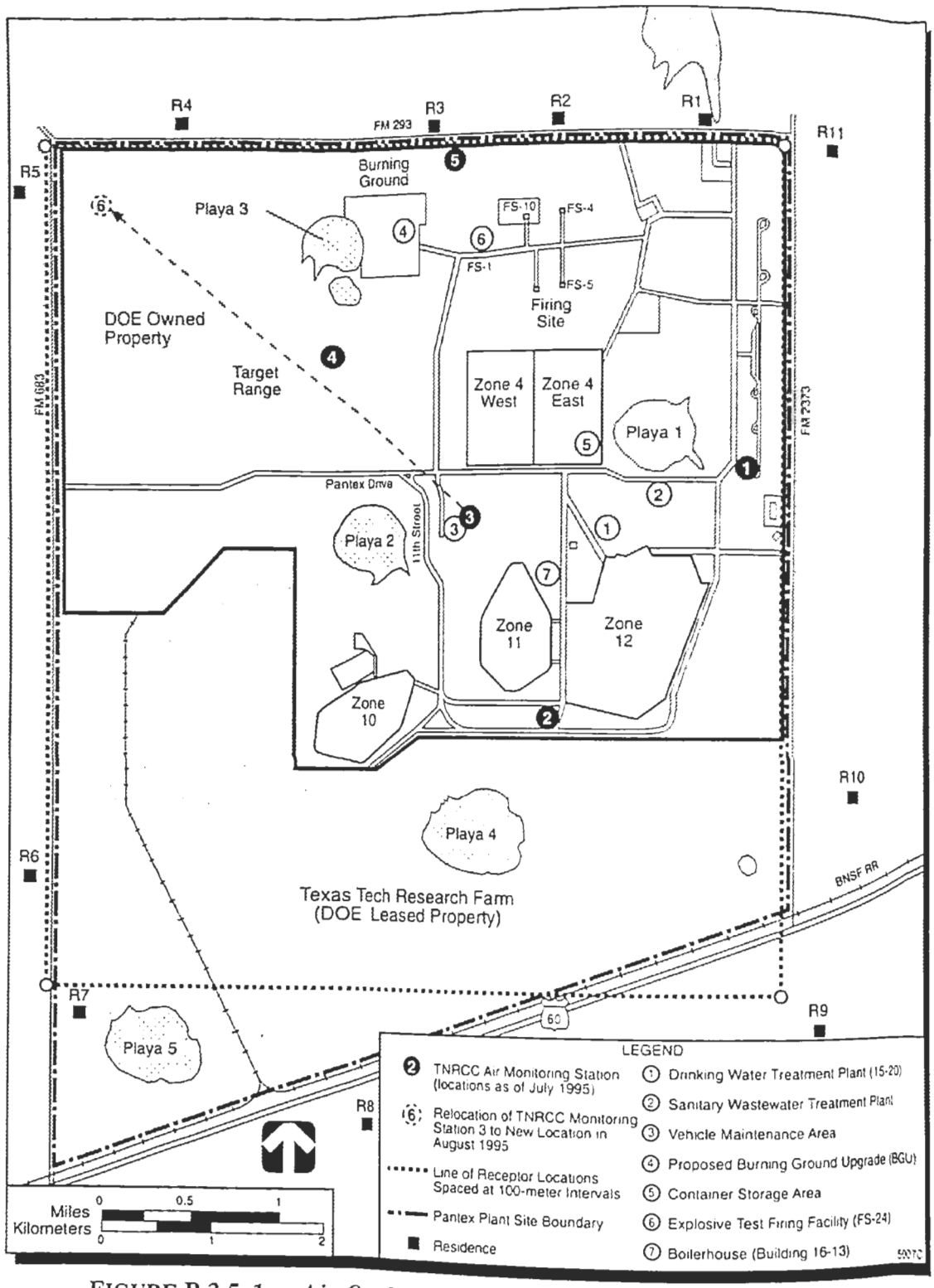

FIGURE B.3.5–1.—*Air Quality Monitoring Stations, Emission Sources, and Receptor Sites at Pantex Plant.*

The emissions from the open burning of HE in the trays were modeled using a "flare" methodology developed by the Radian Corporation and approved by TNRCC (Radian 1993). The input parameters used for the methodology were as follows:

- Flare release height above the ground: 2 meters (6.6 feet).
- Flame temperature: 1900 °K (2961 °F).
- Exit speed: 1.0 meter per second (3.3 feet per second).
- Effective Diameter of flare:
  - — 45.4 kilograms (100 pounds) HE: 1.92 meters (6.3 feet).
  - — 363 kilograms (800 pounds) HE: 8.66 meters (28.4 feet).

It was assumed that the burning of HE that did not contain fluorides would occur between the hours of 7:00 a.m. and 6:00 p.m. Explosives that contained fluoride would only be burned twice a day, at 11:00 a.m. and 3:00 p.m. It should be noted that not more than three burns can be conducted in a day. Also, there is at least a 3-hour waiting period between any two burns for explosives emitting hydrogen fluoride (HF). Two HE scenarios were modeled: one assumed that 45.4 kilograms (100 pounds) of HE were burned, while the other assumed a burn of 363 kilograms (800 pounds) of HE.

Pantex Plant has a commitment to construct a project called the Burning Ground Upgrade (BGU) to replace the current pit burn operation. This project should be completed in the timeframe analyzed in this EIS. This upgrade will consist of a covered three-sided structure with a fan to exhaust emissions through an elevated stack. The wood currently used as an auxiliary heat source for the pit burn will be replaced by natural gas in the BGU. These changes will improve the dispersion characteristics of emissions from this operation and eliminate the toxic emissions common to wood burning.

The BGU operation was assumed to be a point source (stack) with the following stack parameters:

- Stack height: 12.2 meters (40.0 feet).
- Stack diameter: 0.61 meters (2.0 feet).
- Exit speed: 16.2 meters per second (53.2 feet per second).
- Exit temperature: 388.8 °K (240.0 °F).

Building downwash for the BGU was not required for emissions released through the BGU stack (Radian 1994:6-1). Downwash from the BGU structure was also not a consideration with regard to tray burns (Radian 1994:6-1).

B.3.6 Emission Inventory Scenarios

The basic emission inventory used to derive emission rates for Pantex Plant air quality analysis was developed by the Radian Corporation. This emission inventory included emissions from furnaces, boilers, water heaters, diesel generators and engines, the BGU, tray burns (hemispheres, HE, and wet HE), and the solvent area (sampling and bulk handling). The emission sources used for this site-wide analysis are presented in Tables B.3.6–1 through B.3.6–5.

Tables B.3.6–1 and B.3.6–4 present the estimated emission rates for the criteria pollutants. The estimated emission rates in Table B.3.6–1 were used in modeling the current emissions (Affected Environment), which were assumed to be related to the 2,000 weapons level at Pantex Plant. In addition, emission rates for two other weapons levels (1,000 and 500) were developed. Table B.3.6–4 shows the estimated criteria pollutant emission rates for the BGU.

Pantex Plant personnel provided information regarding facilities whose emissions would change or would remain the same if weapons operations were reduced. The facilities whose

emissions would change are indicated with a "W" in the Status column while those remaining the same are indicated with an "S". For those facilities whose emissions would be reduced, it was assumed that the reduction would be in proportion to the weapons operation reduction.

Table B.3.6–2 presents the estimated emission rates for 33 hazardous air pollutants (HAPs), as listed in the *Clean Air Act*, as amended, November 1990 (42 U.S.C. 7401). The emission sources and pollutant emission rates are presented in the same manner as described for Table B.3.6–1.

Table B.3.6–3 presents estimated emission rates for HAPs that are emitted from tray burns of hemispheres, HE, and wet HE. These emission rates are presented in the same manner as described for Table B.3.6–1.

Tables B.3.6–4 and B.3.6–5 present the estimated emission rates for criteria pollutants and HAPs from the BGU. These emissions were not used in modeling the current emission rates (Affected Environment) because the BGU project has not been started but should be completed in the next few years. Therefore, these emissions were included in modeling the emissions for the three weapons levels (2,000, 1,000, and 500) for future operations.

Two scenarios were assumed for modeling the emissions from the trays. One scenario assumed 45.4 kilograms (100 pounds) of HE were burned while the other assumed a burn of 363 kilograms (800 pounds) of HE. For modeling the affected environment, it was assumed that an HE mixture of PBX–9404 and LX–17 was burned. For modeling the emissions from 2,000, 1,000, and 500 weapons levels, it was assumed that a mixture of PBX–9404 and LX–04 was burned. The LX–17 and LX–04 HE were selected because they both emit HF. Although LX–17 is currently burned, it will not be burned during the 10-year period (1997–2007) covered by the EIS. LX–04, however, may continue to be burned durin period.

The emission factors that were used to calc the emission rates for carbon monoxide (nitrogen dioxide (NO_2), hydrogen chl (HCl), and HF for these HE mixtures presented in Table B.3.6–6. The different of HE are mixed to maximize the heat prod by the burning and keep the amount o emitted below the regulatory limits. In ord be conservative, the HE mixes modeled i EIS were chosen for the lowest heat outpu highest emission of HF allowed unde regulatory limits. The emission rates for HE mixtures are presented in Tables B. and B.3.6–8.

A summary of the estimated emission rat CO, NO_2, PM_{10}, HCl, and HF for the aff environment and the three levels of f operations (2,000, 1,000, and 500 weapo year) is presented in Table B.3.6–9.

B.3.7 Receptor Locations

A set of discrete receptors was placed a meter (328-foot) intervals at the Pantex boundary. Another set of 11 discrete rec was established at the locations of t residences which are situated near the F Plant boundary. A grid of offsite recepto not used since most of the emissions Pantex Plant sources were released at rela low heights above the surface. S concentrations from low-level releases w highest near the source and decrease increasing distance from the source. concentration decrease with distance result of the pollutant cloud being contin dispersed with increasing distanc atmospheric turbulence.

B.4 Modeling Results

This section presents the results conservative modeling of the

environment at Pantex Plant and the impacts associated with activity levels of 2,000, 1,000, and 500 weapons per year.

The model calculates the concentrations at each receptor resulting from the weather conditions for each hour within the year's worth of data (i.e., 8,760 hourly values for each receptor). The model uses meteorological data values that were recorded hourly at the Amarillo airport for an entire year (data was validated by TNRCC). The model returns the single maximum concentration seen by each receptor.

For example, for hourly results this maximum concentration value is associated with a certain hour's weather conditions (e.g., 9:00 a.m. December 3). A different receptor (especially one in a different direction from the source) would have a maximum concentration value returned that might be associated with a different set of meteorological conditions (e.g., 7:00 p.m. July 8). Per the example, the maximum concentration value for residence R5 occurs when a gentle wind blows from the source towards R5, and the maximum concentration value for residence R3 occurs when a gentle wind blows towards R3 (see Figure B.3.5–1). Therefore, it is difficult to discuss the relation between the values for different receptors solely in terms of distance from the source. For calculation of health effects, the maximum concentration hourly value is assumed (for conservatism) to exist at all receptors 24 hours a day 365 days a year.

3.4.1 Affected Environment

The maximum concentration found on the site boundary for each modeled criteria pollutant and each HAP is presented in volume I, Tables 4.7.1.3–4 and 4.7.1.3–5, respectively. The appropriate National Ambient Air Quality Standards (NAAQS) or Effects Screening Levels (ESLs) are also shown in the tables for comparison with the calculated concentration.

As shown in Table 4.7.1.3–4, none of the criteria pollutants are expected to exceed their ambient air quality standards. The emission inventory specified an emission rate for a group of pollutants called alcohols. The alcohol species included in the group were not speciated in the inventory. TNRCC in a modeling analysis of Pantex Plant developed a 1-hour ESL for the group of alcohols (TNRCC 1995b). The calculated maximum 1-hour average concentration at the Pantex Plant boundary for this group of alcohols is the only pollutant concentration that exceeded the guideline ESL (see Table 4.7.1.3–5 in volume I).

The maximum concentrations that were calculated for the 11 residences located near the plant boundary are presented in Table B.4.1–1 (see Figure B.3.5–1 for residence location). Alcohols, modeled as a group, were the only pollutants which exceeded the ESL at a residence. A subsequent review of the inventory of the amounts of the individual alcohols present at the Plant showed that the ESL used in the modeling was excessively conservative. Since the emission rates for the individual alcohols in the group were unknown, an estimation of the maximum fence line concentration for each of the alcohols was calculated based on the ratio of the amount of each alcohol to the total inventory of the group of alcohols present at Pantex Plant (see Table B.4.1–2). None of the individual alcohols were calculated to exceed their respective ESLs at or near the Plant boundary.

It should be noted that the maximum concentration at the residences shown in Table B.4.1–1 may not occur at the same time (day and hour). Since meteorological conditions also vary with time, the concentration values shown in this table cannot be used to determine the spatial variability of the concentrations. In order to determine the spatial variability the concentration would have to be determined simultaneously at all locations.

The modeling results for the current estimated pollutant emissions from Pantex Plant facilities indicate that the air quality at the plant boundary and beyond is not adversely impacted by Pantex Plant operations. The results also support the attainment designations for all criteria pollutants in the Pantex Plant area. The onsite air quality is well within the Threshold Limit Values for the pollutants. The impacts of the onsite air quality to workers are discussed in section 4.14.1.2 of volume I.

B.4.2 Air Quality Impacts

Air quality impacts were developed for three different levels of weapons which were assumed to occur during the analysis period of this EIS. The estimated maximum pollutant concentrations that would occur for each of the three levels of weapons are presented for criteria pollutants and HAPs in volume I, Tables 4.7.2.1–1 and 4.7.2.1–2, respectively. As shown in Table 4.7.2.1–1, concentrations of all the criteria pollutants are expected to be below their respective NAAQS.

As described in the Affected Environment (section B.4.1), only alcohols as a group exceeded the INRCC ESL (see Table 4.7.2.1–2) for all three weapons levels.

Table B.4.2–1 presents the estimated maximum pollutant concentration on the Pantex Plant boundary for the 2,000 weapons level as a percentage of the NAAQS. The percentages for the 1,000 and 500 weapons levels would be the same or less than those shown in the table. The greatest percentages of the NAAQS were for the 24-hour and annual PM_{10}. The emission resulting from the burning off 45.4 kilograms (100 pounds) of HE resulted in maximum boundary concentrations that represented about 59 percent of the 24-hour average standard and 18 percent of the annual standard. Maximum concentrations from other criteria pollutants represented less than 7 percent of their respective standards.

Although the mount of pollutants from the 363-kilogram (800-pound) H greater than the amount released from kilogram (1-pound) HE bu concentration f pollutants at the produced from e emissions of a 45.5 (100-pound) burn was greater t produced by 363-kilogram (800-p burn. The lo surface concentrati 363-kilogram 00-pound) burn are t a greater plu rise than occurs for t burn. The hi r plume rise is the larger amount f the hot air than t burn. The lar amount of hot ai increased bu ancy or vertical dispersion of pollutants from the is therefore eater due to this buoyancy. T greater dispersion fo burn results lower surface con than the smal burn.

Table B.4.2 contains informatio similar to wh was contained in Ta for criteria lutants. As show B.4.2–2, alcohols were estimated percent over 30-minute averag other HAPs e expected to be ESLs. The ext highest conc produced by ission of HF resu burning off 45 kilograms (100 p It represented bout 85 percent average HF standard. Other HA more than 50 percent of the re were nickel, Cl, methylene ch disulfide, and lyer.

Table B.4.2–3 resents the estim pollutant con ntrations that cou 111 residences ear the Pantex P Maximum pollutant concentratio the three weapons levels (2,000, are shown. Alcohols, modele exceeded the 30-minute avera Pantex Plant boundary, and at re all three leve of operations. pollutant con entrations at the were estimat to be below t ESLs. Since he maximum co

TABLE B.3.6–1.—*Estimated Emission Rates from Facility-Wide Criteria Pollutants for 2,000, 1,000, and 500 Weapons Scenarios*

SERIAL NO.	FACILITY	STATUS[a]	SOURCE CATEGORY[b]	POLLUTANT	COORDINATES		AFFECTED ENVIRONMENT AND 2,000 WEAPONS SCENARIO[c]				1,000 WEAPONS SCENARIO[d]	500 WEAPONS SCENARIO[d]
					X, UTM (meters)	Y, UTM (meters)	(lb/hr)	(g/sec)	(lb/yr)	(g/sec)	(g/sec)	(g/sec)
80	10-2	W	V	CO	264828	3909243	4.00E-02	5.04E-03	1.40E+01	2.02E-04	2.52E-03	1.26E-03
180	11-2 Water Heaters, Natural Gas	S	V	CO	266711	3910086	2.09E-02	2.63E-03	5.04E+01	7.26E-04	2.63E-03	2.63E-03
164	11-27 Furnaces, Natural Gas	S	V	CO	266716	3910060	1.14E-02	1.44E-03	2.76E+01	3.97E-04	1.44E-03	1.44E-03
165	11-29 Furnaces, Natural Gas	S	V	CO	266739	3910123	1.33E-02	1.68E-03	3.22E+01	4.64E-04	1.68E-03	1.68E-03
166	11-30 Furnaces, Natural Gas	S	V	CO	266620	3910690	2.29E-03	2.89E-04	5.60E+00	8.06E-05	2.89E-04	2.89E-04
158	11-36 Boiler, Natural Gas	S	V	CO	266281	3910425	2.90E-03	3.65E-04	2.04E+01	2.94E-04	3.65E-04	3.65E-04
34	11-38	W	V	CO	266270	3910207	2.30E-02	2.90E-03	1.90E+00	2.74E-05	1.45E-03	7.25E-04
159	11-43 Boiler, Natural Gas	S	V	CO	266465	3910193	1.02E-02	1.29E-03	7.12E+01	1.03E-03	1.29E-03	1.29E-03
181	11-48 Water Heaters, Natural Gas	S	V	CO	266556	3910123	6.10E-03	7.69E-04	1.48E+01	2.13E-04	7.69E-04	7.69E-04
172	12-100 Furnaces, Natural Gas	S	V	CO	267312	3910811	6.95E-03	8.76E-04	1.66E+01	2.39E-04	8.76E-04	8.76E-04
173	12-101 Furnaces, Natural Gas	S	V	CO	267788	3910873	7.71E-03	9.71E-04	1.86E+01	2.68E-04	9.71E-04	9.71E-04
174	12-102 Furnaces, Natural Gas	S	V	CO	267715	3910718	9.52E-03	1.20E-03	2.30E+01	3.31E-04	1.20E-03	1.20E-03
175	12-106 Furnaces, Natural Gas	S	V	CO	267688	3910796	9.14E-03	1.15E-03	2.24E+01	3.23E-04	1.15E-03	1.15E-03
176	12-106A Furnaces, Natural Gas	S	V	CO	267675	3910761	1.36E-02	1.71E-03	3.32E+01	4.78E-04	1.71E-03	1.71E-03
177	12-107 Furnaces, Natural Gas	S	V	CO	267692	3910852	1.90E-02	2.39E-03	4.54E+01	6.54E-04	2.39E-03	2.39E-03
178	12-112 Furnaces, Natural Gas	S	V	CO	267223	3910963	6.67E-03	8.40E-04	1.62E+01	2.33E-04	8.40E-04	8.40E-04
187	12-112 Water Heaters, Natural Gas	S	V	CO	267223	3910963	1.41E-03	1.78E-04	3.40E+00	4.90E-05	1.78E-04	1.78E-04

| | | |

TABLE B.3.6–1.—*Estimated Emission Rates from Facility-Wide Criteria Pollutants for 2,000, 1,000, and 500 Weapons Scenarios*-Continued

SERIAL NO.	FACILITY	STATUS[a]	SOURCE CATEGORY[b]	POLLUTANT	COORDINATES		AFFECTED ENVIRONMENT AND 2,000 WEAPONS SCENARIO[c]				1,000 WEAPONS SCENARIO[d]	500 WEAPONS SCENARIO[d]
					X, UTM (meters)	Y, UTM (meters)	(lb/hr)	(g/sec)	(lb/yr)	(g/sec)	(g/sec)	(g/sec)
162	9-5 Furnaces, Natural Gas	S	V	CO	263502	3909982	2.38E-02	3.00E-03	5.80E+00	8.35E-05	3.00E-03	3.00E-03
163	9-6 Furnaces, Natural Gas	S	V	CO	263407	3910183	2.38E-02	3.00E-03	5.80E+00	8.35E-05	3.00E-03	3.00E-03
2	Diesel Engines	S	A	CO	267138	3910516	8.26E+01	1.04E+01	4.38E+03	6.31E-02	1.04E+01	1.04E+01
82	FS-10	S	V	CO	266525	3914304	5.70E+00	7.18E-01	0.00E+00	0.00E+00	7.18E-01	7.18E-01
73	FS-10 (9404)	S	V	CO	266525	3914304	NA	NA	1.87E+01	2.69E-04	2.69E-04	2.69E-04
72	FS-10 (LX10)	S	V	CO	266525	3914304	NA	NA	1.87E+01	2.69E-04	2.69E-04	2.69E-04
101	FS-10 (RDX)	S	V	CO	266525	3914304	NA	NA	1.00E-01	1.44E-06	1.44E-06	1.44E-06
78	FS-10 (TATB)	S	V	CO	266525	3914304	NA	NA	1.39E+01	2.00E-04	2.00E-04	2.00E-04
67	FS-22	S	V	CO	266603	3913623	2.00E-01	2.52E-02	2.18E+01	3.14E-04	2.52E-02	2.52E-02
65	FS-22 (XTX)	S	V	CO	266603	3913623	NA	NA	2.10E+01	3.02E-04	3.02E-04	3.02E-04
134	FS-23	S	V	CO	266926	3913964	1.88E-04	2.37E-05	0.00E+00	0.00E+00	2.37E-05	2.37E-05
66	FS-24	S	V	CO	266094	3914090	1.20E+00	1.51E-01	2.22E+01	3.20E-04	1.51E-01	1.51E-01
74	FS-24 (TATB)	S	V	CO	266094	3914090	NA	NA	1.95E+01	2.81E-04	2.81E-04	2.81E-04
50	FS-4	S	V	CO	266879	3914306	1.23E+01	1.55E+00	6.29E+01	9.06E-04	1.55E+00	1.55E+00
15	Gasoline Engines	S	A	CO	267272	3910461	NA	NA	1.51E+03	2.17E-02	2.17E-02	2.17E-02
1	Natural Gas Boilers (16-13)	S	P	CO	266865	3910813	3.60E+00	4.54E-01	1.55E+04	2.24E-01	4.54E-01	4.54E-01
3	Natural Gas Engines	S	A	CO	267138	3910516	2.38E+00	3.00E-01	1.26E+03	1.81E-02	3.00E-01	3.00E-01
14	Standby Diesel Generators	S	A	CO	267507	3910490	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE B.3.6–1.—*Estimated Emission Rates from Facility-Wide Criteria Pollutants for 2,000, 1,000, and 500 Weapons Scenarios*-Continued

SERIAL NO.	FACILITY	STATUS[a]	SOURCE CATEGORY[b]	POLLUTANT	COORDINATES		AFFECTED ENVIRONMENT AND 2,000 WEAPONS SCENARIO[c]				1,000 WEAPONS SCENARIO[d]	500 WEAPONS SCENARIO[d]
					X, UTM (meters)	Y, UTM (meters)	(lb/hr)	(g/sec)	(lb/yr)	(g/sec)	(g/sec)	(g/sec)
162	9-5 Furnaces, Natural Gas	S	V	CO	263502	3909982	2.38E-02	3.00E-03	5.80E+00	8.35E-05	3.00E-03	3.00E-03
163	9-6 Furnaces, Natural Gas	S	V	CO	263407	3910183	2.38E-02	3.00E-03	5.80E+00	8.35E-05	3.00E-03	3.00E-03
2	Diesel Engines	S	A	CO	267138	3910516	8.26E+01	1.04E+01	4.38E+03	6.31E-02	1.04E+01	1.04E+01
82	FS-10	S	V	CO	266525	3914304	5.70E+00	7.18E-01	0.00E+00	0.00E+00	7.18E-01	7.18E-01
73	FS-10 (9404)	S	V	CO	266525	3914304	NA	NA	1.87E+01	2.69E-04	2.69E-04	2.69E-04
72	FS-10 (LX10)	S	V	CO	266525	3914304	NA	NA	1.87E+01	2.69E-04	2.69E-04	2.69E-04
101	FS-10 (RDX)	S	V	CO	266525	3914304	NA	NA	1.00E-01	1.44E-06	1.44E-06	1.44E-06
78	FS-10 (TATB)	S	V	CO	266525	3914304	NA	NA	1.39E+01	2.00E-04	2.00E-04	2.00E-04
67	FS-22	S	V	CO	266603	3913623	2.00E-01	2.52E-02	2.18E+01	3.14E-04	2.52E-02	2.52E-02
65	FS-22 (XTX)	S	V	CO	266603	3913623	NA	NA	2.10E+01	3.02E-04	3.02E-04	3.02E-04
134	FS-23	S	V	CO	266926	3913964	1.88E-04	2.37E-05	0.00E+00	0.00E+00	2.37E-05	2.37E-05
66	FS-24	S	V	CO	266094	3914090	1.20E+00	1.51E-01	2.22E+01	3.20E-04	1.51E-01	1.51E-01
74	FS-24 (TATB)	S	V	CO	266094	3914090	NA	NA	1.95E+01	2.81E-04	2.81E-04	2.81E-04
50	FS-4	S	V	CO	266879	3914306	1.23E+01	1.55E+00	6.29E+01	9.06E-04	1.55E+00	1.55E+00
15	Gasoline Engines	S	A	CO	267272	3910461	NA	NA	1.51E+03	2.17E-02	2.17E-02	2.17E-02
1	Natural Gas Boilers (16-13)	S	P	CO	266865	3910813	3.60E+00	4.54E-01	1.55E+04	2.24E-01	4.54E-01	4.54E-01
3	Natural Gas Engines	S	A	CO	267138	3910516	2.38E+00	3.00E-01	1.26E+03	1.81E-02	3.00E-01	3.00E-01
14	Standby Diesel Generators	S	A	CO	267507	3910490	1.92E+01	2.42E+00	6.91E+02	9.95E-03	2.42E+00	2.42E+00

TABLE B.3.6–1.—*Estimated Emission Rates from Facility-Wide Criteria Pollutants for 2,000, 1,000, and 500 Weapons Scenarios*-Continued

SERIAL NO.	FACILITY	STATUS[a]	SOURCE CATEGORY[b]	POLLUTANT	COORDINATES		AFFECTED ENVIRONMENT AND 2,000 WEAPONS SCENARIO[c]				1,000 WEAPONS SCENARIO[d]	500 WEAPONS SCENARIO[d]
					X, UTM (meters)	Y, UTM (meters)	(lb/hr)	(g/sec)	(lb/yr)	(g/sec)	(g/sec)	(g/sec)
80	10-2	W	V	Lead	264828	3909243	4.40E-04	5.54E-05	1.50E-01	2.16E-06	2.77E-05	1.39E-05
22	16-7	W	V	Lead	263889	3912006	1.70E-02	2.14E-03	8.40E+00	1.21E-04	1.07E-03	5.36E-04
22	16-7	W	V	Lead	263889	3912006	1.70E-02	2.14E-03	8.40E+00	1.21E-04	1.07E-03	5.36E-04
21	16-8	W	V	Lead	266975	3911176	1.70E-02	2.14E-03	8.40E+00	1.21E-04	1.07E-03	5.36E-04
21	16-8	W	V	Lead	266975	3911176	1.70E-02	2.14E-03	8.40E+00	1.21E-04	1.07E-03	5.36E-04
21	16-8	W	V	Lead	266975	3911176	1.70E-02	2.14E-03	8.40E+00	1.21E-04	1.07E-03	5.36E-04
21	16-8	W	V	Lead	266975	3911176	1.70E-02	2.14E-03	8.40E+00	1.21E-04	1.07E-03	5.36E-04
Total for Lead							3.44E-02	4.34E-03	1.70E+01	2.44E-04	2.17E-03	1.08E-03
80	10-2	W	V	NO_2	264828	3909243	1.30E-04	1.64E-05	4.00E-02	5.76E-07	2.88E-07	1.44E-07
180	11-2 Water Heaters, Natural Gas	S	V	NO_2	266711	3910086	1.04E-01	1.31E-02	2.52E+02	3.63E-03	1.31E-02	1.31E-02
164	11-27 Furnaces, Natural Gas	S	V	NO_2	266716	3910060	5.71E-02	7.19E-03	1.38E+02	1.99E-03	7.19E-03	7.19E-03
165	11-29 Furnaces, Natural Gas	S	V	NO_2	266739	3910123	6.67E-02	8.40E-03	1.61E+02	2.32E-03	8.40E-03	8.40E-03
166	11-30 Furnaces, Natural Gas	S	V	NO_2	266620	3910690	1.14E-02	1.44E-03	2.80E+01	4.03E-04	1.44E-03	1.44E-03
158	11-36 Boiler, Natural Gas	S	V	NO_2	266281	3910425	1.46E-02	1.84E-03	1.02E+02	1.47E-03	1.84E-03	1.84E-03
34	11-38	W	V	NO_2	266270	3910207	1.50E-03	1.89E-04	1.20E-01	1.73E-06	8.64E-07	4.32E-07
159	11-43 Boiler, Natural Gas	S	V	NO_2	266465	3910193	5.10E-02	6.43E-03	3.56E+02	5.13E-03	6.43E-03	6.43E-03
181	11-48 Water Heaters, Natural Gas	S	V	NO_2	266556	3910123	3.05E-02	3.84E-03	7.40E+01	1.07E-03	3.84E-03	3.84E-03
172	12-100 Furnaces, Natural Gas	S	V	NO_2	267312	3910811	3.48E-02	4.38E-03	8.30E+01	1.20E-03	4.38E-03	4.38E-03
173	12-101 Furnaces, Natural Gas	S	V	NO_2	267788	3910873	3.86E-02	4.86E-03	9.30E+01	1.34E-03	4.86E-03	4.86E-03
174	12-102 Furnaces, Natural Gas	S	V	NO_2	267715	3910718	4.76E-02	6.00E-03	1.15E+02	1.66E-03	6.00E-03	6.00E-03

TABLE B.3.6–1.—*Estimated Emission Rates from Facility-Wide Criteria Pollutants for 2,000, 1,000, and 500 Weapons Scenarios*-Continued

SERIAL NO.	FACILITY	STATUS[a]	SOURCE CATEGORY[b]	POLLUTANT	COORDINATES		AFFECTED ENVIRONMENT AND 2,000 WEAPONS SCENARIO[c]				1,000 WEAPONS SCENARIO[d]	500 WEAPONS SCENARIO[d]
					X, UTM (meters)	Y, UTM (meters)	(lb/hr)	(g/sec)	(lb/yr)	(g/sec)	(g/sec)	(g/sec)
175	12-106 Furnaces, Natural Gas	S	V	NO_2	267688	3910796	4.57E-02	5.76E-03	1.12E+02	1.61E-03	5.76E-03	5.76E-03
176	12-106A Furnaces, Natural Gas	S	V	NO_2	267675	3910761	6.79E-02	8.56E-03	1.66E+02	2.39E-03	8.56E-03	8.56E-03
177	12-107 Furnaces, Natural Gas	S	V	NO_2	267692	3910852	9.52E-02	1.20E-02	2.27E+02	3.27E-03	1.20E-02	1.20E-02
178	12-112 Furnaces, Natural Gas	S	V	NO_2	267223	3910963	3.33E-02	4.20E-03	8.10E+01	1.17E-03	4.20E-03	4.20E-03
187	12-112 Water Heaters, Natural Gas	S	V	NO_2	267223	3910963	7.05E-03	8.88E-04	1.70E+01	2.45E-04	8.88E-04	8.88E-04
179	12-113 Furnaces, Natural Gas	S	V	NO_2	267365	3910842	3.10E-02	3.91E-03	7.50E+01	1.08E-03	3.91E-03	3.91E-03
19	12-13 Paper Incinerator	W	V	NO_2	267993	3910661	6.30E-01	7.94E-02	1.13E+02	1.62E-03	8.10E-04	4.05E-04
168	12-28 Furnaces, Natural Gas	S	V	NO_2	267788	3910703	2.29E-02	2.89E-03	5.60E+01	8.06E-04	2.89E-03	2.89E-03
169	12-36 Furnaces, Natural Gas	S	V	NO_2	267393	3911010	3.81E-02	4.80E-03	9.20E+01	1.32E-03	4.80E-03	4.80E-03
170	12-39 Furnaces, Natural Gas	S	V	NO_2	267378	3910887	9.50E-03	1.20E-03	2.30E+01	3.31E-04	1.20E-03	1.20E-03
185	12-39 Water Heaters, Natural Gas	S	V	NO_2	267378	3910887	3.05E-02	3.84E-03	7.40E+01	1.07E-03	3.84E-03	3.84E-03
171	12-39A Furnaces, Natural Gas	S	V	NO_2	267350	3910889	2.19E-02	2.76E-03	5.20E+01	7.49E-04	2.76E-03	2.76E-03
182	12-5 Water Heaters, Natural Gas	S	V	NO_2	267872	3910891	5.43E-02	6.84E-03	1.32E+02	1.90E-03	6.84E-03	6.84E-03
70	12-5B	W	V	NO_2	267785	3910973	NA	NA	1.35E+02	1.94E-03	9.72E-04	4.86E-04
167	12-6 Furnaces, Natural Gas	S	V	NO_2	267846	3910820	7.60E-03	9.58E-04	1.80E+01	2.59E-04	9.58E-04	9.58E-04
183	12-6 Water Heaters, Natural Gas	S	V	NO_2	267846	3910820	2.10E-02	2.65E-03	5.10E+01	7.34E-04	2.65E-03	2.65E-03
9	12-68	W	V	NO_2	267845	3910587	NA	NA	2.10E+03	3.02E-02	1.51E-02	1.32E-03
184	12-7 Water Heaters, Natural Gas	S	V	NO_2	267827	3910839	7.60E-03	9.58E-04	1.80E+01	2.59E-04	9.58E-04	9.58E-04
186	12-75 Water Heaters, Natural Gas	S	V	NO_2	267279	3910707	1.28E-01	1.61E-02	3.08E+02	4.44E-03	1.61E-02	1.61E-02

	W		1.035
			1.505-03

TABLE B.3.6–1.—*Estimated Emission Rates from Facility-Wide Criteria Pollutants for 2,000, 1,000, and 500 Weapons Scenarios*-Continued

SERIAL NO.	FACILITY	STATUS[a]	SOURCE CATEGORY[b]	POLLUTANT	COORDINATES		AFFECTED ENVIRONMENT AND 2,000 WEAPONS SCENARIO[c]				1,000 WEAPONS SCENARIO[d]	500 WEAPONS SCENARIO[d]
					X, UTM (meters)	Y, UTM (meters)	(lb/hr)	(g/sec)	(lb/yr)	(g/sec)	(g/sec)	(g/sec)
179	12-113 Furnaces, Natural Gas	S	V	PM_{10}	267365	3910842	7.73E-04	9.74E-05	1.88E+00	2.71E-05	9.74E-05	9.74E-05
19	12-13 Paper Incinerator	W	V	PM_{10}	267993	3910661	1.47E+00	1.85E-01	2.63E+02	3.78E-03	9.26E-02	4.63E-02
48	12-16	W	V	PM_{10}	267803	3910653	6.00E-01	7.56E-02	1.36E+01	1.96E-04	3.78E-02	1.89E-02
99	12-024	W	V	PM_{10}	267616	3910122	4.90E-03	6.17E-04	2.10E-01	3.02E-06	3.09E-04	1.54E-04
168	12-028 Furnaces, Natural Gas	S	V	PM_{10}	267788	3910703	2.71E-04	3.41E-05	1.40E+00	2.02E-05	3.41E-05	3.41E-05
169	12-36 Furnaces, Natural Gas	S	V	PM_{10}	267393	3911010	9.52E-04	1.20E-04	2.30E+00	3.31E-05	1.20E-04	1.20E-04
170	12-39 Furnaces, Natural Gas	S	V	PM_{10}	267378	3910887	2.38E-04	3.00E-05	5.80E-01	8.35E-06	3.00E-05	3.00E-05
185	12-39 Water Heaters, Natural Gas	S	V	PM_{10}	267378	3910887	7.61E-04	9.59E-05	1.85E+00	2.66E-05	9.59E-05	9.59E-05
171	12-39A Furnaces, Natural Gas	S	V	PM_{10}	267350	3910889	5.47E-04	6.89E-05	1.30E+00	1.87E-05	6.89E-05	6.89E-05
182	12-5 Water Heaters, Natural Gas	S	V	PM_{10}	267872	3910891	1.36E-03	1.71E-04	3.30E+00	4.75E-05	1.71E-04	1.71E-04
70	12-5B	W	V	PM_{10}	267785	3910973	NA	NA	9.61E+00	1.38E-04	6.92E-05	3.46E-05
167	12-6 Furnaces, Natural Gas	S	V	PM_{10}	267846	3910820	1.90E-04	2.39E-05	4.50E-01	6.48E-06	2.39E-05	2.39E-05
183	12-6 Water Heaters, Natural Gas	S	V	PM_{10}	267846	3910820	5.23E-04	6.59E-05	1.28E+00	1.84E-05	6.59E-05	6.59E-05
9	12-68	W	V	PM_{10}	267845	3910587	NA	NA	1.05E+02	1.51E-03	7.56E-04	3.78E-04
184	12-7 Water Heaters, Natural Gas	S	V	PM_{10}	267827	3910839	1.90E-04	2.39E-05	4.50E-01	6.48E-06	2.39E-05	2.39E-05
186	12-75 Water Heaters, Natural Gas	S	V	PM_{10}	267279	3910707	3.19E-03	4.02E-04	7.70E+00	1.11E-04	4.02E-04	4.02E-04
188	16-10 Water Heaters, Natural Gas	S	V	PM_{10}	265891	3911244	2.38E-03	3.00E-04	5.75E+00	8.28E-05	3.00E-04	3.00E-04
189	16-12 Water Heaters, Natural Gas	S	V	PM_{10}	268836	3911272	6.37E-03	8.03E-04	1.54E+01	2.22E-04	8.03E-04	8.03E-04
190	16-15 Water Heaters, Natural Gas	S	V	PM_{10}	265822	3911413	7.38E-03	9.30E-04	1.78E+01	2.56E-04	9.30E-04	9.30E-04
22	16-7	W	V	PM_{10}	263889	3912006	8.30E-04	1.05E-04	4.20E-01	6.05E-06	5.23E-05	2.61E-05

	V	PM_{10}								

[illegible] Weapons Scenario (PC 1994). For ISCST2 and ISCLT2 modeling, the emission rates (lb/hr and lb/yr, respectively) were converted to g/sec.
[d] Emissions inventory listed for 1,000 and 500 Weapons Scenarios have been assumed to be a linear regression (PC 1994).
NA - Emission rate was not quantified for modeling.
Source: PC 1994, calculated values.

TABLE B.3.6–2.—*Estimated Emission Rates from Facility-Wide Hazardous Air Pollutants[1] for 2,000, 1,000, and 500 Weapons Scenarios*

SERIAL NO.	FACILITY	STATUS[a]	SOURCE CATEGORY[b]	POLLUTANT	COORDINATES		AFFECTED ENVIRONMENT AND 2,000 WEAPONS SCENARIO[c]				1,000 WEAPONS SCENARIO[d]	500 WEAPONS SCENARIO[d]
					X, UTM (meters)	Y, UTM (meters)	(lb/hr)	(g/sec)	(lb/yr)	(g/sec)	(g/sec)	(g/sec)
				CAS No.: 79005								
235	Drum Sampling - Building Area 1	W	A	1,1,2-trichloroethane	267209	3912603	1.01E+00	1.27E-01	8.34E+00	1.20E-04	6.36E-02	3.18E-02
				CAS No.: 106990								
2	Diesel Engines	S	A	1,3-butadiene	267138	3910516	1.98E+00	2.49E-01	1.05E+02	1.51E-03	2.49E-01	2.49E-01
14	Standby Diesel Generators (12-108)	S	A	1,3-butadiene	267507	3910490	2.33E-01	2.94E-02	8.40E+00	1.21E-04	2.94E-02	2.94E-02
70	12-5B	W	V	1,3-butadiene	267785	3910973	2.17E-02	2.73E-03	7.60E-01	1.09E-05	1.36E-03	6.82E-04
	Total for 1,3-butadiene						2.23E+00	2.82E-01	1.14E+02	1.64E-03	2.80E-01	2.79E-01
				CAS No.: 79469								
235	Drum Sampling - Building Area 1	W	A	2- nitropropane	267209	3912603	5.00E-01	6.30E-02	3.76E+00	5.41E-05	3.15E-02	1.58E-02
				CAS No.: No Number								
204	12-19 North Rotoclone	S	V	Alcohols	267680	3910275	6.50E+00	8.19E-01	2.60E+03	3.74E-02	8.19E-01	8.19E-01
235	Bulk Transport-Building Area 1	W	A	Alcohols	267209	3912603	4.37E+00	5.51E-01	1.10E+01	1.58E-04	2.75E-01	1.38E-01
235	Drum Sampling-Building Area 1	W	A	Alcohols	267209	3912603	1.51E+00	1.90E-01	1.40E-01	2.02E-06	9.51E-02	4.76E-02
	Total for alcohols						1.24E+01	1.56E+00	2.61E+03	3.76E-02	1.19E+00	1.00E+00
				CAS No.: 71432								
180	11-2 Water Heaters, Natural Gas	S	V	Benzene	266711	3910086	2.21E-04	2.78E-05	5.36E-01	7.72E-06	2.78E-05	2.78E-05
164	11-27 Furnaces, Natural Gas	S	V	Benzene	266716	3910060	1.21E-04	1.52E-05	2.92E-01	4.20E-06	1.52E-05	1.52E-05
165	11-29 Furnaces, Natural Gas	S	V	Benzene	266739	3910123	1.41E-02	1.78E-03	3.41E-01	4.91E-06	1.78E-03	1.78E-03
166	11-30 Furnaces, Natural Gas	S	V	Benzene	266620	3910690	NA	NA	6.00E-02	8.64E-07	8.64E-07	8.64E-07
158	11-36 Boiler, Natural Gas	S	V	Benzene	266281	3910425	3.20E-05	4.03E-06	2.16E-01	3.11E-06	4.03E-06	4.03E-06
159	11-43 Boiler, Natural Gas	S	V	Benzene	266465	3910193	1.08E-04	1.36E-05	7.55E-01	1.09E-05	1.36E-05	1.36E-05
181	11-48 Water Heaters, Natural Gas	S	V	Benzene	266556	3910123	6.48E-05	8.16E-06	1.57E-01	2.26E-06	8.16E-06	8.16E-06
42	11-51	W	V	Benzene	266292	3910088	2.40E-05	3.02E-06	5.00E-02	7.20E-07	1.51E-06	7.56E-07
172	12-100 Furnaces, Natural Gas	S	V	Benzene	267312	3910811	7.37E-05	9.29E-06	1.76E-01	2.53E-06	9.29E-06	9.29E-06
173	12-101 Furnaces, Natural Gas	S	V	Benzene	267788	3910873	8.18E-05	1.03E-05	1.97E-01	2.84E-06	1.03E-05	1.03E-05

TABLE B.3.6–2.—*Estimated Emission Rates from Facility-Wide Hazardous Air Pollutants[1] for 2,000, 1,000, and 500 Weapons Scenarios*-Continued

SERIAL NO.	FACILITY	STATUS[a]	SOURCE CATEGORY[b]	POLLUTANT	COORDINATES		AFFECTED ENVIRONMENT AND 2,000 WEAPONS SCENARIO[c]				1,000 WEAPONS SCENARIO[d]	500 WEAPONS SCENARIO[d]
					X, UTM (meters)	Y, UTM (meters)	(lb/hr)	(g/sec)	(lb/yr)	(g/sec)	(g/sec)	(g/sec)
174	12-102 Furnaces, Natural Gas	S	V	Benzene	267715	3910718	1.01E-04	1.27E-05	2.44E-01	3.51E-06	1.27E-05	1.27E-05
175	12-106 Furnaces, Natural Gas	S	V	Benzene	267688	3910796	9.69E-05	1.22E-05	2.37E-01	3.41E-06	1.22E-05	1.22E-05
176	12-106A Furnaces, Natural Gas	S	V	Benzene	267675	3910761	1.44E-04	1.81E-05	3.52E-01	5.07E-06	1.81E-05	1.81E-05
177	12-107 Furnaces, Natural Gas	S	V	Benzene	267692	3910852	2.02E-04	2.55E-05	4.81E-01	6.93E-06	2.55E-05	2.55E-05
178	12-112 Furnaces, Natural Gas	S	V	Benzene	267223	3910963	7.06E-05	8.90E-06	1.72E-01	2.48E-06	8.90E-06	8.90E-06
187	12-112 Water Heaters, Natural Gas	S	V	Benzene	267223	3910963	1.48E-05	1.86E-06	3.60E-02	5.18E-07	1.86E-06	1.86E-06
179	12-113 Furnaces, Natural Gas	S	V	Benzene	267365	3910842	6.56E-05	8.27E-06	1.59E-01	2.29E-06	8.27E-06	8.27E-06
168	12-28 Furnaces, Natural Gas	S	V	Benzene	267788	3910703	4.84E-05	6.10E-06	1.19E-01	1.71E-06	6.10E-06	6.10E-06
169	12-36 Furnaces, Natural Gas	S	V	Benzene	267393	3911010	8.08E-05	1.02E-05	1.95E-01	2.81E-06	1.02E-05	1.02E-05
170	12-39 Furnaces, Natural Gas	S	V	Benzene	267378	3910887	2.02E-05	2.55E-06	4.88E-02	7.03E-07	2.55E-06	2.55E-06
185	12-39 Water Heaters, Natural Gas	S	V	Benzene	267378	3910887	6.48E-05	8.16E-06	1.57E-01	2.26E-06	8.16E-06	8.16E-06
171	12-39A Furnaces, Natural Gas	S	V	Benzene	267350	3910889	4.64E-05	5.85E-06	1.10E-01	1.58E-06	5.85E-06	5.85E-06
182	12-5 Water Heaters, Natural Gas	S	V	Benzene	267872	3910891	1.15E-04	1.45E-05	2.80E-01	4.03E-06	1.45E-05	1.45E-05
70	12-5B	W	V	Benzene	267785	3910973	2.43E-02	3.06E-03	8.50E-01	1.22E-05	1.53E-03	7.65E-04
167	12-6 Furnaces, Natural Gas	S	V	Benzene	267846	3910820	1.61E-05	2.03E-06	3.80E-02	5.47E-07	2.03E-06	2.03E-06
183	12-6 Water Heaters, Natural Gas	S	V	Benzene	267846	3910820	4.44E-05	5.59E-06	1.08E-01	1.56E-06	5.59E-06	5.59E-06
9	12-68	S	V	Benzene	267845	3910587	4.00E-04	5.04E-05	1.60E+00	2.30E-05	5.04E-05	5.04E-05
184	12-7 Water Heaters, Natural Gas	S	V	Benzene	267827	3910839	1.60E-05	2.02E-06	3.80E-02	5.47E-07	2.02E-06	2.02E-06
186	12-75 Water Heaters, Natural Gas	S	V	Benzene	267279	3910707	2.70E-04	3.40E-05	6.52E-01	9.39E-06	3.40E-05	3.40E-05
188	16-10 Water Heaters, Natural Gas	S	V	Benzene	265891	3911244	2.02E-04	2.55E-05	4.88E-01	7.03E-06	2.55E-05	2.55E-05
189	16-12 Water Heaters, Natural Gas	S	V	Benzene	268836	3911272	5.40E-04	6.80E-05	1.30E+00	1.87E-05	6.80E-05	6.80E-05
190	16-15 Water Heaters, Natural Gas	S	V	Benzene	265822	3911413	6.24E-04	7.86E-05	1.51E+00	2.17E-05	7.86E-05	7.86E-05
161	9-4 Furnaces, Natural Gas	S	V	Benzene	263530	3909933	2.52E-05	3.18E-06	6.16E-02	8.87E-07	3.18E-06	3.18E-06
162	9-5 Furnaces, Natural Gas	S	V	Benzene	263502	3909982	2.52E-05	3.18E-06	6.16E-02	8.87E-07	3.18E-06	3.18E-06
163	9-6 Furnaces, Natural Gas	S	V	Benzene	263407	3910183	2.52E-05	3.18E-06	6.16E-02	8.87E-07	3.18E-06	3.18E-06
9	Diesel Engines	S	A	Benzene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE B.3.6–2.—*Estimated Emission Rates from Facility-Wide Hazardous Air Pollutants[1] for 2,000, 1,000, and 500 Weapons Scenarios*-Continued

SERIAL NO.	FACILITY	STATUS[a]	SOURCE CATEGORY[b]	POLLUTANT	COORDINATES		AFFECTED ENVIRONMENT AND 2,000 WEAPONS SCENARIO[c]				1,000 WEAPONS SCENARIO[d]	500 WEAPONS SCENARIO[d]
					X, UTM (meters)	Y, UTM (meters)	(lb/hr)	(g/sec)	(lb/yr)	(g/sec)	(g/sec)	(g/sec)
235	Drum Sampling - Building Area 1	W	A	Benzene	267209	3912603	5.10E-01	6.43E-02	8.42E+00	1.21E-04	3.21E-02	1.61E-02
15	Gasoline Engines	S	A	Benzene	267272	3910461	2.65E-02	3.34E-03	9.00E-01	1.30E-05	3.34E-03	3.34E-03
1	Natural Gas Boilers (16-13)	S	P	Benzene	266865	3910813	1.92E-02	2.42E-03	5.00E+01	7.20E-04	2.42E-03	2.42E-03
14	Standby Diesel Generators (12-108)	S	A	Benzene	267507	3910490	2.58E-01	3.25E-02	9.30E+00	1.34E-04	3.25E-02	3.25E-02
		Total for Benzene					3.11E+00	3.91E-01	1.99E+02	2.91E-03	3.58E-01	3.41E-01
				CAS No.: 75150								
235	Drum Sampling - Building Area 1	W	A	Carbon Disulfide	267209	3912603	1.32E+00	1.66E-01	5.96E+01	8.59E-04	8.32E-02	4.16E-02
				CAS No.: 56235								
235	Drum Sampling - Building Area 1	W	A	Carbon Tetrachloride	267209	3912603	1.15E+00	1.45E-01	3.44E+01	4.95E-04	7.25E-02	3.62E-02
				CAS No.: 108907								
235	Bulk Transport - Building Area 1	W	A	Chlorobenzene	267209	3912603	7.10E-01	8.95E-02	8.56E-01	1.23E-05	4.47E-02	2.24E-02
235	Drum Sampling - Building Area 1	W	A	Chlorobenzene	267209	3912603	4.30E-01	5.42E-02	3.08E+00	4.44E-05	2.71E-02	1.35E-02
		Total for Chlorobenzene					1.14E+00	1.44E-01	3.94E+00	5.67E-05	7.18E-02	3.59E-02
				CAS No.: 7440473								
80	10-2	W	V	Chromium	264828	3909243	2.00E-07	2.52E-08	0.00E+00	0.00E+00	1.26E-08	6.30E-09
22	16-7	W	V	Chromium	263889	3912006	6.60E-06	8.32E-07	3.40E-03	4.90E-08	4.16E-07	2.08E-07
21	16-8	W	V	Chromium	266975	3911176	6.60E-06	8.32E-07	3.40E-03	4.90E-08	4.16E-07	2.08E-07
		Total for Chromium					1.34E-05	1.69E-06	6.80E-03	9.79E-08	8.44E-07	4.22E-07

TABLE B.3.6–2.—*Estimated Emission Rates from Facility-Wide Hazardous Air Pollutants[1] for 2,000, 1,000, and 500 Weapons Scenarios*-Continued

TABLE B.3.6–2.—*Estimated Emission Rates from Facility-Wide Hazardous Air Pollutants[1] for 2,000, 1,000, and 500 Weapons Scenarios*-Continued

SERIAL NO.	FACILITY	STATUS[a]	SOURCE CATEGORY[b]	POLLUTANT	COORDINATES		AFFECTED ENVIRONMENT AND 2,000 WEAPONS SCENARIO[c]				1,000 WEAPONS SCENARIO[d]	500 WEAPONS SCENARIO[d]
					X, UTM (meters)	Y, UTM (meters)	(lb/hr)	(g/sec)	(lb/yr)	(g/sec)	(g/sec)	(g/sec)
				CAS No.: 1319773								
235	Drum Sampling - Building Area 1	W	A	Cresols	267209	3912603	3.00E-02	3.78E-03	1.10E-01	1.58E-06	1.89E-03	9.45E-04
235	Drum Sampling - Building Area 1	W	A	Cresylic Acid	267209	3912603	3.00E-01	3.78E-02	1.10E-01	1.58E-06	1.89E-02	9.45E-03
				CAS No.: 68122								
201	11-36 Vent Scrubber	S	V	Dimethylformamide	266281	3910425	2.66E+05	3.91E+06	2.05E+00	2.58E-01	3.91E+06	3.91E+06
202	11-36 Waste Trailer 1	S	V	Dimethylformamide	266460	3910139	2.66E+05	3.91E+06	2.00E-02	2.52E-03	3.91E+06	3.91E+06
203	11-36 Waste Trailer 3	S	V	Dimethylformamide	266281	3910425	2.66E+05	3.91E+06	2.00E-02	2.52E-03	3.91E+06	3.91E+06
	Total for Dimethylformamide						7.99E+05	1.17E+07	2.09E+00	2.63E-01	1.17E+07	1.17E+07
				CAS No.: No Number								
235	Bulk Transport - Building Area 1	W	A	Ester Glycol Ethers	267209	3912603	1.50E+00	1.89E-01	1.83E+00	2.64E-05	9.45E-02	4.73E-02
235	Drum Sampling - Building Area 1	W	A	Ester Glycol Ethers	267209	3912603	3.00E-01	3.78E-02	6.00E-02	8.64E-07	1.89E-02	9.45E-03
	Total for Ester Glycol Ethers						1.80E+00	2.27E-01	1.89E+00	2.72E-05	1.13E-01	5.67E-02
				CAS No.: 141-78-6								
204	12-19 North Rotoclone	S	V	Ethyl Acetate	267680	3910275	6.70E+01	8.44E+00	1.08E+04	1.55E-01	8.44E+00	8.44E+00
205	12-19 Fugitives	S	V	Ethyl Acetate	267680	3910275	9.10E+00	1.15E+00	1.60E+03	2.30E-02	1.15E-01	1.15E+00
235	Bulk Transport - Building Area 1	W	A	Ethyl Acetate	267209	3912603	1.10E+01	1.39E+00	1.37E+01	1.97E-04	6.95E-01	3.47E-01
235	Drum Sampling - Building Area 1	W	A	Ethyl Acetate	267209	3912603	2.48E+01	3.12E-01	1.09E+01	1.57E-04	1.56E-01	7.80E-02
	Total for Ethyl Acetate						8.96E+01	1.13E+01	1.24E+04	1.79E-01		
				CAS No.: 100414								
235	Bulk Transport - Building Area 1	W	A	[illegible]								
235	Drum Sampling [illegible]											

TABLE B.3.6-2.—Estimated Emission Rates from Facility-Wide Hazardous Air Pollutants for 2,000, 1,000, and 500 Weapons Scenarios-Continued

SERIAL NO.	FACILITY	STATUS[a]	SOURCE CATEGORY[b]	POLLUTANT	COORDINATES		AFFECTED ENVIRONMENT AND 2,000 WEAPONS SCENARIO[c]				1,000 WEAPONS SCENARIO[d]	500 WEAPONS SCENARIO[d]
					X, UTM (meters)	Y, UTM (meters)	(lb/hr)	(g/sec)	(lb/yr)	(g/sec)	(g/sec)	(g/sec)
				CAS No.: 50000								
180	11-2 Water Heaters, Natural Gas	S	V	Formaldehyde	266711	3910086	4.42E-04	5.57E-05	1.07E+00	1.54E-05	2.21E-04	2.21E-04
164	11-27 Furnaces, Natural Gas	S	V	Formaldehyde	266716	3910060	2.42E-04	3.05E-05	5.85E-01	8.42E-06	1.21E-04	1.21E-04
165	11-29 Furnaces, Natural Gas	S	V	Formaldehyde	266739	3910123	2.83E-04	3.57E-05	6.83E-01	9.84E-06	1.42E-04	1.42E-04
166	11-30 Furnaces, Natural Gas	S	V	Formaldehyde	266620	3910690	4.84E-05	6.10E-06	1.18E-01	1.70E-06	2.42E-05	2.42E-05
158	11-36 Boiler, Natural Gas	S	V	Formaldehyde	266281	3910425	6.40E-05	8.06E-06	4.33E-01	6.24E-06	3.20E-05	3.20E-05
159	11-43 Boiler, Natural Gas	S	V	Formaldehyde	266465	3910193	2.16E-04	2.72E-05	1.51E+00	2.17E-05	1.08E-04	1.08E-04
181	11-48 Water Heaters, Natural Gas	S	V	Formaldehyde	266556	3910123	1.30E-04	1.64E-05	3.14E-01	4.52E-06	6.50E-05	6.20E-05
172	12-100 Furnaces, Natural Gas	S	V	Formaldehyde	267312	3910811	1.47E-04	1.85E-05	3.52E-01	5.07E-06	7.35E-05	7.35E-05
173	12-101 Furnaces, Natural Gas	S	V	Formaldehyde	267788	3910873	1.64E-04	2.07E-05	3.94E-01	5.67E-06	8.20E-05	8.20E-05
174	12-102 Furnaces, Natural Gas	S	V	Formaldehyde	267715	3910718	2.02E-04	2.55E-05	4.88E-01	7.03E-06	1.01E-04	1.01E-04
175	12-106 Furnaces, Natural Gas	S	V	Formaldehyde	267688	3910796	1.94E-04	2.44E-05	4.75E-01	6.84E-06	9.70E-05	9.70E-05
176	12-106A Furnaces, Natural Gas	S	V	Formaldehyde	267675	3910761	2.88E-04	3.63E-05	7.04E-01	1.01E-05	1.44E-04	1.44E-04
177	12-107 Furnaces, Natural Gas	S	V	Formaldehyde	267692	3910852	4.04E-04	5.09E-05	9.62E-01	1.39E-05	2.02E-04	2.02E-04
178	12-112 Furnaces, Natural Gas	S	V	Formaldehyde	267223	3910963	1.41E-04	1.78E-05	3.43E-01	4.94E-06	7.05E-05	7.05E-05
187	12-112 Water Heaters, Natural Gas	S	V	Formaldehyde	267223	3910963	2.96E-05	3.73E-06	7.20E-02	1.04E-06	1.48E-05	1.48E-05
179	12-113 Furnaces, Natural Gas	S	V	Formaldehyde	267365	3910842	1.31E-04	1.65E-05	3.18E-01	4.58E-06	6.55E-05	6.55E-05
168	12-28 Furnaces, Natural Gas	S	V	Formaldehyde	267788	3910703	9.69E-05	1.22E-05	2.37E-01	3.41E-06	4.85E-05	4.85E-05
169	12-36 Furnaces, Natural Gas	S	V	Formaldehyde	267393	3911010	1.62E-04	2.04E-05	3.90E-01	5.62E-06	8.10E-05	8.10E-05
170	12-39 Furnaces, Natural Gas	S	V	Formaldehyde	267378	3910887	4.03E-05	5.08E-06	9.76E-02	1.41E-06	2.02E-05	2.02E-05
185	12-39 Water Heaters, Natural Gas	S	V	Formaldehyde	267378	3910887	1.30E-04	1.64E-05	3.14E-01	4.52E-06	6.50E-05	6.50E-05
171	12-39A Furnaces, Natural Gas	S	V	Formaldehyde	267350	3910889	9.28E-05	1.17E-05	2.20E-01	3.17E-06	4.64E-05	4.64E-05
182	12-5 Water Heaters, Natural Gas	S	V	Formaldehyde	267872	3910891	2.30E-04	2.90E-05	5.60E-01	8.06E-06	1.15E-04	1.15E-04
167	12-6 Furnaces, Natural Gas	S	V	Formaldehyde	267846	3910820	3.22E-05	4.06E-06	7.60E-02	1.09E-06	1.61E-05	1.61E-05
183	12-6 Water Heaters, Natural Gas	S	V	Formaldehyde	267846	3910820	8.88E-05	1.12E-05	2.16E-01	3.11E-06	4.44E-05	4.44E-05
9	12-68	W	V	Formaldehyde	267845	3910587	8.00E-04	1.01E-04	3.20E+00	4.61E-05	5.04E-05	2.52E-05

| | | |

								2E-03
								0E-03
								1E-04
Methyl Ethyl Ketone			1.30E-02	1.64E-03				
Methyl Ethyl Ketone			4.80E-03	6.05E-04	5.02E-			
	267092	390	1.29E-02	1.63E-03	1.01E-			
thyl Ethyl Ketone	265854	391	1.09E+00	1.37E-01				
thyl Ethyl Ketone	267209	391	1.08E+01	1.36E-00				
thyl Ethyl Ketone			2.16E+00	2.72E-01				
					1.56E+04		00	4.79E+0

TABLE B.3.6–2.—*Estimated Emission Rates from Facility-Wide Hazardous Air Pollutants[1] for 2,000, 1,000, and 500 Weapons Scenarios*-Continued

SERIAL NO.	FACILITY	STATUS[a]	SOURCE CATEGORY[b]	POLLUTANT	COORDINATES X, UTM (meters)	COORDINATES Y, UTM (meters)	AFFECTED ENVIRONMENT AND 2,000 WEAPONS SCENARIO[c] (lb/hr)	(g/sec)	(lb/yr)	(g/sec)	1,000 WEAPONS SCENARIO[d] (g/sec)	500 WEAPONS SCENARIO[d] (g/sec)
235	Drum Sampling - Building Area 1	W	A	Methylene Chloride	267209	3912603	2.36E+00	2.97E-01	1.24E+01	1.78E-04	1.49E-01	7.43E-02
	Total for Methylene Chloride						1.31E+01	1.66E+00	1.14E+02	5.96E-03	1.26E+00	1.07E+00
				CAS No.: 98953								
235	Drum Sampling - Building Area 1	W	A	Nitrobenzene	267209	3912603	3.00E-02	3.78E-03	1.10E-01	1.58E-06	1.89E-03	9.45E-04
				CAS No.: 127184								
235	Drum Sampling - Building Area 1	W	A	Tetrachloroethylene			1.03E+00	1.30E-01	1.42E+01	2.04E-04	6.49E-02	3.24E-02
				CAS No.: 108883								
36	11-17	W	V	Toluene	266460	3910139	2.88E-03	3.63E-04	1.50E-01	2.16E-06	1.81E-04	9.07E-05
71	11-17S	W	V	Toluene	266521	3910149	4.30E-01	5.42E-02	4.30E+00	6.19E-05	2.71E-02	1.35E-02
180	11-2 Water Heaters, Natural Gas	S	V	Toluene	266711	3910086	1.11E-04	1.40E-05	2.68E-01	3.86E-06	1.40E-05	1.40E-05
164	11-27 Furnaces, Natural Gas	S	V	Toluene	266716	3910060	6.06E-05	7.64E-06	1.46E-01	2.10E-06	7.64E-06	7.64E-06
165	11-29 Furnaces, Natural Gas	S	V	Toluene	266739	3910123	7.07E-05	8.91E-06	1.71E-01	2.46E-06	8.91E-06	8.91E-06
166	11-30 Furnaces, Natural Gas	S	V	Toluene	266620	3910690	1.21E-05	1.52E-06	2.96E-02	4.26E-07	1.52E-06	1.52E-06
10	11-36	S	V	Toluene	266281	3910425	4.14E-01	5.22E-02	2.00E+03	2.88E-02	5.22E-02	5.22E-02
158	11-36 Boiler, Natural Gas	S	V	Toluene	266281	3910425	1.60E-05	2.02E-06	1.08E-01	1.56E-06	2.02E-06	2.02E-06
201	11-36 VentScrubber	S	V	Toluene	266281	3910425	3.45E+01	4.35E+00	1.66E+03	2.39E-02	4.35E+00	4.35E+00
202	11-36 Waste Trailer 1	S	V	Toluene	266281	3910425	5.00E-02	6.30E-03	1.00E+01	1.44E-04	6.30E-03	6.03E-03
203	11-36 Waste Trailer 3	S	V	Toluene	266281	3910425	5.00E-02	6.30E-03	4.00E+00	5.76E-05	6.30E-03	6.30E-03
18	11-36P	S	V	Toluene	266287	3910490	4.00E+00	5.04E-01	3.60E+02	5.18E-03	5.04E-01	5.04E-01
64	11-38S	W	V	Toluene	266246	3910196	6.00E-01	7.56E-02	1.10E+00	1.58E-05	3.78E-02	1.89E-02
159	11-43 Boiler, Natural Gas	S	V	Toluene	266465	3910193	5.40E-05	6.80E-06	3.77E-01	5.43E-06	6.80E-06	6.80E-06
181	11-48 Water Heaters, Natural Gas	S	V	Toluene	266556	3910123	3.24E-05	4.08E-06	7.84E-02	1.13E-06	4.08E-06	6.80E-06
42	11-51	W	V	Toluene	266292	3910088	6.92E-03	8.72E-04	1.44E+01	[illegible]	[illegible]	[illegible]
16	11-9	W	V	Toluene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE B.3.6–2.—*Estimated Emission Rates from Facility-Wide Hazardous Air Pollutants[1] for 2,000, 1,000, and 500 Weapons Scenarios*-Continued

SERIAL NO.	FACILITY	STATUS[a]	SOURCE CATEGORY[b]	POLLUTANT	COORDINATES		AFFECTED ENVIRONMENT AND 2,000 WEAPONS SCENARIO[c]				1,000 WEAPONS SCENARIO[d]	500 WEAPONS SCENARIO[d]
					X, UTM (meters)	Y, UTM (meters)	(lb/hr)	(g/sec)	(lb/yr)	(g/sec)	(g/sec)	(g/sec)
173	12-101 Furnaces, Natural Gas	S	V	Toluene	267788	3910873	4.09E-05	5.15E-06	9.86E-02	1.42E-06	5.15E-06	5.15E-06
174	12-102 Furnaces, Natural Gas	S	V	Toluene	267715	3910718	5.05E-05	6.36E-06	1.22E-01	1.76E-06	6.36E-06	6.36E-06
29	12-104	W	V	Toluene	267265	3910216	1.20E-03	1.51E-04	1.82E+00	2.62E-05	7.56E-05	3.78E-05
175	12-106 Furnaces, Natural Gas	S	V	Toluene	267688	3910796	3.68E-05	4.64E-06	1.19E-01	1.71E-06	4.64E-03	4.64E-03
176	12-106A Furnaces, Natural Gas	S	V	Toluene	267675	3910761	4.09E-05	5.15E-06	1.76E-01	2.53E-06	5.15E-03	5.15E-03
177	12-107 Furnaces, Natural Gas	S	V	Toluene	267692	3910852	5.05E-05	6.36E-06	2.41E-01	3.47E-06	6.36E-03	6.36E-03
12	12-110	W	V	Toluene	268036	3910814	4.12E-01	5.19E-02	2.14E+02	3.08E-03	2.60E-02	1.30E-02
47	12-111	W	V	Toluene	267983	3910838	3.27E-03	4.12E-04	1.70E+00	2.45E-05	2.06E-04	1.03E-04
178	12-112 Furnaces, Natural Gas	S	V	Toluene	267223	3910963	3.53E-05	4.45E-06	8.58E-02	1.24E-06	4.45E-06	4.45E-06
187	12-112 Water Heaters, Natural Gas	S	V	Toluene	267223	3910963	7.40E-06	9.32E-07	1.80E-02	2.59E-07	9.32E-07	9.23E-07
179	12-113 Furnaces, Natural Gas	S	V	Toluene	267365	3910842	3.28E-05	4.13E-06	7.95E-02	1.14E-06	4.13E-06	4.13E-06
48	12-16	W	V	Toluene	267803	3910653	1.02E+00	1.29E-01	1.19E+02	1.71E-03	6.43E-02	3.21E-02
55	12-21	W	V	Toluene	267655	3910218	1.88E-01	2.37E-02	7.20E+00	1.04E-04	1.18E-02	5.92E-03
53	12-25	W	V	Toluene	267589	3910055	3.00E-01	3.78E-02	3.00E-01	4.32E-06	1.89E-02	9.45E-03
168	12-28 Furnaces, Natural Gas	S	V	Toluene	267788	3910703	2.42E-05	3.05E-06	5.94E-02	8.55E-07	3.05E-06	3.05E-06
23	12-34SS	W	V	Toluene	267785	3910292	2.20E-04	2.77E-05	2.60E-02	3.74E-07	1.39E-05	6.93E-06
169	12-36 Furnaces, Natural Gas	S	V	Toluene	267393	3911010	4.04E-05	5.09E-06	9.75E-02	1.40E-06	5.09E-06	5.09E-06
170	12-39 Furnaces, Natural Gas	S	V	Toluene	267378	3910887	1.01E-05	1.27E-06	2.44E-02	3.51E-07	1.27E-06	1.27E-06
185	12-39 Water Heaters, Natural Gas	S	V	Toluene	267378	3910887	3.24E-05	4.08E-06	7.84E-02	1.13E-06	4.08E-06	4.08E-06
171	12-39A Furnaces, Natural Gas	S	V	Toluene	267350	3910889	2.32E-05	2.92E-06	5.51E-02	7.93E-07	2.92E-06	2.92E-06
43	12-41	W	V	Toluene	267503	3909659	2.37E+00	2.99E-01	2.59E+01	3.73E-04	1.49E-01	7.47E-02
45	12-44	W	V	Toluene	267410	3909939	1.90E-03	2.39E-04	1.18E+00	1.70E-05	1.20E-04	5.99E-05
182	12-5 Water Heaters, Natural Gas	S	V	Toluene	267872	3910891	5.76E-05	7.26E-06	1.40E-01	2.02E-06	7.26E-03	7.26E-06
51	12-59	W	V	Toluene	267681	3910660	2.50E-03	3.15E-04	1.30E+00	1.87E-05	1.58E-04	7.88E-05
167	12-6 Furnaces, Natural Gas	S	V	Toluene	267846	3910820	8.06E-06	1.02E-06	1.90E-02	2.74E-07	1.02E-06	1.02E-06

TABLE B.3.6–2.—*Estimated Emission Rates from Facility-Wide Hazardous Air Pollutants[1] for 2,000, 1,000, and 500 Weapons Scenarios*-Continued

SERIAL NO.	FACILITY	STATUS[a]	SOURCE CATEGORY[b]	POLLUTANT	COORDINATES		AFFECTED ENVIRONMENT AND 2,000 WEAPONS SCENARIO[c]				1,000 WEAPONS SCENARIO[d]	500 WEAPONS SCENARIO[d]
					X, UTM (meters)	Y, UTM (meters)	(lb/hr)	(g/sec)	(lb/yr)	(g/sec)	(g/sec)	(g/sec)
183	12-6 Water Heaters, Natural Gas	S	V	Toluene	267816	3910870	2.22E-05	2.80E-06	5.40E-02	7.78E-07	2.80E-06	1.02E-06
32	12-64	W	V	Toluene	267315	3910088	2.90E-03	3.65E-04	3.08E+00	4.44E-05	1.83E-04	9.14E-05
9	12-68	W	V	Toluene	267815	3910557	2.00E-04	2.52E-05	8.00E-01	1.15E-05	1.26E-05	6.30E-06
184	12-7 Water Heaters, Natural Gas	S	V	Toluene	267827	3910839	8.00E-06	1.01E-06	1.90E-02	2.74E-07	1.01E-03	1.01E-06
186	12-75 Water Heaters, Natural Gas	S	V	Toluene	267279	3910707	1.38E-04	1.70E-05	3.26E-01	4.69E-06	1.70E-02	1.01E-06
27	12-82	W	V	Toluene	267294	3909766	9.23E-02	1.16E-02	5.30E+01	7.63E-04	5.81E-03	2.91E-03
25	12-84	W	V	Toluene	267203	3910117	8.80E-03	1.11E-03	1.21E+01	1.74E-04	5.54E-04	2.77E-04
61	12-85	W	V	Toluene	267227	3910032	5.00E-04	6.30E-05	1.10E+00	1.58E-05	3.15E-05	1.58E-05
35	12-86	W	V	Toluene	267055	3909814	1.38E-02	1.74E-03	1.08E+01	1.56E-04	8.69E-04	4.35E-04
58	12-98	W	V	Toluene	267111	3910056	3.80E-03	4.79E-04	2.73E+00	3.93E-05	2.39E-04	1.20E-04
38	12-99	W	V	Toluene	267092	3909967	1.38E-02	1.74E-03	7.20E+00	1.04E-04	8.69E-04	4.35E-04
188	16-10 Water Heaters, Natural Gas	S	V	Toluene	265891	3911244	1.01E-04	1.27E-05	2.44E-01	3.51E-06	1.27E-02	1.27E-02
189	16-12 Water Heaters, Natural Gas	S	V	Toluene	265836	3911272	2.70E-04	3.40E-05	6.52E-01	9.39E-06	3.40E-02	3.40E-02
190	16-15 Water Heaters, Natural Gas	S	V	Toluene	265822	3911413	3.12E-04	3.93E-05	7.56E-01	1.09E-05	3.93E-02	3.93E-02
20	16-4	W	V	Toluene	265854	3911416	1.71E+00	2.15E-01	5.76E+01	8.29E-04	1.08E-01	5.39E-02
161	9-4 Furnaces, Natural Gas	S	V	Toluene	263530	3909933	1.26E-05	1.59E-06	3.08E-02	4.44E-07	1.59E-03	1.59E-03
162	9-5 Furnaces, Natural Gas	S	V	Toluene	263502	3909982	1.26E-05	1.59E-06	3.08E-02	4.44E-07	1.59E-03	1.59E-03
163	9-6 Furnaces, Natural Gas	S	V	Toluene	263407	3910183	1.26E-05	1.59E-06	3.08E-02	4.44E-07	1.59E-03	1.59E-03
235	Bulk Transport - Building Area 1	W	A	Toluene	267209	3912603	4.00E+00	5.04E-01	1.01E+01	1.45E-04	2.52E-01	1.26E-01
235	Drum Sampling - Building Area 1	W	A	Toluene	267209	3912603	8.00E-01	1.01E-01	1.00E+01	1.44E-04	5.04E-02	2.52E-02
57	FS-1	S	V	Toluene	265885	3913982	1.88E-01	2.37E-02	6.00E-01	8.64E-06	2.37E-02	2.73E-02
67	FS-22	S	V	Toluene	266603	3913623	1.00E-02	1.26E-03	6.00E-01	8.64E-06	1.26E-03	1.26E-03
134	FS-23	S	V	Toluene	266926	3913964	1.50E-01	1.89E-02	6.00E-01	8.64E-06	1.89E-02	1.89E-02
66	FS-24	S	V	Toluene	266094	3914090	1.00E-02	1.26E-03	6.00E-01	8.64E-06	1.26E-03	1.26E-03
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Estimated Emission Rates from Facility-Wide Hazardous Air Pollutants[f] for 2,000, 1,000, and 500 Weapons Scenarios-Continued

SERIAL NO.	FACILITY	STATUS[a]	SOURCE CATEGORY[b]	POLLUTANT	COORDINATES		AFFECTED ENVIRONMENT AND 2,000 WEAPONS SCENARIO[c]				1,000 WEAPONS SCENARIO[d]	500 WEAPONS SCENARIO[d]
					X, UTM (meters)	Y, UTM (meters)	(lb/hr)	(g/sec)	(lb/yr)	(g/sec)	(g/sec)	(g/sec)
				CAS No.: 79016								
235	Drum Sampling - Building Area 1	W	A	Trichloroethylene	267209	3912603	2.99E+0	3.77E-01	4.3E+01	6.19E-04	1.88E-01	9.42E-02
				CAS No.: 121448								
201	11-36 Vent Scrubber	S	V	Triethylamine	266281	3910425	8.00E-02	1.01E-02	0.00E+00	0.00E+00	1.01E-02	1.01E-02
				CAS No.: 1330207								
16	11-9	W	V	Xylene	266515	3910714	3.80E-03	4.79E-04	3.79E+00	5.46E-05	2.39E-04	1.20E-04
12	12-110	W	V	Xylene	268036	3910814	6.90E-01	8.69E-02	3.59E+02	5.17E-03	4.35E-02	2.17E-02
43	12-41	W	V	Xylene	267503	3909659	4.65E+00	5.86E-01	3.00E+01	4.32E-04	2.93E-01	1.46E-01
30	12-5	W	V	Xylene	267872	3910891	9.80E-05	1.23E-05	2.10E-01	3.02E-06	6.17E-06	3.09E-06
32	12-64	W	V	Xylene	267315	3910068	6.30E-03	7.94E-04	7.52E+00	1.08E-04	3.97E-04	1.98E-04
27	12-82	W	V	Xylene	267294	3909766	1.80E-03	2.27E-04	1.67E+00	2.40E-05	1.13E-04	5.67E-05
25	12-84	W	V	Xylene	267203	3910117	1.78E-02	2.24E-03	1.13E+01	1.63E-04	1.12E-03	5.61E-04
61	12-85	W	V	Xylene	267227	3910032	1.10E-03	1.39E-04	1.26E+00	1.81E-05	6.93E-05	3.47E-05
35	12-86	W	V	Xylene	267055	3909814	4.50E-03	5.67E-04	3.14E+00	4.52E-05	2.84E-04	1.42E-04
58	12-98	W	V	Xylene	267111	3910056	7.00E-04	8.82E-05	6.40E-01	9.22E-06	4.41E-05	2.21E-05
38	12-99	W	V	Xylene	267092	3909967	1.41E-02	1.78E-03	7.44E+00	1.07E-04	8.88E-04	4.44E-04
20	16-4	W	V	Xylene	265854	3911416	2.52E+00	3.18E-01	5.96E+01	8.58E-04	1.59E-01	7.94E-02
235	Bulk Transport - Building Area 1	W	A	Xylene	267209	3912603	1.15E+00	1.45E-01	2.89E+00	4.16E-05	7.25E-02	3.62E-02
235	Drum Sampling - Building Area 1	W	A	Xylene	267209	3912603	2.30E-01	2.90E-02	1.43E+00	2.06E-05	1.45E-02	7.25E-03
15	Gasoline Engines	S	A	Xylene	267272	3910461	2.65E-02	3.34E-03	9.00E-01	1.30E-05	3.34E-03	3.34E-03
				Total for Xylene			9.32E+0	1.17E+0	4.91E+02	7.07E-03	5.89E-01	2.96E-01

[a] Letter designates change in emissions. S for static emissions or no change with time and W for change associated with change in weapons program.
[b] Letter designates source modeling category. V = volume source, A = area source, P = point source.
[c] Emissions inventory listed for 2,000 Weapons Scenario (PC 1994). For ISCST2 and ISCLT2 modeling, the emissions rates (lb/hr and lb/yr, respectively) were converted to g/sec.
[d] Emissions inventory listed for 1,000 and 500 Weapons Scenarios have been assumed to be a linear regression (PC 1994).
[f] As listed in the *Clean Air Act*, as amended, Nov 1990 (42 U.S.C. 7401).
CAS No. - Chemical Abstract Service Registry Number.
NA - emission rate was not quantified for modeling.
Note: Pollutants related to burning of explosives are presented in Tables B.3.6-3, B.3.6-4, and B.3.6-5.
Source: PC 1994, calculated values.

TABLE B.3.6–4.—*Estimated Emission Rates for Criteria Pollutants from the Burning Ground Upgrade for 2,000, 1,000, and 500 Weapons Scenarios*

SERIAL NO.	FACILITY	STATUS[a]	SOURCE CATEGORY[b]	POLLUTANT	COORDINATES		AFFECTED ENVIRONMENT AND 2,000 WEAPONS SCENARIO[c]				1,000 WEAPONS SCENARIO[d]	500 WEAPONS SCENARIO[d]
					X, UTM (meters)	Y, UTM (meters)	(lb/hr)	(g/sec)	(lb/yr)	(g/sec)	(g/sec)	(g/sec)
300	BG Upgrade - Components	S	P	CO	265162	3914189	3.15E+01	3.97E+00	2.36E+02	3.40E-03	3.97E+00	3.97E+00
300	BG Upgrade - Pipes	S	P	CO	265162	3914189	3.08E+02	3.88E+01	1.08E+04	1.56E-01	3.88E+01	3.88E+01
300	BG Upgrade	S	P	Lead	265152	3914189	3.25E-01	4.09E-02	3.91E+02	5.63E-03	5.63E-03	5.63E-03
300	BG Upgrade - Components	S	P	NO_2	265162	3914189	9.81E+00	1.24E+00	7.36E+01	1.06E-03	1.06E-03	1.06E-03
300	BG Upgrade - Pipes	S	P	NO_2	265162	3914189	1.05E+02	1.32E+01	2.31E+03	3.33E-02	3.33E-02	3.33E-02
300	BG Upgrade	S	P	SO_2	265162	391418	2.88E-04	3.63E-05	2.16E-01	2.72E-02	3.63E-05	3.63E-05

[a] Letter designates change in emissions. S for static emissions or no change with time and W for change associated with change in weapons program.
[b] Letter designates source modeling category. V = volume source, A = area source, P = point source.
[c] Emissions inventory listed for 2,000 Weapons Scenario (PC 1994). For ISCST2 and ISCLT2 modeling, the emissions rates (lb/hr and lb/yr, respectively) were converted to g/sec.
[d] Emissions inventory listed for 1,000 and 500 Weapons Scenarios have been assumed to be a linear regression (PC 1994).
BG - Burning Ground
Source: PC 1994; calculated values

1.26E-01	1.2

-01	1.34E-01
-04	4.42E-04

TABLE B.3.6–6.—*High Explosive Emission Factors*

EXPLOSIVE	POLLUTANTS			
	CO (lb/ton)	NO_2 (lb/ton)	HCl (lb/ton)	HF (lb/ton)
PBX-9404[a]	5.50	37.90	21.88	0.00
LX-17[a]	51.80	139.00	39.38	80.03
LX-04[b]	0.95	25.12	220.80	528.00

[a]Radian 1993
[b]Carter 1978

TABLE B.3.6–7.—*Calculated Emission Rates for Pantex Affected Environment*

EXPLOSIVE	PERCENTAGE BY WEIGHT[a]	POLLUTANTS			
		CO (g/sec)	NO_2 (g/sec)	HCl (g/sec)	HF (g/sec)
PBX-9404	75%	0.0260	0.1780	0.1030	0.0000
LX-17	25%	0.0816	0.2190	0.0621	0.1260
Total	100%	0.1076	0.3970	0.1651	0.1260

[a]Weight is based on 100 lbs.
Note: Emission rates were calculated using emission factors from Table B.3.6–6.
Source: PC 1994

TABLE B.3.6–8.—*Calculated Emission Rates for 2,000, 1,000, and 500 Weapons*

EXPLOSIVE	PERCENTAGE BY WEIGHT[a]	POLLUTANTS			
		CO (g/sec)	NO_2 (g/sec)	HCl (g/sec)	HF (g/sec)
PBX-9404	75%	0.0260	0.1780	0.1030	0.0000
LX-04	25%	0.0015	0.8320	0.0396	0.3480
Total	100%	0.0275	1.0100	0.1426	0.3480

[a]Weight is based on 100 lbs.
Note: Emission rates were calculated using emission factors from Table B.3.6–6.
Source: PC 1994

Pollutants' from Open Burning for

S	P			
S	P			
S	P			
S	P			
S	P			

2.75E-02	2.75E-02	2.75E-02

[illegible]	[illegible]	

[illegible] WEAPONS SCENARIO[illegible]	506 WEAPONS SCENARIO[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

TABLE B.4.1–1.—*Estimated Maximum Concentrations of Hazardous Air[1] and Criteria Pollutants at Local Residences Surrounding the Pantex Plant, ($\mu g/m^3$)*-Continued

POLLUTANT	AVG. TIME	NAAQS OR TSI ($\mu g/m^3$)	RESIDENCE 1	2	3	4	5	6	7	8	9	10	11
Cresols	Annual	[illegible]	[illegible]	1.16E-03	5.00E-04	1.20E-04	6.00E-05	6.00E-05	6.00E-05	1.00E-04	1.10E-04	2.00E-04	2.00E-04
	30-min	[illegible]	[illegible]	1.13E-01	5.05E-02	3.08E-02	2.18E-02	2.71E-02	1.59E-02	1.21E-01	2.50E-02	4.96E-02	1.96E-01
Cresylic Acid	Annual	NA	[illegible]	1.23E-03	6.30E-01	1.50E-04	7.00E-05	7.00E-05	7.00E-05	1.30E-04	1.30E-04	2.50E-03	1.00E-03
	30-min	[illegible]	[illegible]	[illegible]	6.28E-02	3.83E-02	2.72E-02	3.37E-02	1.99E-02	1.50E-01	3.23E-02	6.17E-02	2.44E-01
Dibenzofurans 45.4 kg (100 lb) HE	Annual	NA	[illegible]	[illegible]	1.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	30-min	NA	[illegible]	[illegible]	[illegible]	3.00E-04	2.10E-04	1.10E-04	1.20E-04	9.00E-05	1.30E-04	1.60E-04	2.00E-04
Dibenzofurans 363 kg (800 lb) HE	Annual	NA	[illegible]	[illegible]	[illegible]	[illegible]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	30-min	NA	4.00E-05	[illegible]	[illegible]	[illegible]	3.00E-05	2.00E-05	3.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05
Dimethylformamide	Annual	3.00E+01	3.13E-02	[illegible]	[illegible]	[illegible]	1.11E-02	5.42E-03	7.13E-03	1.62E-02	1.75E-02	2.67E-02	3.09E-02
	30-min	3.00E+02	6.82E+00	8.30E+00	[illegible]	[illegible]	[illegible]	6.70E+00	6.23E+00	6.06E+00	7.08E+00	1.41E+00	7.15E+00
Ethyl Glycol Ethers	Annual	NA	1.08E-01	1.01E-01	[illegible]	[illegible]	[illegible]	5.05E-03	4.79E-03	9.05E-03	9.32E-03	1.73E-02	7.22E-02
	30-min	NA	1.32E+01	1.24E+01	[illegible]	[illegible]	[illegible]	[illegible]	1.39E+00	1.05E+01	2.26E+00	4.32E+00	1.71E+01
Ethyl Acetate	Annual	1.44E+03	2.31E+00	1.68E+00	[illegible]	[illegible]	[illegible]	[illegible]	2.14E-01	4.06E-01	9.91E-01	4.32E+00	1.71E+01
	30-min	1.44E+04	2.48E+02	2.95E+02	2.89E+02	[illegible]	[illegible]	[illegible]	[illegible]	1.55E+02	3.94E+02	1.26E+03	3.67E+02
Ethyl Benzene	Annual	4.34E+02	9.35E-02	8.72E-02	3.80E-02	[illegible]	[illegible]	[illegible]	[illegible]	7.84E-03	8.07E-03	1.50E-02	6.25E-02
	30-min	2.00E+03	1.15E+01	1.08E+01	3.80E+00	[illegible]	[illegible]	[illegible]	[illegible]	1.96E+00	3.74E+00	1.48E+01
Ethylene Dichloride	Annual	4.00E+00	2.88E-02	2.69E-02	1.17E-02	2.85E-03	1.38E-03	[illegible]	[illegible]	2.31E-03	2.48E-03	4.63E-03	1.93E-02
	30-min	1.60E+02	3.53E+00	3.32E+00	1.17E+00	7.15E-01	5.07E-01	[illegible]	[illegible]	[illegible]	6.03E-01	1.15E+00	4.56E+00
Formaldehyde 45.4 kg (100 lb) HE	Annual	1.50E+00	7.10E-04	7.70E-04	4.80E-04	2.10E-04	1.30E-04	7.00E-05	1.00E-03	1.90E-04	2.70E-04	5.30E-04	6.20E-04
	30-min	1.50E+01	7.71E-02	8.20E-02	4.63E-02	3.04E-02	4.01E-02	3.56E-02	4.74E-02	3.40E-02	6.32E-02	8.43E-02	7.87E-02
Formaldehyde - 363 kg (800 lb) HE	Annual	1.50E+00	7.10E-04	7.70E-04	4.80E-04	2.10E-04	1.30E-04	7.00E-05	1.00E-04	1.90E-04	2.70E-04	5.30E-04	6.20E-04
	30-min	1.50E+01	7.71E-02	8.20E-02	4.63E-02	3.04E-02	4.01E-02	3.56E-02	4.74E-02	3.40E-02	6.32E-02	8.43E-02	7.87E-02
HCl - 45.4 kg (100 lb) HE	Annual	1.00E-01	3.47E-02	2.81E-02	5.06E-02	6.00E-03	4.00E-03	5.20E-03	5.28E-03	7.53E-03	3.47E-03	4.28E-03	7.85E-03
	30-min	7.50E+01	1.71E+00	2.57E+00	4.04E+00	1.85E+00	1.34E+00	9.51E-01	8.24E-01	9.45E-01	8.58E-01	2.07E+00	1.23E+00
HCl - 363 kg (800 lb) HE	Annual	1.00E-01	1.11E-02	1.76E-02	3.28E-02	4.04E-03	1.83E-03	1.23E-03	1.08E-03	1.39E-03	6.80E-04	1.05E-03	2.15E-03
	30-min	7.50E+01	8.43E-01	2.30E+00	2.94E+00	1.76E+00	1.34E+00	6.90E-01	4.05E-01	3.33E-01	2.22E-01	6.83E-01	5.46E-01
HF 45.4 kg (100 lb) HE	3-hour	4.90E+00	1.35E-01	4.09E-01	1.03E+00	3.89E-01	1.66E-01	1.76E-01	1.03E-01	8.48E-02	3.35E-02	4.56E-02	1.34E-01
			[illegible]	[illegible]	[illegible]	[illegible]	4.16E-02	4.39E-02	2.58E-02	2.12E-02	8.38E-03	5.70E-02	3.36E-02

TABLE B.4.1–1.—*Estimated Maximum Concentrations of Hazardous Air[1] and Criteria Pollutants at Local Residences Surrounding the Pantex Plant, ($\mu g/m^3$)*-Continued

POLLUTANT	AVG. TIME	NAAQS OR ESL $\mu g/m^3$	RESIDENCE										
			1	2	3	4	5	6	7	8	9	10	11
HE - 363 kg (800 lb) HE	3-hour	4.90E+00	5.07E-02	7.44E-02	8.56E-02	5.61E-02	4.03E-02	2.46E-02	2.07E-02	2.12E-02	2.73E-02	2.53E-02	3.92E-02
	12-hour	3.68E+00	1.27E-02	1.86E-02	2.14E-02	1.40E-02	1.01E-02	6.15E-03	5.27E-03	6.87E-03	6.82E-03	6.23E-03	9.81E-03
	24-hour	2.86E+00	6.34E-03	1.59E-02	1.20E-02	9.35E-03	5.26E-03	3.81E-03	3.09E-03	4.63E-03	3.41E-03	3.16E-03	5.53E-03
Lead	1st Qtr	1.50E+00[a]	5.20E-04	6.80E-04	6.00E-04	2.80E-04	2.40E-04	2.00E-04	1.70E-04	2.20E-04	3.90E-04	6.10E-04	5.50E-04
	2nd Qtr	1.50E+00[a]	3.10E-04	6.50E-04	6.20E-04	6.40E-04	3.90E-04	1.20E-04	1.60E-04	1.40E-04	1.60E-04	2.70E-04	3.10E-04
	3rd Qtr	1.50E+00[a]	1.06E-03	1.29E-03	1.07E-03	8.30E-04	3.00E-04	1.10E-04	1.20E-04	1.30E-04	1.00E-04	2.20E-04	6.20E-04
	4th Qtr	1.50E+00[a]	6.80E-04	7.80E-04	6.40E-04	5.40E-04	1.70E-04	2.10E-04	1.40E-04	2.40E-04	2.40E-04	5.80E-04	6.40E-04
Mercury	Annual	5.00E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	30-min	5.00E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	24-hour	2.50E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methanol	Annual	2.62E+02	3.64E-01	4.42E-01	2.84E-01	1.50E-01	1.00E-01	5.04E-02	6.52E-02	1.47E-01	1.58E-01	2.44E-01	3.12E-01
	30-min	2.62E+03	6.17E+01	7.29E+01	7.45E+01	2.73E+01	5.16E+01	5.86E+01	5.45E+01	5.40E+01	6.19E+01	1.23E+02	6.25E+01
Methyl Cyanide - 4.54 kg (100 lb) HE	Annual	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	30-min	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methyl Cyanide - 363 kg (800 lb) HE	Annual	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	30-min	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methyl Ethyl Ketone	Annual	5.90E+02	1.36E+00	8.24E-01	6.38E-01	2.83E-01	1.83E-01	1.27E-01	1.48E-01	2.83E-01	6.75E-01	1.87E+00	1.20E+00
	30-min	3.90E+03	1.85E+02	1.98E+02	2.03E+02	1.09E+02	1.05E+02	9.84E+01	1.88E+02	1.14E+02	2.75E+02	8.98E+02	2.77E+02
Methyl Isobutyl Ketone	Annual	2.05E+02	1.53E-01	1.43E-02	6.22E-03	1.51E-03	7.30E-04	7.20E-04	6.80E-04	1.28E-03	1.32E-03	2.46E-03	1.10E-02
	30-min	2.05E+03	1.88E+00	1.76E+00	6.22E-01	3.80E-01	2.69E-01	3.34E-01	1.97E-01	1.49E+00	3.21E-01	6.12E-01	2.42E+00
Methylene Chloride	Annual	2.60E+01	4.67E-01	3.92E-01	1.97E-01	6.21E-02	3.56E-02	2.87E-02	3.08E-02	5.84E-02	1.05E-01	2.75E-01	3.45E-01
	30-min	2.60E+02	3.93E+01	3.69E+01	2.90E+01	1.39E+01	1.32E+01	1.24E+01	2.36E+01	3.11E+01	3.77E+01	1.15E+02	5.07E+01
Naphthalene - 45.4 kg (100 lb) HE	Annual	5.00E+01	1.00E-05	2.00E-05	7.00E-05	1.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	30-min	4.40E+02	1.73E-03	2.28E-03	4.16E-03	1.70E-03	1.30E-03	6.30E-04	6.60E-04	5.20E-04	7.30E-04	9.00E-04	1.16E-03
Naphthalene - 363 kg (800 lb) HE	Annual	5.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	30-min	4.40E+02	2.50E-04	2.90E-04	3.40E-04	2.00E-04	1.20E-03	1.10E-04	1.60E-04	2.20E-04	2.30E-04	2.40E-04	2.60E-04
Nitrobenzene	Annual	5.00E+00	1.54E-03	1.44E-03	6.30E-04	1.50E-04	7.00E-05	7.00E-05	7.00E-05	1.30E-04	1.30E-04	2.50E-04	1.03E-03
	30-min	2.40E+01	1.89E-01	1.78E-01	6.28E-02	3.83E-02	2.72E-02	3.37E-02	1.99E-02	1.50E-01	3.23E-02	6.17E-02	2.45E-01

TABLE B.4.1–1.—*Estimated Maximum Concentrations of Hazardous Air[1] and Criteria Pollutants at Local Residences Surrounding the Pantex Plant, (μg/m³)*-Continued

POLLUTANT	AVG. TIME	NAAQS OR ESL μg/m³	RESIDENCE										
			1	2	3	4	5	6	7	8	9	10	11
NO_2 - 45.4 kg (100 lb) HE	Annual	1.00E+02[b]	2.46E-01	3.15E-01	4.76E-01	9.53E-02	6.04E-02	5.25E-02	5.24E-02	9.41E-02	8.79E-02	1.65E-01	1.99E-01
NO_2 - 363 kg (800 lb) HE	Annual	1.00E+02[b]	2.18E-01	3.06E-01	2.56E-01	8.29E-02	5.21E-02	3.37E-02	3.14E-02	5.93E-02	7.30E-02	1.46E-01	1.71E-01
Phenol - 45.4 kg (100 lb) HE	Annual	1.90E+01	3.00E-05	1.30E-04	3.70E-04	3.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	2.00E-05
	30 min	1.54E+02	9.25E-03	1.22E-02	2.22E-02	9.05E-03	6.53E-03	3.37E-03	3.51E-03	2.75E-03	3.89E-03	4.82E-03	6.17E-03
Phenol - 363 kg (800 lb) HE	Annual	1.90E+01	1.00E-05	2.00E-05	2.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-05	0.00E+00	0.00E+00	1.00E-05
	30 min	[illegible]	1.32E-03	1.57E-03	1.79E-03	1.08E-03	8.20E-04	5.80E-04	8.50E-04	1.17E-03	1.25E-03	1.30E-03	1.41E-03
PM_{10} - 45.4 kg (100 lb) HE	[illegible]	[illegible]	6.87E-01	2.13E+00	5.64E+00	5.19E-01	2.13E-01	1.51E-01	1.52E-01	2.11E-01	2.38E-01	4.39E-01	5.22E-01
	[illegible]	[illegible]	[illegible]	2.12E+01	5.36E+01	1.26E+01	1.03E+01	3.14E+00	3.32E+00	2.41E+00	3.16E+00	6.07E+00	5.00E+00
PM_{10} - 363 kg (800 lb) HE	[illegible]	[illegible]	[illegible]	5.08E-01	4.70E-01	1.27E-01	7.98E-02	9.08E-02	9.28E-02	1.55E-01	1.78E-01	3.43E-01	3.62E-01
	[illegible]	[illegible]	[illegible]	[illegible]	1.68E+00	2.19E+00	1.49E+00	1.48E+00	1.82E+00	1.45E+00	2.47E+00	4.70E+00	3.26E+00
Tetrachloroethylene	Annual	[illegible]	[illegible]	[illegible]	2.15E-02	5.23E-03	2.54E-03	2.48E-03	2.35E-03	4.44E-03	4.57E-03	8.51E-03	3.54E-03
	30 min	[illegible]	[illegible]	[illegible]	2.15E+00	1.31E+00	9.32E-01	1.16E+00	6.80E-01	5.14E+00	1.10E+00	2.11E+00	8.34E-01
Toluene	Annual	[illegible]	[illegible]	[illegible]	[illegible]	3.79E-01	2.50E-01	1.33E-01	1.66E-01	3.61E-01	4.34E-01	6.78E-01	9.50E-01
	30 min	1.88E+03	[illegible]	[illegible]	[illegible]	[illegible]	1.16E+02	1.25E+02	1.20E+02	1.17E+02	1.35E+02	2.69E+02	1.45E+02
Trichloroethylene	Annual	1.35E+02	1.53E-01	[illegible]	[illegible]	[illegible]	7.36E-03	6.82E-03	1.28E-02	1.32E-02	2.47E-02	1.03E-01	1.12E-01
	30 min	1.35E+03	1.88E+00	[illegible]	[illegible]	[illegible]	2.70E+00	3.35E+00	1.98E+00	1.49E+01	3.21E+00	1.14E+00	1.43E+01
Triethylamine	Annual	4.00E+00	1.32E-03	1.65E-03	[illegible]	[illegible]	3.30E-03	2.10E-04	6.20E-04	1.03E-03	1.19E-02	1.00E-05	2.00E-05
	30 min	4.00E+01	2.61E-01	3.19E-01	[illegible]	[illegible]	[illegible]	2.57E-01	2.39E-01	2.32E-01	2.72E-01	5.40E-01	2.74E-01
Xylene	Annual	4.34E+02	2.23E-01	2.03E-01	1.48E-01	[illegible]	[illegible]	[illegible]	2.39E-02	4.68E-02	9.84E-02	1.52E-01	1.83E-01
	30 min	3.70E+03	1.57E+01	4.59E+01	1.85E+01	[illegible]	[illegible]	[illegible]	1.12E+01	1.11E+01	2.85E+01	5.51E+01	2.33E+01

[a]Alcohols - Alcohols is the only pollutant which exceeded the ESL at the fence line. Therefore, modeling results are also reported for all the residences for alcohols.

[b]Indicates a NAAQS. Other values are ESLs.

[1]As listed in the *Clean Air Act*, as amended, Nov 1990 (42 U.S.C. 7401).

NA - An ESL has not been established by TNRCC.

Note: Table shows the results (maximum concentrations at residences) from models ISCST2 and ISCLT2.

Sources: TNRCC 1993a; TNRCC 1996a

TABLE B.4.1–2.—*Calculated Concentrations of Individual Alcohols Based on Percentage of Inventory*

ALCOHOLS	TOTAL QUANTITIES (GALLONS)	PERCENT OF INVENTORY (GALLONS)	PRORATED CONCEN-TRATIONS ($\mu g/m^3$)	1-HOUR ESL ($\mu g/m^3$)	PERCENT OF ESL
Gelvatol 9000	3.12E+01	1.78	3.46	NA	NA
1-butanol/ N-butyl Alcohol	1.18E+01	6.72E-01	1.31	7.60E+02	0.2
2-methyl 1-propanol	3.50E-01	2.00E-02	3.89E-02	NA	NA
2-propanol/ Isopropyl Alcohol	1.11E+03	6.30E+01	1.23E+02	7.86E+03	1.6
Methanol / Methyl Alcohol	4.56E+02	2.60E+01	5.07E+01	2.62E+03	1.9
Ethyl Alcohol	1.07E+02	6.11	1.19E+01	1.88E+04	0.1
1-propanol/ Propyl Alcohol/n-propyl Alcohol	2.94E+01	1.68	3.27	4.92E+03	0.1
Cetyl Alcohol/ 1-hexadecanol	3.40	1.94E-01	3.78E-01	NA	NA
TERT-AMYL Alcohol	3.20	1.82E-01	3.56E-01	8.30E+02	0.0
Triton X-100	1.30	7.41E-02	1.44E-01	6.00E+02	0.0
1-tetradecanol	2.24E-01	1.28E-02	2.49E-02	NA	NA
Cinnamyl Alcohol	1.79E-01	1.02E-02	1.99E-02	NA	NA
Elvanol Polyvinyl Alcohol	2.60E-01	1.48E-02	2.89E-02	NA	NA
1-octanol	1.00	5.70E-02	1.11E-01	1.01E+02	0.1
2-butanol/SEC-Butyl Alcohol	1.72	9.82E-02	1.91E-01	3.03E+03	0.0
WABCOL Alcohol Prep Pad	7.46E-01	4.25E-02	8.29E-02	NA	NA
Phenolphthalein Indicator	1.00E-01	5.70E-03	1.11E-02	NA	NA
2-pentanol	6.61E-01	3.77E-02	7.35E-02	NA	NA
Cyclohexanol	1.25E-01	7.13E-03	1.39E-02	6.01E+03	0.0
Total	1.75E+03	—	—	—	—

Source: PC 1996l

TABLE B.4.2–1.—*Percentage of the NAAQS Consumed by the Estimated Maximum Criteria Pollutant Concentration at Pantex Plant Boundary (2,000 Weapons)*

POLLUTANT	AVERAGING TIME	NAAQS $\mu g/m^3$	MAXIMUM CONCENTRATION AT BOUNDARY $\mu g/m^3$	PERCENT OF NAAQS
CO - 45.4 kg (100 lb) HE	1-hour	4.00E+04	9.24E+02	2.3
	8-hour	1.00E+04	1.61E+02	1.6
CO - 363 kg (800 lb) HE	1-hour	4.00E+04	9.24E+02	2.3
	8-hour	1.00E+04	1.61E+02	1.6
CO - BGU	1-hour	4.00E+04	2.90E+03	[illegible]
	8-hour	1.00E+04	6.02E+02	[illegible]
Lead	1st Qtr	1.50	1.02E-03	[illegible]
	2nd Qtr	1.50	9.64E-04	[illegible]
	3rd Qtr	1.50	1.58E-03	[illegible]
	4th Qtr	1.50	9.50E-03	[illegible]
Lead - BGU	1st Qtr	1.50	2.28E-02	[illegible]
	2nd Qtr	1.50	6.62E-02	[illegible]
	3rd Qtr	1.50	[illegible]	[illegible]
	4th Qtr	1.50	[illegible]	[illegible]
NO_2 - 45.4 kg (100 lb) HE	Annual	1.00E+02		
NO_2 - 363 (800 lb) HE	Annual	1.00E+02		
NO_2 - BGU	Annual	1.00E+02		[illegible]
PM_{10} - 45.4 kg (100 lb) HE	Annual	5.00E+01		[illegible]
	24-hour	1.50E+02		[illegible]
PM_{10} - 363 kg (800 lb) HE	Annual	[illegible]		[illegible]
	24-hour	[illegible]		[illegible]
SO_2 - BGU	Annual	[illegible]		[illegible]
	24-hour	[illegible]		[illegible]
	3-hour			[illegible]
	30-min			[illegible]

[a]The ISCST2 air quality model returns a va[illegible]
than one ten millionth of a part per billion [illegible]
[b]Percent of NAAQS is shown as zero, as [illegible]
Note: Table shows the results (maximum [illegible]
Source: TNRCC 1993a

.E B.4.2–2.—*Percentage of the TNRCC ESL Consumed by the Estimated Maximum centration of Air Pollutants at Pantex Plant Boundary (2,000 Weapons)-Continued*

)LLUTANT	AVERAGING TIME	ESL µg/m³	MAXIMUM CONCENTRATION AT BOUNDARY µg/m³	PERCENT OF ESL
Ethers	Annual	NA	1.50E-01	—
	30-min	NA	3.59E+01	—
:	Annual	1.44E+03	6.93	0.5
	30-min	1.44E+04	1.99E+03	13.8
ıe	Annual	4.34E+02	1.29E-01	0.0[b]
	30-min	2.00E+03	3.11E+01	1.6
hloride	Annual	4.00	3.99E-02	1.0
	30-min	1.60E+02	9.58	6.0
e - 45.4 kg (100 lb) HE	Annual	1.50	4.03E-03	0.3
	30-min	1.50E+01	3.66E-01	2.4
e - 363 kg (800 lb) HE	Annual	1.50	4.03E-03	0.3
	30-min	1.50E+01	3.66E-01	2.4
loride - 45.4 kg (100 lb)	Annual	1.00E-01	7.59E-02	75.9
	30-min	7.50E+01	5.19	6.9
loride - 363 kg (800 lb)	Annual	1.00E-01	3.06E-02	30.6
	30-min	7.50E+01	3.24	4.3
loride - BGU	Annual	1.00E-01	6.89E-02	68.9
	30-min	7.50E+01	6.17	8.2
anide - BGU	Annual	5.50	1.00E-05	0.0[b]
	30-min	5.50E+01	7.70E-04	0.0[b]
oride - 45.4 kg (100 lb)	3-hour	4.90	4.21	85.9
	12-hour	3.68	1.05	28.6
	24-hour	2.86	7.46E-02	26.1
oride - 363 kg (800 lb)	3-hour	4.90	[illegible]	6.0
	12-hour	3.68	[illegible]	2.0
	24-hour	2.86	[illegible]	2.0
oride - BGU	3-hour	4.90	[illegible]	73.2
	12-hour	3.68	[illegible]	35.8
	24-hour	2.86	[illegible]	26.2
	Annual	5.00E-02	[illegible]	0.0[b]
	24-hour	2.50E-03	[illegible]	0.0[b]
	30-min	5.00E-[illegible]	0.00[a]	0.0[b]
	Annual	[illegible]	5.75E-01	0.2
	30-min	[illegible]	2.45E+02	9.3
ıide - 45.4 kg (100 lb)	Annual	[illegible]	0.00[a]	—
	30-min	[illegible]	0.00[a]	—

TABLE B.4.2–2.—*Percentage of the TNRCC ESL Consumed by the Estimated Maximum Concentration of Air Pollutants at Pantex Plant Boundary (2,000 Weapons)-Continued*

POLLUTANT	AVERAGING TIME	ESL µg/m³	MAXIMUM CONCENTRATION AT BOUNDARY µg/m³	PERCENT OF ESL
Methyl Cyanide - 363 kg (800 lb) HE	Annual	NA	0.00[a]	—
	30-min	NA	0.00[a]	—
Methyl Ethyl Ketone	Annual	5.90E+02	5.10	0.9
	30-min	3.90E+03	1.40E+03	36.0
Methyl Isobutyl Ketone	Annual	2.05E+02	1.85E-02	0.0[b]
	30-min	2.05E+03	4.45	0.2
Methylene Chloride	Annual	2.60E+01	7.37E-01	2.8
	30-min	2.60E+02	1.80E+02	69.2
Naphthalene - 45.4 kg (100 lb) HE	Annual	5.00E+01	1.10E-04	0.0[b]
	30-min	4.40E+02	5.48E-03	0.0[b]
Naphthalene - 363 kg (800 lb) HE	Annual	5.00E+01	0.00[a]	0.0[b]
	30-min	4.40E+02	4.30E-04	0.0[b]
Nickel - BGU	Annual	1.50E-02	2.40E-04	1.6
	30-min	1.50E-01	2.16E-02	14.4
Nitrobenzene	Annual	5.00	2.14E-03	0.0[b]
	30-min	2.40E+01	5.13E-01	2.1
Phenol - 45.4 kg (100 lb) HE	Annual	1.90E+01	5.70E-04	0.0[b]
	30-min	1.54E+02	2.92E-02	0.0[b]
Phenol - 363 kg (800 lb) HE	Annual	1.90E+01	2.00E-05	0.0[b]
	30-min	1.54E+02	2.29E-03	0.0[b]
Tetrachloroethylene	Annual	3.40E+01	7.33E-02	0.2
	30-min	3.40E+02	1.76E+01	5.2
Titanium - BGU	Annual	NA	6.50E-04	—
	30-min	5.00E+02	5.82E-02	0.0[b]
Toluene	Annual	1.88E+02	1.73	0.9
	30-min	1.88E+03	5.58E+02	29.6
Trichloroethylene	Annual	1.35E+02	2.12E-01	0.2
	30-min	1.35E+03	5.11E+01	3.8
Triethylamine	Annual	4.00	2.38E-03	0.6
	30-min	4.00E+01	1.08	2.7
Xylene	Annual	4.34E+02	4.74E-01	0.1
	30-min	3.70E+03	1.45E+02	3.9

TABLE B.4.2–2.—*Percentage of the TNRCC ESL Consumed by the Estimated Maximum Concentration of Air Pollutants at Pantex Plant Boundary (2,000 Weapons)-Continued*

POLLUTANT	AVERAGING TIME	ESL µg/m³	MAXIMUM CONCENTRATION AT BOUNDARY µg/m³	PERCENT OF ESL
TNRCC Listed Air Pollutants				
chloroethane	Annual	5.00E+01	5.28E-01	1.1
	30-min	5.00E+02	1.27E+02	25.4
trinitrobenzene - 45.4 kg (100	Annual	NA	0.00[a]	—
E	30-min	2.00	3.00E-05	0.0[b]
trinitrobenzene - 363 kg (800	Annual	NA	0.00[a]	—
E	30-min	2.00	0.00[a]	0.0[b]
nol	Annual	7.60E+01	1.99E-02	0.0[b]
	30-min	7.60E+02	4.79	0.6
trinitrotoluene - 45.4 kg (100	Annual	NA	0.00[a]	—
E	30-min	5.00	3.30E-04	0.0[b]
trinitrotoluene - 363 kg (800	Annual	NA	0.00[a]	—
E	30-min	5.00	2.00E-05	0.0[b]
nitrotoluene - 45.4 kg (100 lb)	Annual	1.50E-01	0.00[a]	—
	30-min	1.50E+01	5.00E-05	0.0[b]
nitrotoluene - 363 kg (800 lb)	Annual	1.50E-01	0.00[a]	—
	30-min	1.50E+01	3.00E-05	0.0[b]
nitrotoluene - 45.4 kg (100lb)	Annual	NA	0.00[a]	—
	30-min	1.50E+01	5.00E-04	0.0[b]
nitrotoluene - 363 kg (800 lb)	Annual	NA	0.00[a]	—
	30-min	1.50E+01	4.00E-05	0.0[b]
oxyethanol	Annual	NA	3.91E-01	—
	30-min	1.80E+02	9.42	5.2
onaphthalene - 45.4 kg (100	Annual	NA	1.00E-05	—
E	30-min	5.00E+02	4.20E-03	0.0[b]
onaphthalene - 363 kg (800 lb)	Annual	NA	[illegible]	—
	30-min	5.00E+02	[illegible]	0.0
ne	Annual	5.90E+02	[illegible]	0.6
	30-min	5.90E+03	[illegible]	8.8
lene - 45.4 kg (100 lb) HE	Annual	2.66E+03	[illegible]	0.0[b]
	30-min	2.66E+04	[illegible]	0.0[b]
lene - 363 kg (800 lb) HE	Annual	2.66E+03	[illegible]	0.0[b]
	30-min	2.66E+04	[illegible]	0.0[b]
inum - 45.4 kg (100 lb) HE	Annual	[illegible]	1.28E-03	0.0[b]
	30-min	[illegible]	5.22E-02	0.1

Barium

g (800)

ABLE B.4.2–2.—*Percentage of the TNRCC ESL Consumed by the Estimated Maximum Concentration of Air Pollutants at Pantex Plant Boundary (2,000 Weapons)-Continued*

POLLUTANT	AVERAGING TIME	ESL $\mu g/m^3$	MAXIMUM CONCENTRATION AT BOUNDARY $\mu g/m^3$	PERCENT OF ESL
	Annual	9.00E+01	7.88E-01	0.9
	30-min	9.00E+02	3.57E+01	4.0
ıer	Annual	NA	3.33E-01	—
	30-min	9.27E+02	7.96E+01	8.6
- 45.4 kg (100 lb) HE	Annual	NA	6.04E-01	—
	30-min	1.17E+03	2.53E+02	21.6
- 363 kg (800 lb) HE	Annual	NA	6.04E-01	—
	30-min	1.17E+03	2.44E+02	20.9
ıcid - 45.4 kg(100lb) HE	Annual	9.40	0.00[a]	0.0[b]
	30-min	9.40E+01	8.00E-05	0.0[b]
ıcid - 363 kg (800 lb) HE	Annual	9.40	0.00[a]	0.0[b]
	30-min	9.40E+01	2.00E-05	0.0[b]
.4 kg (100 lb) HE	Annual	NA	4.99E-02	—
	30-min	5.00E+01	1.82	3.6
3 kg (800 lb) HE	Annual	NA	2.44E-02	—
	30-min	5.00E+01	1.02	2.0
e	Annual	1.90E+03	4.01E-02	0.0[b]
	30-min	4.85E+03	1.39E+01	0.3
ol	Annual	1.52E+02	2.27E-02	0.0[b]
	30-min	1.52E+03	5.46	0.4
45.4 kg (100 lb) HE	Annual	9.00E-01	0.00[a]	0.0[b]
	30-min	9.00	0.00[a]	0.0[b]
363 kg (800 lb) HE	Annual	9.00E-01	0.00[a]	0.0[b]
	30-min	9.00	0.00[a]	0.0[b]
	Annual	NA	1.39E-01	—
	30-min	1.00E+02	3.34E+01	33.4
	Annual	NA	[illegible]	—
	30-min	1.00E+01	[illegible]	0.0[b]
um	Annual	NA	[illegible]	—
	30-min	5.00E+01	[illegible]	0.1
: - 45.4 kg (100 lb) HE	Annual	NA	[illegible]	—
	30-min	3.00E+04	[illegible]	0.1
: - 363 kg (800 lb) HE	Annual	NA	[illegible]	—
	30-min	3.00E+04	[illegible]	0.1
Alcohol	Annual	[illegible]	[illegible]	0.2
	30-min	[illegible]	3.25	0.4

TABLE B.4.2–2.—*Percentage of the TNRCC ESL Consumed by the Estimated Maximum Concentration of Air Pollutants at Pantex Plant Boundary (2,000 Weapons)-Continued*

POLLUTANT	AVERAGING TIME	ESL $\mu g/m^3$	MAXIMUM CONCENTRATION AT BOUNDARY $\mu g/m^3$	PERCENT OF ESL
Non-F Listed Solvents[c]	Annual	NA	9.40E-04	—
	30-min	1.00E+01	2.26E-01	2.3
Ortho-dichlorobenzene	Annual	NA	6.36E-01	—
	30-min	1.50E+03	1.53E+02	10.2
Propane	Annual	1.80E+03	4.21E-02	0.0[b]
	30-min	1.80E+04	1.32E+01	0.1
Propene	Annual	NA	3.71E-01	—
	30-min	3.00E+04	1.56E+02	0.5
Pyrene - 45.4 kg (100 lbs) HE	Annual	5.00E-02	5.00E-04	1.0
	30-min	5.00E-01	1.57E-03	0.3
Pyrene - 90.8 kg (200 lbs) HE	Annual	5.00E-02	0.00[a]	0.0[b]
	30-min	5.00E-01	9.00E-05	0.0[b]
Pyridine	Annual	1.50E+01	3.78E-01	2.5
	30-min	6.90E+01	9.08	13.2
Silver	Annual	5.00	0.00[a]	—
	30-min	5.00E+02	2.90E-04	0.0[b]
Sulfur	Annual	1.00E-02	1.45E-03	14.5
	30-min	1.00E-01	6.22E-02	62.2
Tetrahydrofuran	Annual	5.90E+02	7.55E-01	0.1
	30-min	5.90E+03	3.42E+02	5.8
Trichlorofluoromethane	Annual	5.62E+03	4.21E-01	0.0[b]
	30-min	2.80E+04	1.01E+02	0.4
Trichlorotrifluoroethane	Annual	NA	1.77	—
	30-min	7.60E+04	4.73E+02	0.6
Zinc	Annual	NA	1.32E-03	—
	30-min	5.00E+01	5.58E-02	0.1

[a]The ISCST2 air quality model returns a value of 0.00 for any concentration equal to or less than 1.00×10^{-5} $\mu g/m^3$ (i.e., less than one ten millionth of a part per billion or less than ten parts per quadrillion).
[b]Percent of ESL is shown as zero, as it is below 0.05.
[c]Those solvents not listed under 40 CFR 261.33 (Hazardous Waste from Non-specific Sources).
Note: Table shows the modeling results (maximum concentrations at boundary) from models ISCST2 and ISCLT2. The above chemicals were modeled with appropriate time periods for Open Burning, Burning Ground Upgrade, and Engine Emission Area.
Source: TNRCC 1996a

mua.

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TABLE B.4.2–3.—*Estimated Maximum Concentrations of Hazardous Air[1] and Criteria Pollutants for 2,000, 1,000, and 500 Weapons at Local Residences Surrounding Pantex Plant (μg/m³)*-Continued

POLLUTANT	OPS	AVG. TIME	NAAQS OR ESL μg/m³	RESIDENCE										
				1	2	3	4	5	6	7	8	9	10	11
Alcohols[a]	2000	30-min	1.00E+02	3.71E+01	3.48E+01	2.78E+01	1.35E+01	1.27E+01	1.20E+01	2.30E+01	2.94E+01	3.73E+01	1.12E+02	4.79E+01
	1000	30-min	1.00E+02	2.18E+01	2.92E+01	2.62E+01	1.35E+01	1.27E+01	1.20E+01	2.30E+01	1.47E+01	3.61E+01	1.12E+02	3.26E+01
	500	30-min	1.00E+02	2.18E+01	2.67E+01	2.54E+01	1.35E+01	1.27E+01	1.20E+01	2.30E+01	1.37E+01	3.55E+01	1.12E+02	3.26E+01
Benzene	2000	Annual	3.00E+01	3.59E-02	3.19E-02	1.53E-02	4.86E-03	2.76E-03	2.74E-03	2.50E-03	5.99E-03	7.54E-03	1.49E-02	2.65E-02
	1000	Annual	3.00E+01	1.17E-02	8.74E-03	5.82E-03	2.74E-03	1.91E-03	1.74E-03	1.86E-03	4.47E-03	5.40E-03	1.16E-02	1.03E-02
	500	Annual	3.00E+01	1.16E-02	8.64E-03	5.75E-03	2.71E-03	1.89E-03	1.73E-03	1.84E-03	4.44E-03	5.35E-03	1.15E-02	1.02E-02
Benzene	2000	30-min	7.50E+01	3.22E+00	3.04E+00	1.12E+00	7.72E-01	6.38E-01	6.83E-01	6.56E-01	2.55E+00	1.85E+00	2.76E+00	4.16E+00
	1000	30-min	7.50E+01	2.25E+00	1.68E+00	1.09E+00	1.74E-01	6.38E-01	6.26E-01	1.93E-01	1.45E+00	1.78E+00	1.91E+00	1.55E+00
	500	30-min	7.50E+01	2.24E+00	1.68E+00	1.09E+00	1.74E-01	6.36E-01	6.25E-01	1.93E-01	1.44E+00	1.78E+00	1.91E+00	1.54E+00
Carbon Disulfide	2000	Annual	3.00E+00	6.78E-02	6.32E-02	2.76E+00	6.70E-02	3.26E-03	3.17E-03	3.01E-02	5.69E-03	5.85E-03	1.09E-02	4.53E-02
	1000	Annual	3.00E+00	3.39E-02	3.16E-02	1.38E-02	3.35E-03	1.63E-03	1.59E-03	1.51E-03	2.84E-03	2.93E-03	5.45E-03	2.27E-02
	500	Annual	3.00E+00	1.70E-02	1.58E-02	6.90E-03	1.68E-03	8.10E-04	7.90E-04	7.50E-04	1.42E-03	1.46E-03	2.73E-03	1.13E-02
Carbon Disulfide	2000	30-min	3.00E+01	8.33E+00	7.81E+00	2.76E+00	1.68E+00	1.19E+00	1.48E+00	8.73E-01	6.59E+00	1.42E+00	2.71E+00	1.08E+01
	1000	30-min	3.00E+01	4.16E+00	3.91E+00	1.38E+00	8.42E-01	5.97E-01	7.41E-01	4.37E-01	3.30E+00	7.10E-01	1.36E+00	5.37E+00
	500	30-min	3.00E+01	2.08E+00	1.95E+00	6.90E-01	4.21E-01	2.99E-01	3.70E-01	2.18E-01	1.65E+00	3.55E-01	6.78E-01	2.69E+00
Carbon Tetrachloride	2000	Annual	1.30E+01	5.92E-02	5.52E-02	2.41E-02	5.85E-03	2.84E-03	2.77E-03	2.63E-03	4.96E-03	5.10E-03	9.51E-03	3.95E-02
	1000	Annual	1.30E+01	2.94E-02	2.74E-02	1.19E-02	2.90E-03	1.41E-03	1.37E-03	1.30E-03	2.46E-03	2.53E-03	4.72E-03	1.96E-02
	500	Annual	1.30E+01	1.47E-02	1.37E-02	5.97E-03	1.45E-03	7.05E-04	6.85E-04	6.50E-04	1.23E-03	1.27E-03	2.36E-03	9.82E-03
Carbon Tetrachloride	2000	30-min	1.26E+02	7.26E+00	6.81E+00	2.41E+00	1.47E+00	1.04E+00	1.29E+00	7.62E-01	5.75E+00	1.24E+00	2.37E+00	9.37E+00
	1000	30-min	1.26E+02	3.61E+00	3.38E+00	1.19E+00	7.29E-01	5.17E-01	6.42E-01	3.78E-01	2.86E+00	6.15E-01	1.18E+00	4.65E+00
	500	30-min	1.26E+02	1.80E+00	1.69E+00	5.97E-01	3.65E-01	2.59E-01	3.21E-01	1.89E-01	1.43E+00	3.08E-01	5.88E-01	2.33E+00
Chlorobenzene	2000	Annual	4.60E+01	5.87E-02	5.48E-02	2.39E-02	5.81E-03	2.82E-03	2.75E-03	2.61E-03	4.92E-03	5.07E-03	9.44E-03	3.93E-02
	1000	Annual	4.60E+01	2.94E-02	2.74E-02	1.19E-02	2.90E-03	1.41E-03	1.37E-03	1.30E-03	2.46E-03	2.53E-03	4.72E-03	1.96E-02
	500	Annual	4.60E+01	1.47E-02	1.37E-02	5.97E-03	1.45E-03	7.05E-04	6.85E-04	6.50E-04	1.23E-03	1.27E-03	2.36E-03	9.82E-03
Chlorobenzene	2000	30-min	4.60E+02	7.21E+00	6.77E+00	2.39E+00	1.46E+00	1.03E+00	1.28E+00	7.56E-01	5.71E+00	1.23E+00	2.35E+00	9.31E+00
	1000	30-min	4.60E+02	3.61E+00	3.38E+00	1.19E+00	7.29E-01	5.17E-01	6.42E-01	3.78E-01	2.86E+00	6.15E-01	1.18E+00	4.65E+00
	500	30-min	4.60E+02	1.80E+00	1.69E+00	5.97E-01	3.65E-01	2.59E-01	3.21E-01	1.89E-01	1.43E+00	3.08E-01	5.88E-01	2.33E+00

500 Weapons at Local Residences Surrounding Pantex Plant (μg/m³)

POLLUTANT	OPS	AVG. TIME	NAAQS OR ESL μg/m³	RESIDENCE 1	2	3	4	5	6	7	8	9	10	11
1,2-trichloroethane	2000	Annual	5.50E-01	6.89E-02	3.32E-02	1.43E-02	3.69E-03	2.25E-03	2.10E-03	2.19E-03	3.19E-03	4.99E-03	7.55E-03	4.82E-02
	1000	Annual	5.50E+01	3.42E-02	1.65E-02	7.08E-03	1.83E-03	1.12E-03	1.40E-03	1.08E-03	1.58E-03	2.47E-03	3.75E-03	2.39E-02
	500	Annual	5.50E+01	1.71E-02	8.23E-03	3.54E-03	9.15E-04	5.60E-04	7.00E-04	5.40E-04	7.90E-04	1.24E-03	1.88E-03	1.19E-02
1,1,2-trichloroethane	2000	30-min	5.50E+02	1.72E+01	2.26E+00	1.52E+00	1.16E+00	1.09E+00	1.27E+00	9.87E-01	1.07E+00	1.08E+00	1.82E+00	1.03E+01
	1000	30-min	5.50E+02	8.53E+00	1.12E+00	7.52E-01	5.78E-01	5.42E-01	6.31E-01	4.89E-01	5.31E-01	5.36E-01	9.04E-01	5.12E-01
	500	30-min	5.50E+02	4.27E+00	5.60E-01	3.76E-01	2.89E-01	2.71E-01	3.15E-01	2.45E-01	2.65E-01	2.68E-01	4.52E-01	2.56E-01
1,3-butadiene 45.4 kg (100 lb) HE	2000	Annual	1.10E+01	1.89E-03	1.71E-03	7.64E-04	5.40E-03	3.70E-04	3.40E-04	2.50E-04	8.60E-04	9.10E-04	2.38E-03	2.10E-03
	1000	Annual	1.10E+01	1.59E-03	1.53E-03	6.40E-04	4.80E-04	3.40E-04	3.20E-04	2.20E-04	8.10E-04	8.20E-04	2.19E-03	1.86E-03
	500	Annual	1.10E+01	1.45E-03	1.44E-03	5.80E-04	4.50E-04	3.20E-04	3.10E-04	2.10E-04	7.90E-04	7.80E-04	2.09E-03	1.73E-03
1,3-butadiene 45.4 kg (100 lb) HE	2000	30-min	1.10E+02	8.85E-01	9.75E-01	5.51E-01	4.96E-01	5.54E-01	4.57E-01	3.27E-01	1.27E+00	6.54E-01	1.85E+00	6.81E-01
	1000	30-min	1.10E+02	8.83E-01	9.74E-01	5.46E-01	4.94E-01	5.53E-01	4.55E-01	3.26E-01	1.26E-01	6.54E-01	1.85E+00	6.77E-01
	500	30-min	1.10E+02	8.82E-01	9.73E-01	5.44E-01	4.93E-01	5.53E-01	4.55E-01	3.25E-01	1.26E-01	6.53E-01	1.84E+00	6.75E-01
1,3-butadiene 800 kg (363 lb) HE	2000	Annual	1.10E+01	1.89E-03	1.71E-03	7.64E-04	5.40E-03	3.70E-04	3.40E-04	2.50E-04	8.60E-04	9.10E-04	2.38E-03	2.10E-03
	1000	Annual	1.10E+01	1.59E-03	1.53E-03	6.40E-04	4.80E-04	3.40E-04	3.20E-04	2.20E-04	8.10E-04	8.20E-04	2.19E-03	1.86E-03
	500	Annual	1.10E+01	1.45E-03	1.44E-03	5.80E-04	4.50E-04	3.20E-04	3.10E-04	2.10E-04	7.90E-04	7.80E-04	2.09E-03	1.73E-03
1,3-butadiene 45.4 kg (800 lb) HE	2000	30-min	1.10E+02	8.85E-01	9.75E-01	5.51E-01	4.96E-01	5.54E-01	4.57E-01	3.27E-01	1.27E+00	6.54E-01	1.85E+00	6.81E-01
	1000	30-min	1.10E+02	8.83E-01	9.74E-01	5.46E-01	4.94E-01	5.53E-01	4.55E-01	3.26E-01	1.26E-01	6.54E-01	1.85E+00	6.77E-01
	500	30-min	1.10E+02	8.82E-01	9.73E-01	5.44E-01	4.93E-01	5.53E-01	4.55E-01	3.25E-01	1.26E-01	6.53E-01	1.84E+00	6.75E-01
2-nitropropane	2000	Annual	5.00E+00	2.57E-02	2.39E-02	1.04E-02	2.53E-03	1.23E-03	1.20E-03	1.14E-03	2.15E-03	2.21E-03	4.12E-03	1.72E-02
	1000	Annual	5.00E+00	1.28E-02	1.12E-02	5.21E-03	1.27E-03	6.20E-04	6.00E-04	5.70E-04	1.07E-03	1.11E-03	2.06E-03	8.57E-03
	500	Annual	5.00E+00	6.41E-03	5.98E-03	2.60E-03	6.35E-04	3.10E-04	3.00E-04	2.85E-04	5.35E-04	5.55E-04	1.03E-03	4.28E-03
2-nitropropane	2000	30-min	5.00E+01	3.14E+00	2.95E+00	1.04E+00	6.37E-01	4.52E-01	5.60E-01	3.30E-01	2.49E+00	5.37E-01	1.03E+00	4.06E+00
	1000	30-min	5.00E+01	1.57E+00	1.48E+00	5.21E-01	3.18E-01	2.26E-01	2.80E-01	1.65E-01	1.25E+00	2.69E-01	5.13E-01	2.03E+00
	500	30-min	5.00E+01	7.87E-01	7.39E-01	2.61E-01	1.59E-01	1.13E-01	1.40E-01	8.25E-02	6.23E-01	1.19E-01	2.56E-01	1.02E+00
Alcohols[a]	2000	Annual	NA	4.41E-01	3.71E-01	1.86E-01	5.86E-02	3.36E-02	2.71E-02	2.91E-02	5.51E-02	9.87E-02	2.60E-01	3.26E-01
	1000	Annual	NA	2.89E-01	2.29E-01	1.24E-01	4.37E-02	2.63E-02	2.00E-02	2.24E-02	4.24E-02	8.57E-02	2.36E-01	2.25E-01
	500	Annual	NA	2.14E-01	1.59E-01	9.34E-02	3.62E-02	2.27E-02	1.64E-02	1.91E-02	3.60E-02	7.91E-02	2.24E-01	1.74E-01

TABLE B.4.2–3.—*Estimated Maximum Concentrations of Hazardous Air[1] and Criteria Pollutants for 2,000, 1,000, and 500 Weapons at Local Residences Surrounding Pantex Plant (μg/m³)*-Continued

POLLUTANT	OPS	AVG. TIME	NAAQS OR ESL μg/m³	RESIDENCE										
				1	2	3	4	5	6	7	8	9	10	11
Chromium - 45.4 kg (100 lb) HE	2000	Annual	1.00E-01	9.00E-05	4.30E-04	1.22E-03	1.00E-04	4.00E-05	3.00E-05	3.00E-05	3.00E-05	2.00E-05	4.00E-05	6.00E-05
	1000	Annual	1.00E-01	9.00E-05	4.30E-04	1.22E-03	1.00E-04	4.00E-05	3.00E-05	3.00E-05	3.00E-05	2.00E-05	4.00E-05	6.00E-05
	500	Annual	1.00E-01	9.00E-05	4.30E-04	1.22E-03	1.00E-04	4.00E-05	3.00E-05	3.00E-05	3.00E-05	2.00E-05	4.00E-05	6.00E-05
Chromium - 45.4 kg (100 lb) HE	2000	30-min	1.00E+00	3.08E-02	4.06E-02	7.68E-02	3.78E-02	2.17E-02	1.12E-02	1.17E-02	9.15E-03	1.29E-02	1.60E-02	2.05E-02
	1000	30-min	1.00E+00	3.08E-02	4.06E-02	7.38E-02	3.01E-02	2.17E-02	1.12E-02	1.17E-02	9.15E-03	1.29E-02	1.60E-02	2.05E-02
	500	30-min	1.00E+00	4.38E-03	5.21E-03	5.96E-03	3.58E-03	2.73E-03	1.93E-03	2.84E-03	3.88E-03	4.17E-03	4.31E-03	4.70E-03
Chromium - 363 kg (800 lb) HE	2000	Annual	1.00E-01	3.00E-05	7.00E-05	8.00E-05	2.00E-05	1.00E-05	1.00E-05	1.00E-05	2.00E-05	1.00E-05	1.00E-05	2.00E-05
	1000	Annual	1.00E-01	3.00E-05	7.00E-05	8.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	2.00E-05	1.00E-05	1.00E-05	2.00E-05
	500	Annual	1.00E-01	3.00E-05	7.00E-05	8.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	2.00E-05	1.00E-05	1.00E-05	2.00E-05
Chromium - 363 kg (800 lb) HE	2000	30-min	1.00E+00	2.51E-02	3.79E-02	7.67E-02	3.62E-02	2.16E-02	1.14E-02	1.04E-02	7.53E-03	9.99E-03	9.45E-03	1.63E-02
	1000	30-min	1.00E+00	4.38E-03	5.21E-03	5.96E-03	3.58E-03	2.73E-03	1.93E-03	2.84E-03	3.88E-03	4.17E-03	4.31E-03	4.70E-03
	500	30-min	1.00E+00	4.38E-03	5.21E-03	5.96E-03	3.58E-03	2.73E-03	1.93E-03	2.84E-03	3.88E-03	4.17E-03	4.31E-03	4.70E-03
Chromium - BGU	2000	Annual	1.00E-01	8.00E-05	3.90E-04	9.90E-04	1.00E-04	4.00E-05	3.00E-05	2.00E-05	3.00E-05	2.00E-05	3.00E-05	5.00E-05
	1000	Annual	1.00E-01	8.00E-05	3.90E-04	9.90E-04	1.00E-04	4.00E-05	3.00E-05	2.00E-05	3.00E-05	2.00E-05	3.00E-05	5.00E-05
	500	Annual	1.00E-01	8.00E-05	3.90E-04	9.90E-04	1.00E-04	4.00E-05	3.00E-05	2.00E-05	3.00E-05	2.00E-05	3.00E-05	5.00E-05
Chromium - BGU	2000	30-min	1.00E+00	2.51E-02	3.79E-02	7.67E-02	3.62E-02	2.16E-02	1.14E-02	1.04E-02	7.53E-03	9.99E-03	9.45E-03	1.63E-02
	1000	30-min	1.00E+00	2.51E-02	3.79E-02	7.67E-02	3.62E-02	2.16E-02	1.14E-02	1.04E-02	7.53E-03	9.99E-03	9.45E-03	1.63E-02
	500	30-min	1.00E+00	2.51E-02	3.79E-02	7.67E-02	3.62E-02	2.16E-02	1.14E-02	1.04E-02	7.53E-03	9.99E-03	9.45E-03	1.63E-02
CO - 45.4 kg (100 lb) HE	2000	1-hour	4.00E+04[b]	2.28E+02	4.92E+02	1.81E+02	4.03E+01	3.23E+01	2.99E+01	2.81E+01	6.06E+01	7.54E+01	1.18E+02	1.39E+02
	1000	1-hour	4.00E+04[b]	2.27E+02	4.92E+02	1.81E+02	4.03E+01	3.23E+01	2.95E+01	2.76E+01	6.01E+01	7.49E+01	1.17E+02	1.39E+02
	500	1-hour	4.00E+04[b]	2.27E+02	4.92E+02	1.81E+02	4.03E+01	3.23E+01	2.94E+01	2.75E+01	6.01E+01	7.47E+01	1.17E+02	1.39E+02
CO - 45.4 kg (100 lb) HE	2000	8-hour	1.00E+04[b]	5.22E+01	8.19E+01	2.26E+01	8.40E+00	6.85E+00	9.36E+00	6.19E+00	9.29E+00	1.33E+01	2.51E+01	1.73E+01
	1000	8-hour	1.00E+04[b]	5.22E+01	8.19E+01	2.26E+01	8.29E+00	6.75E+00	9.28E+00	6.11E+00	9.09E+00	1.31E+01	2.49E+01	1.73E+01
	500	8-hour	1.00E+04[b]	5.22E+01	8.18E+01	2.26E+01	8.26E+00	6.73E+00	9.27E+00	6.10E+00	9.08E+00	1.31E+01	2.48E+01	1.73E+01
CO - 363 kg (800 lb) HE	2000	1-hour	4.00E+04[b]	2.28E+02	4.92E+02	1.81E+02	4.03E+01	3.23E+01	2.99E+01	2.81E+01	6.06E+01	7.54E+01	1.18E+02	1.39E+02
	1000	1-hour	4.00E+04[b]	2.27E+02	4.92E+02	1.81E+02	4.03E+01	3.23E+01	2.95E+01	2.76E+01	6.01E+01	7.49E+01	1.17E+02	1.39E+02
	500	1-hour	4.00E+04[b]	2.27E+02	4.92E+02	1.81E+02	4.03E+01	3.23E+01	2.94E+01	2.75E+01	6.01E+01	7.47E+01	1.17E+02	1.39E+02

Cresols

TABLE B.4.2–3.—*Estimated Maximum Concentrations of Hazardous Air[1] and Criteria Pollutants for 2,000, 1,000, and 500 Weapons at Local Residences Surrounding Pantex Plant ($\mu g/m^3$)*-Continued

POLLUTANT	OPS	AVG. TIME	NAAQS OR ESL $\mu g/m^3$	RESIDENCE										
				1	2	3	4	5	6	7	8	9	10	11
Ethyl Benzene	2000	30-min	2.00E+03	5.74E+00	5.38E+00	1.90E+00	1.16E+00	8.23E-01	1.02E+00	6.02E-01	4.54E+00	9.79E-01	1.87E+00	7.41E+00
	1000	30-min	2.00E+03	2.87E+00	2.69E+00	9.51E-01	5.80E-01	4.12E-01	5.11E-01	3.01E-01	2.27E+00	4.90E-01	9.35E-01	3.70E+00
	500	30-min	2.00E+03	1.43E+00	1.34E+00	4.75E-01	2.90E-01	2.06E-01	2.55E-01	1.50E-01	1.13E+00	2.45E-01	4.67E-01	1.85E+00
Ethylene Dichloride	2000	Annual	4.00E+00	4.07E-02	1.31E-02	5.72E-03	1.39E-03	6.70E-04	6.60E-04	6.20E-04	1.18E-03	1.21E-03	2.26E-03	9.40E-03
	1000	Annual	4.00E+00	2.04E-02	6.56E-03	2.86E-03	6.95E-04	3.35E-04	3.30E-04	3.10E-04	5.90E-04	6.05E-04	1.13E-03	4.70E-03
	500	Annual	4.00E+00	1.02E-02	3.28E-03	1.43E-03	3.47E-04	1.65E-04	1.65E-04	1.55E-04	2.95E-04	3.02E-04	5.65E-04	2.35E-03
Ethylene Dichloride	2000	30-min	1.60E+02	1.73E+00	1.62E+00	5.72E-01	3.49E-01	2.48E-01	3.07E-01	1.81E-01	1.37E+00	2.95E-01	5.63E-01	2.23E+00
	1000	30-min	1.60E+02	8.63E-01	8.10E-01	2.86E-01	1.75E-01	1.24E-01	1.54E-01	9.00E-02	6.84E-01	1.47E-01	2.81E-01	1.11E+00
	500	30-min	1.60E+02	4.30E-01	4.05E-01	1.43E-01	8.75E-02	6.20E-02	7.70E-02	4.51E-02	3.42E-01	7.35E-02	1.40E-01	5.55E-01
Formaldehyde - 45.4 kg (100 lb) HE	2000	Annual	1.50E+00	7.10E-04	7.70E-04	4.80E-04	2.10E-04	1.30E-04	7.00E-05	1.00E-04	1.90E-04	2.70E-04	5.30E-04	6.20E-04
	1000	Annual	1.50E+00	7.00E-04	7.70E-04	4.80E-04	2.10E-04	1.30E-04	7.00E-05	1.00E-04	1.90E-04	2.70E-04	5.20E-04	6.10E-04
	500	Annual	1.50E+00	6.90E-04	7.60E-04	4.80E-04	2.10E-04	1.30E-04	7.00E-05	1.00E-04	1.80E-04	2.70E-04	5.10E-04	6.10E-04
Formaldehyde - 45.4 kg (100 lb) HE	2000	30-min	1.50E+01	7.71E-02	8.20E-02	4.63E-02	3.04E-02	4.01E-02	3.56E-02	4.74E-02	3.40E-02	6.32E-02	8.43E-02	7.87E-02
	1000	30-min	1.50E+01	7.71E-02	8.20E-02	4.63E-02	3.04E-02	3.96E-02	3.55E-02	4.74E-02	3.39E-02	6.32E-02	8.43E-02	7.87E-02
	500	30-min	1.50E+01	7.71E-02	8.20E-02	4.63E-02	3.04E-02	3.94E-02	3.55E-02	4.74E-02	3.39E-02	6.32E-02	8.43E-02	7.87E-02
Formaldehyde - 363 kg (800 lb) HE	2000	Annual	1.50E+00	7.10E-04	7.70E-04	4.80E-04	2.10E-04	1.30E-04	7.00E-05	1.00E-04	1.90E-04	2.70E-04	5.30E-04	6.70E-04
	1000	Annual	1.50E+00	7.00E-04	7.70E-04	4.80E-04	2.10E-04	1.30E-04	7.00E-05	1.00E-04	1.90E-04	2.70E-04	5.20E-04	6.10E-04
	500	Annual	1.50E+00	6.90E-04	7.60E-04	4.80E-04	2.10E-04	1.30E-04	7.00E-05	1.00E-04	1.80E-04	2.70E-04	5.10E-04	6.10E-04
Formaldehyde - 363 kg (800 lb) HE	2000	30-min	1.50E+01	7.71E-02	8.20E-02	4.63E-02	3.04E-02	4.01E-02	3.56E-02	4.74E-02	3.40E-02	6.32E-02	8.43E-02	7.87E-02
	1000	30-min	1.50E+01	7.71E-02	8.20E-02	4.63E-02	3.04E-02	3.96E-02	3.55E-02	4.74E-02	3.39E-02	6.32E-02	8.43E-02	7.87E-02
	500	30-min	1.50E+01	7.71E-02	8.20E-02	4.63E-02	3.04E-02	3.94E-02	3.55E-02	4.74E-02	3.39E-01	6.32E-02	8.43E-02	7.87E-02
Hydrogen Chloride - 45.4 kg (100 lb) HE	2000	Annual	1.00E-01	5.65E-03	2.64E-02	7.52E-02	6.27E-03	2.42E-03	1.66E-03	1.65E-03	1.92E-03	1.51E-03	2.16E-03	3.54E-03
	1000	Annual	1.00E-01	5.65E-03	2.64E-02	7.52E-02	6.27E-03	2.42E-03	1.66E-03	1.65E-03	1.92E-03	1.51E-03	2.16E-03	3.54E-03
	500	Annual	1.00E-01	5.65E-03	2.64E-02	7.52E-02	6.27E-03	2.42E-03	1.66E-03	1.65E-03	1.92E-03	1.51E-03	2.16E-03	3.54E-03
Hydrogen Chloride - 45.4 kg (100 lb) HE	2000	30-min	7.50E+01	1.89E+00	2.49E+00	4.54E+00	1.85E+00	1.34E+00	6.90E-01	7.78E-01	5.64E-01	7.96E-01	9.86E-01	1.26E+00
	1000	30-min	7.50E+01	1.89E+00	2.49E+00	4.54E+00	1.85E+00	1.34E+00	6.90E-01	7.78E-01	5.64E-01	7.96E-01	9.86E-01	1.26E+00
	500	30-min	7.50E+01	1.89E+00	2.49E+00	4.54E+00	1.85E+00	1.34E+00	6.90E-01	7.78E-01	5.64E-01	7.96E-01	9.86E-01	1.26E+00

TABLE B.4.2–3.—*Estimated Maximum Concentrations of Hazardous Air[1] and Criteria Pollutants for 2,000, 1,000, and 500 Weapons at Local Residences Surrounding Pantex Plant (μg/m³)*-Continued

POLLUTANT	OPS	AVG. TIME	NAAQS OR ESL μg/m³	RESIDENCE										
				1	2	3	4	5	6	7	8	9	10	11
Hydrogen Chloride - 363 kg (800 lb) HE	2000	Annual	1.00E-01	1.57E-03	3.77E-03	4.10E-03	7.90E-04	5.20E-04	7.30E-04	7.40E-04	1.00E-03	6.00E-04	7.40E-04	1.17E-03
	1000	Annual	1.00E-01	1.57E-03	3.77E-03	4.10E-03	7.90E-04	5.20E-04	7.30E-04	7.40E-04	1.00E-03	6.00E-04	7.40E-04	1.17E-03
	500	Annual	1.00E-01	1.57E-03	3.77E-03	4.10E-03	7.90E-04	5.20E-04	7.30E-04	7.40E-04	1.00E-03	6.00E-04	7.40E-04	1.17E-03
Hydrogen Chloride - 363 kg (800 lb) HE	2000	30-min	7.50E+01	2.33E-01	2.78E-01	3.18E-01	1.91E-01	1.45E-01	1.03E-01	1.51E-01	2.07E-01	2.22E-01	2.30E-01	2.51E-01
	1000	30-min	7.50E+01	2.33E-01	2.78E-01	3.18E-01	1.91E-01	1.45E-01	1.03E-01	1.51E-01	2.07E-01	2.22E-01	2.30E-01	2.51E-01
	500	30-min	7.50E+01	2.33E-01	2.78E-01	3.18E-01	1.91E-01	1.45E-01	1.03E-01	1.51E-01	2.07E-01	2.22E-01	2.30E-01	2.51E-01
Hydrogen Chloride - BGU	2000	Annual	1.00E-01	3.85E-03	1.81E-02	4.60E-02	4.56E-03	1.70E-03	1.17E-03	1.15E-03	1.35E-03	1.04E-03	1.46E-03	2.50E-03
	1000	Annual	1.00E-01	3.85E-03	1.81E-02	4.60E-02	4.56E-03	1.70E-03	1.17E-03	1.15E-03	1.35E-03	1.04E-03	1.46E-03	2.50E-03
	500	Annual	1.00E-01	3.85E-03	1.81E-02	4.60E-02	4.56E-03	1.70E-03	1.17E-03	1.15E-03	1.35E-03	1.04E-03	1.46E-03	2.50E-03
Hydrogen Chloride - BGU	2000	30-min	7.50E+01	1.17E+00	1.76E+00	3.56E+00	1.68E+00	9.99E-01	5.26E-01	4.80E-01	3.49E-01	4.63E-01	4.39E-01	7.54E-01
	1000	30-min	7.50E+01	1.17E+00	1.76E+00	3.56E+00	1.68E+00	9.99E-01	5.26E-01	4.80E-01	3.49E-01	4.63E-01	4.39E-01	7.54E-01
	500	30-min	7.50E+01	1.17E+00	1.76E+00	3.56E+00	1.68E+00	9.99E-01	5.26E-01	4.80E-01	3.49E-01	4.63E-01	4.39E-01	7.54E-01
Hydrogen Fluoride - 45.4 kg (100 lb) HE	2000	3-hour	4.90E+00	3.72E-01	1.13E+00	2.84E+00	1.08E+00	4.59E-01	4.85E-01	2.85E-01	2.34E-01	9.26E-01	1.26E-01	3.71E-01
	1000	3-hour	4.90E+00	3.72E-01	1.13E+00	2.84E+00	1.08E+00	4.59E-01	4.85E-01	2.85E-01	2.34E-01	9.26E-01	1.26E-01	3.71E-01
	500	3-hour	4.90E+00	3.72E-01	1.13E+00	2.84E+00	1.08E+00	4.59E-01	4.85E-01	2.85E-01	2.34E-01	9.26E-01	1.26E-01	3.71E-01
Hydrogen Fluoride - 45.4 kg (100 lb) HE	2000	12-hour	3.68E+00	9.30E-02	2.83E-01	7.11E-01	2.94E-01	1.15E-01	1.21E-01	7.12E-02	5.85E-02	2.31E-02	3.15E-02	9.27E-02
	1000	12-hour	3.68E+00	9.30E-02	2.83E-01	7.11E-01	2.94E-01	1.15E-01	1.21E-01	7.12E-02	5.85E-02	2.31E-02	3.15E-02	9.27E-02
	500	12-hour	3.68E+00	9.30E-02	2.83E-01	7.11E-01	2.94E-01	1.15E-01	1.21E-01	7.12E-02	5.85E-02	2.31E-02	3.15E-02	9.27E-02
Hydrogen Fluoride - 45.4 kg (100 lb) HE	2000	24-hour	2.86E+00	4.65E-02	1.67E-01	4.24E-01	2.09E-01	5.74E-02	7.23E-02	3.71E-02	2.93E-02	1.16E-02	1.57E-02	4.63E-02
	1000	24-hour	2.86E+00	4.65E-02	1.67E-01	4.24E-01	2.09E-01	5.74E-02	7.23E-02	3.71E-02	2.93E-02	1.16E-02	1.57E-02	4.63E-02
	500	24-hour	2.86E+00	4.65E-02	1.67E-01	4.24E-01	2.09E-01	5.74E-02	7.23E-02	3.71E-02	2.93E-02	1.16E-02	1.57E-02	4.63E-02
Hydrogen Fluoride - 363 kg (800 lb) HE	2000	3-hour	4.90E+00	1.40E-01	2.05E-01	2.36E-01	1.55E-01	1.11E-01	6.79E-02	5.72E-02	5.86E-02	7.54E-02	6.98E-02	1.08E-02
	1000	3-hour	4.90E+00	1.40E-01	2.05E-01	2.36E-01	1.55E-01	1.11E-01	6.79E-02	5.72E-02	5.86E-02	7.54E-02	6.98E-02	1.08E-02
	500	3-hour	4.90E+00	1.40E-01	2.05E-01	2.36E-01	1.55E-01	1.11E-01	6.79E-02	5.72E-02	5.86E-02	7.54E-02	6.98E-02	1.08E-02
Hydrogen Fluoride - 363 kg (800 lb) HE	2000	12-hour	3.68E+00	3.50E-02	5.14E-02	5.91E-02	3.87E-02	2.78E-02	1.69E-02	1.45E-02	1.89E-02	1.88E-02	1.74E-02	2.71E-02
	1000	12-hour	3.68E+00	3.50E-02	5.14E-02	5.91E-02	3.87E-02	2.78E-02	1.69E-02	1.45E-02	1.89E-02	1.88E-02	1.74E-02	2.71E-02
	500	12-hour	3.68E+00	3.50E-02	5.14E-02	5.91E-02	3.87E-02	2.78E-02	1.69E-02	1.45E-02	1.89E-02	1.88E-02	1.74E-02	2.71E-02

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TABLE B.4.2–3.—*Estimated Maximum Concentrations of Hazardous Air[1] and Criteria Pollutants for 2,000, 1,000, and 500 Weapons at Local Residences Surrounding Pantex Plant (μg/m³)*-Continued

POLLUTANT	OPS	AVG. TIME	NAAQS OR ESL μg/m³	RESIDENCE										
				1	2	3	4	5	6	7	8	9	10	11
Naphthalene - 45.4 kg (100 lb) HE	2000	Annual	5.00E+01	1.00E-05	2.00E-05	7.00E-05	1.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	1000	Annual	5.00E+01	1.00E-05	2.00E-05	7.00E-05	1.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	500	Annual	5.00E+01	1.00E-05	2.00E-05	7.00E-05	1.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Naphthalene - 45.4 kg (100 lb) HE	2000	30-min	4.40E+02	1.73E-03	2.28E-03	4.16E-03	1.70E-03	1.20E-03	6.30E-04	6.60E-04	5.20E-04	7.30E-04	9.00E-04	1.16E-03
	1000	30-min	4.40E+02	1.73E-03	2.28E-03	4.16E-03	1.70E-03	1.20E-03	6.30E-04	6.60E-04	5.20E-04	7.30E-04	9.00E-04	1.16E-03
	500	30-min	4.40E+02	1.73E-03	2.28E-03	4.16E-03	1.70E-03	1.20E-03	6.30E-04	6.60E-04	5.20E-04	7.30E-04	9.00E-04	1.16E-03
Naphthalene - 363 kg (800 lb) HE	2000	Annual	5.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	1000	Annual	5.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	500	Annual	5.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Naphthalene - 363 kg (800 lb) HE	2000	30-min	4.40E+02	2.50E-04	2.90E-04	3.40E-04	2.00E-04	1.30E-04	1.10E-04	1.60E-04	2.20E-04	2.30E-04	2.40E-04	2.60E-04
	1000	30-min	4.40E+02	2.50E-04	2.90E-04	3.40E-04	2.00E-04	1.50E-04	1.10E-04	1.60E-04	2.20E-04	2.30E-04	2.40E-04	2.60E-04
	500	30-min	4.40E+02	2.50E-04	2.90E-04	3.40E-04	2.00E-04	1.50E-04	1.10E-04	1.60E-04	2.20E-04	2.30E-04	2.40E-04	2.60E-04
Nickel - BGU	2000	Annual	1.50E-02	1.00E-05	6.00E-05	1.60E-04	2.00E-05	1.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-05	1.00E-05
	1000	Annual	1.50E-02	1.00E-05	6.00E-05	1.60E-04	2.00E-05	1.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-05	1.00E-05
	500	Annual	1.50E-02	1.00E-05	6.00E-05	1.60E-04	2.00E-05	1.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-05	1.00E-05
Nickel - BGU	2000	30-min	1.50E-01	4.09E-03	6.16E-03	1.25E-02	5.89E-03	3.51E-03	1.85E-03	1.68E-03	1.22E-03	1.62E-03	1.54E-03	2.64E-03
	1000	30-min	1.50E-01	4.09E-03	6.16E-03	1.25E-02	5.89E-03	3.51E-03	1.85E-03	1.68E-03	1.22E-03	1.62E-03	1.54E-03	2.64E-03
	500	30-min	1.50E-01	4.09E-03	6.16E-03	1.25E-02	5.89E-03	3.51E-03	1.85E-03	1.68E-03	1.22E-03	1.62E-03	1.54E-03	2.64E-03
Nitrobenzene	2000	Annual	5.00E+00	1.54E-03	1.44E-03	6.30E-04	1.50E-04	7.00E-05	7.00E-05	7.00E-05	1.30E-04	1.30E-04	2.50E-04	1.03E-03
	1000	Annual	5.00E+00	7.70E-04	7.20E-04	3.10E-04	8.00E-05	4.00E-05	4.00E-05	4.00E-05	6.00E-05	6.50E-05	1.25E-04	5.15E-04
	500	Annual	5.00E+00	3.85E-04	3.60E-04	1.55E-04	4.00E-05	2.00E-05	2.00E-05	2.00E-05	3.00E-05	3.25E-05	6.25E-05	2.57E-04
Nitrobenzene	2000	30-min	2.40E+01	1.89E-01	1.78E-01	6.28E-02	3.83E-02	2.72E-02	3.37E-02	1.99E-02	1.50E-01	3.23E-02	6.17E-02	2.45E-01
	1000	30-min	2.40E+01	9.45E-02	8.86E-02	3.13E-02	1.91E-02	1.36E-02	1.68E-02	9.91E-03	7.48E-02	1.61E-02	3.08E-02	1.22E-01
	500	30-min	2.40E+01	4.72E-02	4.43E-02	1.57E-02	9.56E-03	6.78E-03	8.41E-03	4.96E-03	3.74E-02	8.06E-03	1.54E-02	6.10E-02
NO_2 - 45.4 kg (100 lb) HE	2000	Annual	1.00E+02[b]	3.69E-01	4.78E-01	4.39E-01	1.29E-01	1.08E-01	9.18E-02	9.39E-02	1.69E-01	1.43E-01	2.13E-01	2.99E-01
	1000	Annual	1.00E+02[b]	3.65E-01	4.76E-01	4.38E-01	1.28E-01	1.07E-01	9.16E-02	9.36E-02	1.68E-01	1.42E-01	2.10E-01	2.97E-01
	500	Annual	1.00E+02[b]	3.63E-01	4.75E-01	4.37E-01	1.28E-01	1.07E-01	9.14E-02	9.34E-02	1.68E-01	1.41E-01	2.08E-01	2.96E-01

TABLE B.4.2–3.—*Estimated Maximum Concentrations of Hazardous Air[1] and Criteria Pollutants for 2,000, 1,000, and 500 Weapons at Local Residences Surrounding Pantex Plant (μg/m³)*-Continued

POLLUTANT	OPS	AVG. TIME	NAAQS OR ESL μg/m³	RESIDENCE 1	2	3	4	5	6	7	8	9	10	11
NO_2 - 363 kg (800 lb) HE	2000	Annual	1.00E+02[b]	2.83E-01	4.72E-01	9.52E-02	1.14E-01	7.92E-02	4.12E-02	4.13E-02	7.45E-02	9.31E-02	1.56E-01	2.15E-01
	1000	Annual	1.00E+02[b]	2.80E-01	4.70E-01	9.51E-02	1.14E-01	7.90E-02	4.09E-02	4.11E-02	7.40E-02	9.17E-02	1.52E-01	2.12E-01
	500	Annual	1.00E+02[b]	2.78E-01	4.69E-01	9.51E-01	1.13E-01	7.86E-02	4.08E-02	4.09E-02	7.36E-02	9.09E-02	1.51E-01	2.11E-01
NO_2 - BGU	2000	Annual	1.00E+02[b]	1.75E-01	2.11E-01	1.42E-01	5.13E-02	3.02E-02	2.01E-02	2.25E-02	4.05E-02	7.14E-02	1.24E-01	1.43E-01
	1000	Annual	1.00E+02[b]	1.71E-01	2.08E-01	1.41E-01	5.07E-02	2.98E-02	1.99E-02	2.25E-02	3.99E-02	7.00E-02	1.21E-01	1.40E-01
	500	Annual	1.00E+02[b]	1.69E-01	2.07E-01	1.40E-01	5.03E-02	2.96E-02	1.98E-02	2.21E-02	3.97E-02	6.93E-02	1.19E-01	1.39E-01
Phenol - 45.4 kg (100 lb) HE	2000	Annual	1.90E+01	3.00E-05	1.30E-04	3.70E-04	3.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	2.00E-05
	1000	Annual	1.90E+01	3.00E-05	1.30E-04	3.70E-04	3.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	2.00E-05
	500	Annual	1.90E+01	3.00E-05	1.30E-04	3.70E-04	3.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	2.00E-05
Phenol - 45.4 kg (100 lb) HE	2000	30-min	1.54E+02	9.25E-03	1.22E-02	2.22E-02	9.05E-03	6.53E-03	3.37E-03	3.51E-03	2.75E-03	3.89E-03	4.82E-03	6.17E-03
	1000	30-min	1.54E+02	9.25E-03	1.22E-02	2.22E-02	9.05E-03	6.53E-03	3.37E-03	3.51E-03	2.75E-03	3.89E-03	4.82E-03	6.17E-03
	500	30-min	1.54E+02	9.25E-03	1.22E-02	2.22E-02	9.05E-03	6.53E-03	3.37E-03	3.51E-03	2.75E-03	3.89E-03	4.82E-03	6.17E-03
Phenol - 363 kg (800 lb) HE	2000	Annual	1.90E+01	1.00E-05	2.00E-05	2.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-05	0.00E+00	0.00E+00	1.00E-05
	1000	Annual	1.90E+01	1.00E-05	2.00E-05	2.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-05	0.00E+00	0.00E+00	1.00E-05
	500	Annual	1.90E+01	1.00E-05	2.00E-05	2.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-05	0.00E+00	0.00E+00	1.00E-05
Phenol - 363 kg (800 lb) HE	2000	30-min	1.54E+02	1.32E-03	1.57E-03	1.79E-03	1.08E-03	8.20E-04	5.80E-04	8.50E-04	1.17E-03	1.25E-03	1.30E-03	1.41E-03
	1000	30-min	1.54E+02	1.32E-03	1.57E-03	1.79E-03	1.08E-03	8.20E-04	5.80E-04	8.50E-04	1.17E-03	1.25E-03	1.30E-03	1.41E-03
	500	30-min	1.54E+02	1.32E-03	1.57E-03	1.79E-03	1.08E-03	8.20E-04	5.80E-04	8.50E-04	1.17E-03	1.25E-03	1.30E-03	1.41E-03
PM10 - 45.4 kg (100 lb) HE	2000	Annual	5.00E+01[b]	6.87E-01	2.13E+00	5.64E+00	5.19E-01	2.13E-01	1.51E-01	1.52E-01	2.11E-01	2.38E-01	4.39E-01	5.22E-01
	1000	Annual	5.00E+01[b]	5.65E-01	2.05E+00	5.59E+00	4.94E-01	1.99E-01	1.41E-01	1.40E-01	1.90E-01	1.86E-01	3.19E-01	4.01E-01
	500	Annual	5.00E+01[b]	5.28E-01	2.03E+00	5.57E+00	4.86E-01	1.95E-01	1.39E-01	1.37E-01	1.83E-01	1.71E-01	2.83E-01	3.66E-01
PM10 - 45.4 kg (100 lb) HE	2000	24-hour	1.50E+02[b]	8.85E+00	2.17E+01	5.36E+01	1.26E+01	1.03E+01	3.14E+00	3.32E+00	2.41E+00	3.16E+00	6.07E+00	5.00E+00
	1000	24-hour	1.50E+02[b]	8.85E+00	2.17E+01	5.36E+01	1.26E+01	1.01E+01	3.12E+00	3.32E+00	2.32E+00	2.84E+00	5.52E+00	5.00E+00
	500	24-hour	1.50E+02[b]	8.85E+00	2.17E+01	5.36E+01	1.26E+01	1.01E+01	3.12E+00	3.32E+00	2.29E+00	2.74E+00	5.35E+00	5.00E+00
PM10 - 363 kg (800 lb) HE	2000	Annual	5.00E+01[b]	4.05E-01	5.08E-01	4.70E-01	1.27E-01	7.98E-02	9.08E-02	9.28E-02	1.55E-01	1.78E-01	3.43E-01	3.62E-01
	1000	Annual	5.00E+01[b]	2.83E-01	4.33E-01	4.18E-01	1.02E-01	6.61E-02	8.17E-02	8.12E-02	1.33E-01	1.26E-01	2.23E-01	2.41E-01
	500	Annual	5.00E+01[b]	2.46E-01	4.09E-01	4.02E-01	9.04E-02	6.19E-02	7.90E-02	7.78E-02	1.27E-01	1.11E-01	1.87E-01	2.05E-01

TABLE B.4.2–3.—*Estimated Maximum Concentrations of Hazardous Air[1] and Criteria Pollutants for 2,000, 1,000, and 500 Weapons at Local Residences Surrounding Pantex Plant (μg/m³)*-Continued

POLLUTANT	OPS	AVG. TIME	NAAQS OR ESL μg/m³	RESIDENCE										
				1	2	3	4	5	6	7	8	9	10	11
PM10 - 363 kg (800 lb) HE	2000	24-hour	1.50E+02[b]	1.89E+00	3.92E+00	4.68E+00	2.19E+00	1.49E+00	1.48E+00	1.82E+00	1.45E+00	2.47E+00	4.70E+00	3.26E+00
	1000	24-hour	1.50E+02[b]	1.89E+00	3.92E+00	4.68E+00	2.16E+00	1.34E+00	1.48E+00	1.92E+00	1.26E+00	2.20E+00	3.17E+00	1.85E+00
	500	24-hour	1.50E+02[b]	1.89E+00	3.92E+00	4.68E+00	2.16E+00	1.29E+00	1.48E+00	1.92E+00	1.25E+00	2.12E+00	2.80E+00	1.85E+00
Tetrachloroethylene	2000	Annual	3.40E+01	5.29E-02	4.94E-02	2.15E-02	5.23E-03	2.54E-03	2.48E-03	2.35E-03	4.44E-03	4.57E-03	8.51E-03	3.54E-03
	1000	Annual	3.40E+01	2.65E-02	2.47E-02	1.08E-02	2.62E-03	1.27E-03	1.24E-03	1.18E-03	2.22E-03	2.28E-03	4.25E-03	1.77E-03
	500	Annual	3.40E+01	1.32E-02	1.23E-02	5.40E-03	1.31E-03	6.35E-04	6.2E-04	5.90E-04	1.11E-03	1.14E-03	2.12E-03	8.85E-04
Tetrachloroethylene	2000	30-min	3.40E+02	6.50E+00	6.10E+00	2.15E+00	1.31E+00	9.32E-01	1.16E+00	6.80E-01	5.14E+00	1.10E+00	2.11E+00	8.39E-01
	1000	30-min	3.40E+02	3.25E+00	3.05E+00	1.08E+00	6.57E-01	4.67E-01	5.78E-01	3.41E-01	2.57E+00	5.54E-01	1.06E+00	4.19E-01
	500	30-min	3.40E+02	1.62E+00	1.52E+00	5.40E-01	3.28E-01	2.33E-01	2.89E-01	1.70E-01	1.28E+00	2.77E-01	5.30E-01	2.09E-01
Titanium - BGU	2000	Annual	NA	4.00E-05	1.70E-04	4.30E-04	4.00E-05	2.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	2.00E-05
	1000	Annual	NA	4.00E-05	1.70E-04	4.30E-04	4.00E-05	2.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	2.00E-05
	500	Annual	NA	4.00E-05	1.70E-04	4.30E-04	4.00E-05	2.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	2.00E-05
Titanium - BGU	2000	30-min	5.00E+02	1.10E-03	1.66E-02	3.36E-02	1.58E-02	9.44E-03	4.97E-03	4.53E-03	3.30E-03	4.37E-03	4.14E-03	7.12E-03
	1000	30-min	5.00E+02	1.10E-03	1.66E-02	3.36E-02	1.58E-02	9.44E-03	4.97E-03	4.53E-03	3.30E-03	4.37E-03	4.14E-03	7.12E-03
	500	30-min	5.00E+02	1.10E-03	1.66E-02	3.36E-02	1.58E-02	9.44E-03	4.97E-03	4.53E-03	3.30E-03	4.37E-03	4.14E-03	7.12E-03
Toluene	2000	Annual	1.88E+02	1.15E+00	1.18E+00	7.49E-01	3.79E-01	2.50E-01	1.33E-01	1.66E-01	3.61E-01	4.34E-01	6.78E-01	9.50E-01
	1000	Annual	1.88E+02	9.09E-01	5.47E-01	6.60E-01	3.45E-01	2.30E-01	1.18E-01	1.50E-01	3.33E-01	3.83E-01	5.96E-01	7.70E-01
	500	Annual	1.88E+02	4.65E-01	2.98E-01	3.43E-01	1.75E-01	1.16E-01	5.95E-02	7.56E-02	1.67E-01	1.88E-01	2.93E-01	3.87E-01
Toluene	2000	30-min	1.88E+03	1.39E+02	1.62E+02	1.63E+02	7.34E+01	1.16E+02	1.25E+02	1.20E+02	1.17E+02	1.35E+02	1.34E+01	1.45E+02
	1000	30-min	1.88E+03	1.34E+02	1.61E+02	1.61E+02	6.65E+01	1.13E+02	1.24E+02	1.19E+02	1.15E+02	1.33E+02	2.68E+02	1.39E+02
	500	30-min	1.88E+03	6.69E+01	8.22E+01	8.06E+01	3.46E+01	5.60E+01	6.19E+01	5.94E+01	5.77E+01	6.65E+01	1.34E+01	6.96E+01
Trichloroethylene	2000	Annual	1.35E+02	1.53E-01	1.43E-01	6.24E-02	1.52E-02	7.36E-03	7.18E-03	6.82E-03	1.29E-03	1.32E-03	2.47E-03	1.03E-02
	1000	Annual	1.35E+02	7.65E-02	7.14E-02	3.11E-02	7.56E-02	3.67E-03	3.58E-03	3.40E-03	6.40E-04	6.60E-04	1.23E-03	5.12E-03
	500	Annual	1.35E+02	3.81E-02	3.55E-02	1.55E-02	3.26E-03	1.83E-03	1.78E-03	1.69E-03	3.19E-04	3.28E-04	6.12E-04	2.54E-03
Trichloroethylene	2000	30-min	1.35E+03	1.88E+01	1.77E+01	6.24E+00	3.81E+00	2.70E+00	3.35E+00	1.98E+00	1.49E+00	3.21E+00	6.14E+00	2.43E+00
	1000	30-min	1.35E+03	9.39E+02	8.81E+00	3.11E+00	1.90E+00	1.35E+00	1.67E+00	9.85E-01	7.45E-01	1.60E+00	3.06E+00	1.21E+00
	500	30-min	1.35E+03	4.67E+00	4.38E+00	1.55E+00	9.45E-01	6.70E-01	8.31E-01	4.90E-01	3.70E-01	8.02E-01	1.52E+00	6.03E-01

			33[b]
			33[b]
			03[b]

REFERENCES

40 CFR 51 — EPA, "Implementation Plans, Requirements for Preparation, Adoption, and Submittal", *Code of Federal Regulations,* Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC, Revised July 1, 1994.

42 USC 7401 — *Clean Air Act of 1990*, 42 United States Code 7401.

Auer 1978 — Auer, *Journal of Applied Meteorology*, Volume 17, 1978.

Carter 1978 — Carter, Roy V., "Emissions from the Open Burning or Detonation of Explosives", prepared for presentation at the 71st Annual Meeting of the Air Pollution Control Association, Houston, TX, June 25–30, 1978.

PC 1994 — Ecklund, B., "U.S. Department of Energy, Pantex Plant, Current Emissions Inventory", Letter from Bart Ecklund, Radian Corporation, Austin, TX, to Robert Roulston, Pantex, December 2, 1994.

PC 1996l — Bowman, A., "Identification of Alcohols," Pantex EIS Support Request provided by Alan Bowman, to Raji Sinha, Tetra Tech, Inc., Albuquerque, NM, July 12, 1996.

Radian 1993 — Radian Corporation, *Air Quality Impact Analysis Open Burning of Explosives*, prepared under Contract DCN 93-0252-012-01, by Radian Corporation, Austin, TX, managed by Battelle Pantex, Amarillo, TX, for the U.S. Department of Energy, September 1993.

Radian 1994 — Radian Corporation, *Air Quality Impact Analysis in Support of Permit Number HW-50284,* RCN:252-012-05-01, prepared by Radian Corporation, Austin, TX, managed by Battelle Pantex, Amarillo, TX, for the U.S. Department of Energy, June 1994.

TNRCC 1993a — Texas Natural Resources Conservation Commission, *Air Quality Modeling Guidelines,* Modeling Division, Austin, TX, December, 1993.

TNRCC 1995b — Texas Natural Resources Conservation Commission, *Modeling Analysis of the Pantex Plant, Amarillo, Texas,* Modeling Division, Austin, TX, June 1995.

TNRCC 1996a — Texas Natural Resources Conservation Commission, *Effective Screening Levels (ESLs),* Modeling Division, Austin, TX, April 15, 1996.

USGS 1973 — US Geological Survey, *Sevenmile Basin, Quadrangle Texas, 7.5 Minute Series Topographic Map,* US Department of Interior, Denver, CO, 1953, Photorevised 1967 and 1973.

APPENDIX C

Water Resources Analysis

Pantex Plant playas; these decision criteria were selected for comparative purposes only. The State of Texas applies regulations through the concentration limits specified in permits; therefore, decision criteria for surface water compliance are based on permit limits established in the EPA NPDES Permit and TNRCC Wastewater Discharge Permit for Pantex Plant. Pantex Plant has worked very closely with EPA Region VI and TNRCC to produce wastewater discharge permits (EPA NPDES Permit No. TX-0107107 and TNRCC Wastewater Discharge Permit No. 02296) that dictate stringent wastewater discharge requirements protective of human health and the environment. Permit limits specified in the Pantex Plant NPDES Permit for various outfalls are provided in Table C.1.2–2.

Pantex Plant wastewater discharge permit limits meet or exceed all current regulations that apply to surface water. DOE Derived Concentration Guides (DOE Order 5400.5) are used as decision criteria for radionuclides. The *Atomic Energy Act of 1954* (42 U.S.C. 2011), as amended, authorizes DOE to protect public health and safety and the environment in conducting programs, such as Pantex Plant operations. As a result, DOE is self-regulating with respect to standards and requirements for radiation.

The following assumptions were made for this analysis:

- Some of the Texas State Water Quality Criteria standards (e.g., copper, nickel, zinc, cadmium, and lead) are defined as a function of hardness. The average water hardness at Pantex Plant was assumed to be 128 milligrams per liter. Therefore, the following criteria were determined:
  - — Copper = 0.024 milligrams per liter.
  - — Nickel = 1.75 milligrams per liter.
  - — Zinc = 0.144 milligrams per liter.
  - — Cadmium = 0.045 milligrams per liter.
  - — Lead = 0.112 milligrams per liter.
- Tabulated water quality data are assumed to be representative of the sampling locations. State-approved standard operating procedures have been used in sample collection and analysis, and the results are assumed to be validated using EPA-approved methodology.

The emphasis of the surface water quality analysis results is placed on Playa 1, since it is the only onsite perennial wetland and receives discharge from the Wastewater Treatment Facility. The suspected COCs in samples from Playa 1 are presented in Table C.1.2–3. With the exception of Playa 1, all Pantex Plant surface water sampling locations are usually dry except during storm events. Because of frequent dry periods, soil sampling is likely to be more representative of the extent of contamination, if any, at these sampling locations. Soil sampling is discussed in section 4.5 and appendix I. Surface water quality results for sampling locations other than Playa 1 are presented in Table C.1.2–4.

C.2 GROUNDWATER

Evaluation of Pantex Plant groundwater resources involved three primary components:

- Hydrogeologic site characterization of the perched and Ogallala aquifers.
- Evaluation of groundwater quality data.
- Determination of groundwater availability and use.

C.2.1 Hydrogeologic Properties

Hydrogeologic parameters (e.g., hydraulic conductivity, transmissivity, recharge, groundwater velocity) at Pantex Plant have been

estimated during investigations by Battelle Pantex, the University Consortium (including Texas Tech University and Texas A&M University), the U.S. Army Corps of Engineers (COE), Argonne National Laboratories, Engineering-Science, Inc., and Radian Corporation.

Existing available well information for the Pantex Plant Site area has been identified, compiled, and tabulated (Table C.2.1–1). This table was compiled based on data provided by Pantex Plant, Texas A&M University, and COE. Wells reported with an unknown status are those for which data were unavailable. Well locations are shown in volume I, Figure 4.6.1.2–2. Well construction information and hydraulic parameter data were compiled and tabulated to determine which wells would provide enough information to assess the groundwater hydraulic parameters (Table C.2.1–2).

Available Pantex Plant area well logs and specific capacity estimates from wells within an 8-kilometer (5-mile) radius from Pantex Plant Site were obtained from COE except where noted. Vertical saturated hydraulic conductivities were determined for the Texas Department of Criminal Justice Playa, located approximately 11 kilometers (7 miles) northeast of Pantex Plant. The results of this playa investigation are summarized in Table C.2.1–3.

The following assumptions were made in the evaluation of the existing hydrogeologic data:

- The Theis curve method was assumed to be the most representative method to evaluate the drawdown data used to calculate transmissivities from perched monitoring wells OW–WR–19, –20, –38, –44, and –45.
- For wells BEG–PTX2, BEG–PTX3, PTX08–1008, and PTX06–1004, the ambient vertical hydraulic conductivity (K_V) value was reported.
- When actual Quality Assurance/Quality Control forms, data validation forms, or chain of custody information was unavailable it was assumed that the data presented in each report were valid and that approved methodologies for sample collecting and testing were implemented.

C.2.2 Groundwater Quality

Baseline groundwater quality was assessed using data tabulated in Pantex Plant annual environmental reports for a 5-year period, from 1990 through 1994. Additional perched groundwater quality data, collected in conjunction with the *Resource Conservation and Recovery Act* (RCRA) site investigations, were also examined. Groundwater quality monitoring data were collected from wells completed in the perched and Ogallala aquifers. Groundwater quality data used for the analysis were collected from reported onsite sampling locations from January 1990 to December 1994. The drinking water from an Ogallala water supply well at Bushland, located 54 kilometers (34 miles) west of Pantex Plant was also sampled to provide regional background groundwater quality data. The control well at Bushland is completed in the Ogallala aquifer upgradient from Pantex Plant and is, therefore, unaffected by plant operations (Pantex 1996a:82).

Groundwater samples collected from perched and Ogallala wells were analyzed for a full suite of analytical laboratory parameters, including radionuclides, metals, HEs, PCBs, pesticides, herbicides, volatile organics, semivolatile organics and other miscellaneous constituents and field parameters. It should be noted that the groundwater data collected over the 5 years does not include every sampling location or parameter each year. The following decision criteria for groundwater quality were used in the evaluation:

- TNRCC Primary and Secondary Drinking Water Standards Governing Drinking Water Quality and Reporting Requirements (§290.101–290.119).
- EPA, Drinking Water Regulations and Health Advisories, Maximum Contaminant Levels, and Secondary Maximum Contaminant Levels.
- DOE Derived Concentration Guides (DOE Order 5400.5) for radionuclide health standards.

In addition, groundwater quality data were compared to Pantex Plant Risk Reduction Standards (RRSs), or proposed groundwater cleanup levels for anticipated potential contaminants at Pantex Plant. These derived RRS values were established for the RCRA Facility Investigations (RFIs) (DOE 1994). The summary of groundwater quality decision criteria and RRS values is presented in Table C.2.2–1.

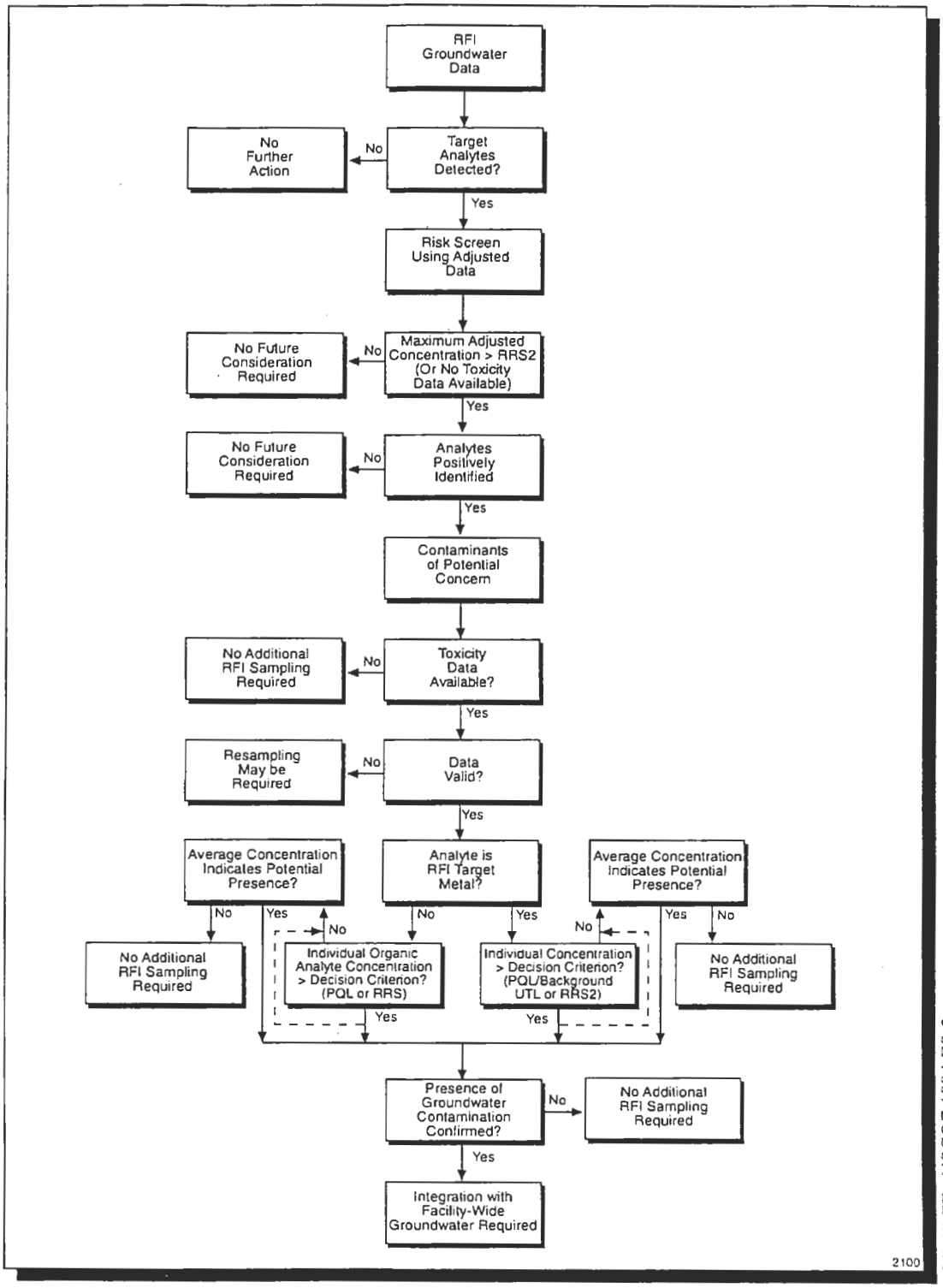
The following assumptions were made in the groundwater quality evaluation for the EIS:

- Gross alpha (dissolved) (GAd) and gross beta (dissolved) (GBd) values reported in the annual environmental reports were the actual measured values.
- Tabulated water quality data are assumed to be representative of the sampling locations. Agency-approved standard operating procedures have been used in sample collection and analysis, and the results are assumed to be validated using EPA-approved methodology.

In addition to the routine sampling documented in the annual environmental reports, available COE quarterly groundwater monitoring reports were reviewed. Quarterly groundwater monitoring was conducted to characterize the groundwater quality and extent of contamination in the perched aquifer, in association with the Ditches and Playas RFI for Flow System 6, groundwater in the perched aquifer. Flow System No. 6 includes groundwater data from perched monitoring wells constructed in Solid Waste Management Unit (SWMU) 5 Areas 10, 11, 12, and SWMU 6. Groundwater samples were collected from perched aquifer monitoring wells to determine the nature and presence or probable absence of contamination. Figure C.2.2–1 outlines the decision tree used to evaluate the groundwater data.

All groundwater samples were analyzed for total metals, cyanide, volatile organics, semivolatile organics, HEs, radionuclides, pesticides, and PCBs. Analytical data collected during the RFI were screened using a risk-based approach. This approach is based on the toxicological properties and the maximum reported concentrations of detected RFI target analytes. Throughout this screening process, the constituents that pose no significant risk to human health and the environment were eliminated from further consideration. After this process was complete, a list of suspected constituents of potential concern was compiled.

In general, analytical data were evaluated against decision criteria, including Texas RRS 1 (background upper tolerance limits and practical quantitation limits) and RRS 2 (risk based action levels), to determine the nature and extent of contamination and to assess the need for additional sampling (USCOE 1994:ES-1, ES-2, 1-1, 1-3). It should be noted that the water quality constituents that were analyzed for the COE investigation are not always the same constituents that were analyzed for the annual environmental reports. The results of both the annual environmental reports and COE investigations are presented in Table C.2.2–2 for the perched aquifer and Table C.2.2–3 for the Ogallala aquifer. Site characterization investigations are ongoing.



SOURCE: USCOE 1994:ES-2

FIGURE C.2.2–1.—*Decision Tree for Evaluating Groundwater Data.*

TABLE C.1.2–1.—*Defined Surface Water Quality Decision Criteria for Pantex Plant Surface Water*

PARAMETERS	UNITS	STD	BACKGROUND (BUSHLAND) (1994)	
			MAX.	AVG.
METALS				
Aluminum	mg/L	0.84/1.77 (3)	22.700	9.500
Antimony	mg/L	*	NA	0.048
Arsenic	mg/L	0.360 (1)	0.030	0.010
Barium	mg/L	1.0 (2)	0.300	0.270
Beryllium	mg/L	*	NA	0.008
Boron	mg/L	NA	0.100	0.075
Bromide	mg/L	NA	1.300	0.610
Cadmium	mg/L	0.045 (1,5)	NA	0.004
Calcium	mg/L	NA	47.800	39.700
Chromium (hexavalent)	mg/L	0.016 (1)	0.020	0.020
Chromium	mg/L	*	0.020	0.009
Cobalt	mg/L	*	0.005	0.012
Copper	mg/L	0.024 (1,5)	0.040	0.016
Cyanide	mg/L	0.046 (1)	0.010	0.006
Fluoride	mg/L	4.0 (2)	0.600	0.500
Iron	mg/L	NA	15.400	6.400
Lead	mg/L	0.112 (1,5)	0.020	0.010
Magnesium	mg/L	NA	9.000	7.200
Manganese	mg/L	*	0.200	0.200
Mercury	mg/L	0.0024 (1)	NA	0.0001
Molybdenum	mg/L	*	NA	0.200
Nickel	mg/L	1.75 (1,5)	0.020	0.011
Nitrate [as Nitrogen (N)]	mg/L	10.0 (2)	0.890	0.500
Nitrite (N)	mg/L	NA	0.490	0.150
Potassium	mg/L	NA	23.400	19.800
Selenium	mg/L	0.02 (1)	NA	0.005
Scandium	mg/L	NA	NM	NM
Silica	mg/L	NA	53.000	26.100
Silver	mg/L	0.05 (2,6)	NA	0.005
Sodium	mg/L	NA	25.000	5.700
Strontium	mg/L	NA	0.170	0.200
Thallium	mg/L	*	NA	0.200

TABLE C.1.2–1.—*Defined Surface Water Quality Decision Criteria for Pantex Plant Surface Water*-Continued

PARAMETERS	UNITS	STD	BACKGROUND (BUSHLAND) (1994)	
			MAX.	AVG.
Tin	mg/L	NA	NA	0.040
Titanium	mg/L	*	0.300	0.130
Vanadium	mg/L	NA	0.040	0.030
Zinc	mg/L	0.144 (1,5)	0.200	0.070
RADIOACTIVE MATERIALS				
Gross Alpha (dissolved)	µCi E-9/ml	NA	2 +/-1	1.5 +/-1.0
Gross Alpha (suspended)	µCi E-9/ml	NA	12 +/-5	8.5 +/-4.0
Gross Beta (dissolved)	µCi E-9/ml	NA	62 +/-6	29.5 +/-3.0
Gross Beta (suspended)	µCi E-9/ml	NA	100 +/-20	58.5 +/-11.5
Plutonium-239/240	µCi E-9/ml	30.0 (4)	0.03 +/-0.04	0.015 +/-0.033
Radium-226	µCi E-9/ml	100.0 (4)	0.9 +/-0.4	0.65 +/-0.33
Radium-228	µCi E-9/ml	100.0 (4)	1.4 +/-0.5	1.15 +/-0.6
Tritium	µCi E-6/ml	2000.0 (4)	0.12 +/-0.21	0.078 +/-0.205
Uranium-234	µCi E-9/ml	500.0 (4)	0.6 +/-0.2	0.3 +/-0.15
Uranium-238	µCi E-9/ml	600.0 (4)	0.3 +/-0.2	0.23 +/-0.15
ORGANICS				
2,4-dinitrotoluene	mg/L	0.1 (2)	NM	NM
3,3'-dichlorobenzidine	mg/L	*	NM	NM
4-methyl-2-pentanone	mg/L	NA	NM	NM
4-methylphenol	mg/L	NA	NM	NM
Acetone	mg/L	NA	NM	NM
Benzoic Acid	mg/L	NA	NM	NM
Chloroform	mg/L	*	NM	NM
Dieldrin	mg/L	0.0025 (1)	NM	NM
Endrin	mg/L	0.00018 (1)	NM	NM
Ethylbenzene	mg/L	*	NM	NM
Heptachlor	mg/L	0.00052 (1)	NM	NM
Lindane	mg/L	0.002 (1)	NM	NM
Methylene chloride	mg/L	*	NM	NM
Phenol	mg/L	*	0.030	0.020
Tetrahydrofuran	mg/L	NA	NM	NM
Toluene	mg/L	*	NM	NM
Total Xylenes	mg/L	NA	NM	NM

TABLE C.1.2–2.—*Pantex Plant NPDES Permit No. TX0107107 Requirements*

PARAMETER	OUTFALL	SAMPLE ID	DISCHARGE LIMITATIONS				FREQUENCY
			QUANTITY (MGD)		QUALITY (mg/L)		
			DAILY AVG	DAILY MAX	DAILY AVG	DAILY MAX	
Flow	001	WWTF	0.65	0.82	NA	NA	Continuous
	002	Z-12-EN	Report	Report	NA	NA	Daily
	003	Z-12-W	Report	Report	NA	NA	Daily
	004	16-1	Report	Report	NA	NA	Daily
	005	NDITCH	Report	Report	NA	NA	Daily
	006	Z-12-S	Report	Report	NA	NA	Daily
	101	12-21	Report	Report	NA	NA	Daily
	102	12-17-N	Report	Report	NA	NA	Daily
	103	11-20	Report	Report	NA	NA	Daily
	104	11-50	Report	Report	NA	NA	Daily
	201	12-84-B1	Report	Report	NA	NA	Daily
	202	12-17-S	Report	Report	NA	NA	Daily
	203	11-38	Report	Report	NA	NA	Daily
	301	12-84-B10	Report	Report	NA	NA	Daily
	302	12-19-S	Report	Report	NA	NA	Daily
	401	12-116R110	Report	Report	NA	NA	Daily
	402	12-19-N	Report	Report	NA	NA	Daily
	501	12-104a-B19	Report	Report	NA	NA	Daily
	502	12-19-CT	Report	Report	NA	NA	Daily
	601	12-104a-B23	Report	Report	NA	NA	Daily
	602	12-43	Report	Report	NA	NA	Daily
	702	12-39	Report	Report	NA	NA	Daily
Ammonia (as N)	001	WWTF	NA	NA	5	10	1/week
Biochemical Oxygen Demand	001	WWTF	NA	NA	30	70	1/week
Chemical Oxygen Demand	002	Z-12-EN	NA	NA	NA	120	1/week
	003	Z-12-W	NA	NA	NA	120	1/week
	004	16-1	NA	NA	NA	120	1/week
	005	NDITCH	NA	NA	NA	200	1/week
	006	Z-12-S	NA	NA	NA	120	1/week
	102	12-17-N	NA	NA	25	50	1/6 months
	103	11-20	NA	NA	25	50	1/month
	104	11-50	NA	NA	25	75	1/month

TABLE C.1.2–2.—*Pantex Plant NPDES Permit No. TX0107107 Requirements*-Continued

PARAMETER	OUTFALL	SAMPLE ID	DISCHARGE LIMITATIONS				FREQUENCY
			QUANTITY (MGD)		QUALITY (mg/L)		
			DAILY AVG	DAILY MAX	DAILY AVG	DAILY MAX	
Chemical Oxygen Demand (cont'd)	202	12-17-S	NA	NA	25	50	1/6 months
	302	12-19-S	NA	NA	25	50	1/6 months
	402	12-19-N	NA	NA	25	50	1/6 months
	502	12-19-CT	NA	NA	25	50	1/6 months
	602	12-43	NA	NA	25	50	1/month
	702	12-39	NA	NA	10	20	1/6 months
Oil & Grease	001	WWTF	NA	NA	NA	15	1/week
	002	Z-12-EN	NA	NA	NA	15	1/week
	003	Z-12-W	NA	NA	NA	15	1/week
	004	16-1	NA	NA	NA	15	1/week
	005	NDITCH	NA	NA	NA	15	1/week
	006	Z-12-S	NA	NA	NA	15	1/week
	102	12-17-N	NA	NA	Report	15	1/6 months
	103	11-20	NA	NA	Report	15	1/month
	104	11-50	NA	NA	Report	15	1/month
	202	12-17-S	NA	NA	Report	15	1/6 months
	302	12-19-S	NA	NA	Report	15	1/6 months
	402	12-19-N	NA	NA	Report	15	1/6 months
	502	12-19-CT	NA	NA	Report	15	1/6 months
	602	12-43	NA	NA	Report	15	1/month
	702	12-39	NA	NA	Report	15	1/6 months
pH	001	WWTF	NA	NA	NA	6.0-10.0	1/week
	002	Z-12-EN	NA	NA	NA	6.0-10.0	1/week
	003	Z-12-W	NA	NA	NA	6.0-10.0	1/week
	004	16-1	NA	NA	NA	6.0-10.0	1/week
	005	NDITCH	NA	NA	NA	6.0-9.0	1/week
	006	Z-12-S	NA	NA	NA	6.0-10.0	1/week
	101	12-21	NA	NA	NA	6.0-9.0	1/6 months
	102	12-17-N	NA	NA	NA	6.0-9.0	1/6 months
	103	11-20	NA	NA	NA	6.0-9.0	1/month
	104	11-50	NA	NA	NA	6.0-9.0	1/month
	201	12-84-B1	NA	NA	NA	6.0-9.0	1/6 months
	202	12-17-S	NA	NA	NA	6.0-9.0	1/6 months
	203	11-38	NA	NA	NA	6.0-9.0	1/6 months

TABLE C.1.2–2.—*Pantex Plant NPDES Permit No. TX0107107 Requirements*-Continued

PARAMETER	OUTFALL	SAMPLE ID	DISCHARGE LIMITATIONS				FREQUENCY
			QUANTITY (MGD)		QUALITY (mg/L)		
			DAILY AVG	DAILY MAX	DAILY AVG	DAILY MAX	
pH (cont'd)	301	12-84-B10	NA	NA	NA	6.0-9.0	1/6 months
	302	12-19-S	NA	NA	NA	6.0-9.0	1/6 months
	401	12-116R110	NA	NA	NA	6.0-9.0	1/6 months
	402	12-19-N	NA	NA	NA	6.0-9.0	1/6 months
	501	12-104a-B19	NA	NA	NA	6.0-9.0	1/6 months
	502	12-19-CT	NA	NA	NA	6.0-9.0	1/6 months
	601	12-104a-B23	NA	NA	NA	6.0-9.0	1/6 months
	602	12-43	NA	NA	NA	6.0-9.0	1/month
	702	12-39	NA	NA	NA	6.0-9.0	1/6 months
Total Suspended Solids	001	WWTF	NA	NA	30	60	1/week
	102	12-17-N	NA	NA	20	70	1/6 months
	103	11-20	NA	NA	10	15	1/month
	104	11-50	NA	NA	25	75	1/month
	202	12-17-S	NA	NA	10	15	1/6 months
	302	12-19-S	NA	NA	25	50	1/6 months
	402	12-19-N	NA	NA	25	100	1/6 months
	502	12-19-CT	NA	NA	10	15	1/6 months
	602	12-43	NA	NA	20	30	1/month
	702	12-39	NA	NA	10	15	1/6 months
Total Dissolved Solids	103	11-20	NA	NA	Report	Report	1/month
	104	11-50	NA	NA	Report	Report	1/month
	602	12-43	NA	NA	Report	Report	1/month
Antimony (T)	001	WWTF	NA	NA	Report	Report	1/6 months
	002	Z-12-EN	NA	NA	Report	Report	1/month
	003	Z-12-W	NA	NA	Report	Report	1/month
	004	16-1	NA	NA	Report	Report	1/month
	006	Z-12-S	NA	NA	Report	Report	1/month
	103	11-20	NA	NA	Report	Report	1/month
	104	11-50	NA	NA	Report	Report	1/month
	602	12-43	NA	NA	Report	Report	1/month
Arsenic (T)	001	WWTF	NA	NA	0.019	0.030	1/6 months
	002	Z-12-EN	NA	NA	0.019	0.030	1/month
	003	Z-12-W	NA	NA	0.019	0.030	1/month
	004	16-1	NA	NA	0.019	0.030	1/month

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TABLE C.1.2–2.—*Pantex Plant NPDES Permit No. TX0107107 Requirements*-Continued

PARAMETER	OUTFALL	SAMPLE ID	DISCHARGE LIMITATIONS				FREQUENCY
			QUANTITY (MGD)		QUALITY (mg/L)		
			DAILY AVG	DAILY MAX	DAILY AVG	DAILY MAX	
Cobalt (T) (cont'd)	104	11-50	NA	NA	Report	Report	1/month
	602	12-43	NA	NA	Report	Report	1/month
Copper (T)	001	WWTF	NA	NA	0.033	0.046	1/6 months
	002	Z-12-EN	NA	NA	0.033	0.046	1/month
	003	Z-12-W	NA	NA	0.033	0.046	1/month
	004	16-1	NA	NA	0.033	0.046	1/month
	006	Z-12-S	NA	NA	0.033	0.046	1/month
	103	11-20	NA	NA	0.067	Report	1/month
	104	11-50	NA	NA	0.067	Report	1/month
	602	12-43	NA	NA	0.067	Report	1/month
Cyanide (T)	101	12-21	NA	NA	NA	<0.02	1/6 months
	201	12-84-B1	NA	NA	NA	<0.02	1/6 months
	301	12-84-B10	NA	NA	NA	<0.02	1/6 months
	401	12-116-R110	NA	NA	NA	<0.02	1/6 months
	501	12-104a-B19	NA	NA	NA	<0.02	1/6 months
	601	12-104a-B23	NA	NA	NA	<0.02	1/6 months
Cyanide (amenable)	101	12-21	NA	NA	NA	<0.02	1/6 months
	201	12-84-B1	NA	NA	NA	<0.02	1/6 months
	301	12-84-B10	NA	NA	NA	<0.02	1/6 months
	401	12-116-R110	NA	NA	NA	<0.02	1/6 months
	501	12-104a-B19	NA	NA	NA	<0.02	1/6 months
	601	12-104a-B23	NA	NA	NA	<0.02	1/6 months
Lead (T)	001	WWTF	NA	NA	0.172	0.229	1/6 months
	002	Z-12-EN	NA	NA	0.172	0.229	1/month
	003	Z-12-W	NA	NA	0.172	0.229	1/month
	004	16-1	NA	NA	0.172	0.229	1/month
	006	Z-12-S	NA	NA	0.172	0.229	1/month
	103	11-20	NA	NA	0.230	Report	1/month
	104	11-50	NA	NA	0.230	Report	1/month
	602	12-43	NA	NA	0.230	Report	1/month
Manganese (T)	001	WWTF	NA	NA	0.439	0.557	1/6 months
	002	Z-12-EN	NA	NA	0.439	0.557	1/month
	003	Z-12-W	NA	NA	0.439	0.557	1/month
	004	16-1	NA	NA	0.439	0.557	1/month

TABLE C.1.2–2.—*Pantex Plant NPDES Permit No. TX0107107 Requirements*-Continued

PARAMETER	OUTFALL	SAMPLE ID	DISCHARGE LIMITATIONS				FREQUENCY
			QUANTITY (MGD)		QUALITY (mg/L)		
			DAILY AVG	DAILY MAX	DAILY AVG	DAILY MAX	
Manganese (T) (cont'd)	006	Z-12-S	NA	NA	0.439	0.557	1/month
	103	11-20	NA	NA	0.239	0.290	1/month
	104	11-50	NA	NA	0.239	0.290	1/month
	602	12-43	NA	NA	0.239	0.290	1/month
Mercury (T)	001	WWTF	NA	NA	0.0003	0.0007	1/6 months
	002	Z-12-EN	NA	NA	0.0003	0.0007	1/month
	003	Z-12-W	NA	NA	0.0003	0.0007	1/month
	004	16-1	NA	NA	0.0003	0.0007	1/month
	006	Z-12-S	NA	NA	0.0003	0.0007	1/month
	103	11-20	NA	NA	0.0004	0.0005	1/month
	104	11-50	NA	NA	0.0004	0.0005	1/month
	602	12-43	NA	NA	0.0004	0.0005	1/month
Molybdenum (T)	001	WWTF	NA	NA	Report	Report	1/month
	002	Z-12-EN	NA	NA	Report	Report	1/month
	003	Z-12-W	NA	NA	Report	Report	1/month
	004	16-1	NA	NA	Report	Report	1/month
	006	Z-12-S	NA	NA	Report	Report	1/month
	103	11-20	NA	NA	Report	Report	1/month
	104	11-50	NA	NA	Report	Report	1/month
	602	12-43	NA	NA	Report	Report	1/month
Nickel (T)	001	WWTF	NA	NA	0.042	0.055	1/6 months
	002	Z-12-EN	NA	NA	0.042	0.055	1/month
	003	Z-12-W	NA	NA	0.042	0.055	1/month
	004	16-1	NA	NA	0.042	0.055	1/month
	006	Z-12-S	NA	NA	0.042	0.055	1/month
	103	11-20	NA	NA	0.030	0.030	1/month
	104	11-50	NA	NA	0.030	0.030	1/month
	602	12-43	NA	NA	0.030	0.030	1/month
Selenium (T)	001	WWTF	NA	NA	Report	Report	1/6 months
	002	Z-12-EN	NA	NA	Report	Report	1/month
	003	Z-12-W	NA	NA	Report	Report	1/month
	004	16-1	NA	NA	Report	Report	1/month
	006	Z-12-S	NA	NA	Report	Report	1/month
	103	11-20	NA	NA	Report	Report	1/month

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TABLE C.1.2–3.—*Contaminants with Values Greater than or without Defined Water Quality Criteria for Surface Water at Playa 1 (OW–WR–08) for 1990 to 1994*

PARAMETER	UNITS	STD	MAX	AVG	# OF SAMP	YEAR
Aluminum	mg/L	NA	16.7	3.5	16	1994
Aluminum	mg/L	NA	20.0	5.8	10	1993
Bromide	mg/L	NA	2.1	0.9	15	1994
Bromide	mg/L	NA	3.2	1.1	13	1993
Chromium	mg/L	NA	0.079	0.019	11	1990
Endrin	mg/L	NA	NA	0.00035	13	1994
Gross Alpha (dissolved)	µCi E-9/ml	NA	7	2.93	14	1994
Gross Alpha (dissolved)	µCi E-9/ml	NA	15	6.09	11	1991
Gross Alpha (dissolved)	µCi E-9/ml	NA	13	7.1	8	1993
Gross Alpha (dissolved)	µCi E-9/ml	NA	82	18.85	13	1990
Gross Alpha (suspended)	µCi E-9/ml	NA	5	1.93	14	1994
Gross Alpha (suspended)	µCi E-9/ml	NA	10	3	11	1991
Gross Alpha (suspended)	µCi E-9/ml	NA	6	3.3	8	1993
Gross Alpha (suspended)	µCi E-9/ml	NA	260	43.46	13	1990
Gross Beta (dissolved)	µCi E-9/ml	NA	22	17.21	14	1994
Gross Beta (dissolved)	µCi E-9/ml	NA	26	17.8	8	1993
Gross Beta (dissolved)	µCi E-9/ml	NA	34	20.7	11	1991
Gross Beta (dissolved)	µCi E-9/ml	NA	86	31.69	13	1990
Gross Beta (suspended)	µCi E-9/ml	NA	9	4	14	1994
Gross Beta (suspended)	µCi E-9/ml	NA	17	5.64	11	1991
Gross Beta (suspended)	µCi E-9/ml	NA	15	7.4	8	1993
Gross Beta (suspended)	µCi E-9/ml	NA	240	48	13	1990
Heptachlor	mg/L	NA	NA	0.0006	13	1994
Iron	mg/L	NA	11	2.5	16	1994
Iron	mg/L	NA	12	3.618	10	1993
Iron	mg/L	NA	15	5.5	22	1991
Iron	mg/L	NA	53	9.5	10	1990
Manganese	mg/L	NA	0.53	0.35	8	1991
Manganese	mg/L	NA	0.556	0.31	10	1993
Specific Conductance	µmho/cm	NA	833	827.5	2	1994
Specific Conductance	µmho/cm	NA	1053	953	13	1993
Total Dissolved Solids	mg/L	NA	860	470.4	15	1994
Total Dissolved Solids	mg/L	NA	736	517.7	13	1993
Total Dissolved Solids	mg/L	NA	3000	990	9	1990
Titanium	mg/L	NA	0.27	0.08	10	1993
Titanium	mg/L	NA	0.3	0.08	13	1994

TABLE C.1.2–3.—*Contaminants with Values Greater than or without Defined Water Quality Criteria for Surface Water at Playa 1 (OW–WR–08) for 1990 to 1994*-Continued

PARAMETER	UNITS	STD	MAX	AVG	# OF SAMP	YEAR
Total Organic Halogen	mg/L	NA	70	21.64	14	1994
Total Organic Halogen	mg/L	NA	68	33.4	13	1993
Total Suspended Solids	mg/L	NA	240	125.93	15	1994
Total Suspended Solids	mg/L	NA	1200	250	8	1990

NA - Not Applicable

Sources: MH 1991; Battelle 1992; Battelle 1993; DOE 1994a; DOE 1995

TABLE C.1.2–4.—*Contaminants with Values Greater than or without Defined Water Quality Criteria for Surface Water Sampling Locations at Permitted Outfalls and Pantex Playas for 1990 to 1994*

PARAMETER	UNITS	STD	MAX	AVG	# OF SAMP	YEAR	LOCATION
'-dichlorobenzidine	mg/L	0.00015	0.04	0.034	4	1993	OW–WR–01
uminum	mg/L	0.84	13	2.2	10	1991	11–20
uminum	mg/L	0.84	6.1	2.4	8	1991	12–17–N
uminum	mg/L	0.84	8.9	2.4	22	1992	16–1
uminum	mg/L	0.84	5.8	3.7	9	1993	16–1
uminum	mg/L	0.84	27	4.5	12	1994	16–1
luminum	mg/L	0.84	12	5.3	9	1991	16–1
luminum	mg/L	0.84	2.4	2.4	1	1994	NDITCH
luminum	mg/L	0.84	12	7.4	5	1993	OW–WR–01
luminum	mg/L	0.84	32	19.6	3	1994	OW–WR–01
luminum	mg/L	0.84	2.1	2.1	1	1994	OW–WR–24
luminum	mg/L	0.84	15	9.7	5	1994	OW–WR–27
luminum	mg/L	0.84	2.2	1.9	2	1993	OW–WR–34
luminum	mg/L	0.84	22.7	9.5	6	1994	OW–WR–34
luminum	mg/L	0.84	130	70	3	1993	OW–WR–36
luminum	mg/L	0.84	7	3.1	8	1992	Z–12–EN
luminum	mg/L	0.84	16	5.5	5	1991	Z–12–EN
luminum	mg/L	0.84	44	8	9	1994	Z–12–EN
luminum	mg/L	0.84	27	10.2	5	1993	Z–12–EN
luminum	mg/L	0.84	21	4.4	37	1993	Z–12–S
luminum	mg/L	0.84	18	5.3	21	1994	Z–12–S
luminum	mg/L	0.84	9.3	5.7	4	1990	Z–12–S
luminum	mg/L	0.84	30	7.7	13	1991	Z–12–S
luminum	mg/L	0.84	6.4	1.1	12	1991	Z–12–W
luminum	mg/L	0.84	6.3	1.5	15	1994	Z–12–W
luminum	mg/L	0.84	9	2.7	9	1993	Z–12–W
luminum	mg/L	0.84	19	4.2	22	1992	Z–12–W
Ammonia (as N)	mg/L	5/10	12	5.8	14	1993	INCOMING
Ammonia (as N)	mg/L	5/10	12.5	7.9	15	1994	INCOMING
Antimony	mg/L	Report	0.06	0.03	91	1994	DACAUTO
Barium	mg/L	1	10.0	1.7	6	1993	11–20
Barium	mg/L	1	3.4	1.2	3	1990	12–17–N
Beryllium	mg/L	Report	0.005	0.003	91	1994	DACAUTO

TABLE C.1.2–4.—*Contaminants with Values Greater than or without Defined Water Quality Criteria for Surface Water Sampling Locations at Permitted Outfalls and Pantex Playas for 1990 to 1994*-Continued

PARAMETER	UNITS	STD	MAX	AVG	# OF SAMP	YEAR	LOCATION
Beryllium	mg/L	Report	0.005	0.005	64	1991	DACAUTO
Beryllium	mg/L	Report	0.004	0.005	14	1993	INCOMING
BOD	mg/L	30/70	152	45	80	1994	INCOMING
Chromium	mg/L	0.043	28	3.5	8	1990	Z–12–S
Chromium	mg/L	0.009	0.1	NA	1	1990	11–20
Chromium	mg/L	0.009	0.012	<0.006	10	1991	11–20
Chromium	mg/L	0.043	0.057	0.038	2	1991	OW–WR–24
Chromium	mg/L	0.043	0.08	0.04	3	1993	OW–WR–36
Chromium	mg/L	0.043	0.3	0.03	16	1994	Incoming
Chromium (hexavalent)	mg/L	0.016	0.12	0.12	1	1990	12–17–N
Chromium (hexavalent)	mg/L	0.016	0.02	0.02	3	1994	OW–WR–34
Chromium (hexavalent)	mg/L	0.016	0.8	0.2	7	1990	Z–12–S
Copper	mg/L	0.024	0.15	0.044	8	1991	12–17–N
Copper	mg/L	0.024	0.051	0.033	11	1993	12–17–S
Copper	mg/L	0.024	0.093	0.025	10	1993	12–19–N
Copper	mg/L	0.024	0.26	0.061	10	1993	12–19–S
Copper	mg/L	0.024	0.54	0.068	14	1993	INCOMING
Copper	mg/L	0.024	13	0.8	16	1994	INCOMING
Copper	mg/L	0.024	0.046	0.038	2	1991	OW–WR–24
Copper	mg/L	0.024	0.07	0.04	3	1993	OW–WR–36
Gross Alpha (dissolved)	µCi E-9/ml	NA	2	NA	1	1990	11–20
Gross Alpha (dissolved)	µCi E-9/ml	NA	3	3	1	1993	11–50
Gross Alpha (dissolved)	µCi E-9/ml	NA	9	NA	2	1990	12–43
Gross Alpha (dissolved)	µCi E-9/ml	NA	6	6	2	1993	12–43
Gross Alpha (dissolved)	µCi E-9/ml	NA	2	0.7	6	1993	16–1
Gross Alpha (dissolved)	µCi E-9/ml	NA	6	0.88	8	1991	16–1
Gross Alpha (dissolved)	µCi E-9/ml	NA	2	0.92	7	1994	16–1
Gross Alpha (dissolved)	µCi E-9/ml	NA	7	NA	2	1990	DAC
Gross Alpha (dissolved)	µCi E-9/ml	NA	12	7.2	15	1994	DAC
Gross Alpha (dissolved)	µCi E-9/ml	NA	14	7.9	14	1993	DAC
Gross Alpha (dissolved)	µCi E-9/ml	NA	1	NA	1	1990	DACAUTO
Gross Alpha (dissolved)	µCi E-9/ml	NA	11	4.25	12	1991	DACAUTO
Gross Alpha (dissolved)	µCi E-9/ml	NA	11	3.92	12	1991	INCOMING
Gross Alpha (dissolved)	µCi E-9/ml	NA	8	4.75	4	1990	INCOMING
Gross Alpha (dissolved)	µCi E-9/ml	NA	8	5	14	1994	INCOMING

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TABLE C.1.2–4.—*Contaminants with Values Greater than or without Defined Water Quality Criteria for Surface Water Sampling Locations at Permitted Outfalls and Pantex Playas for 1990 to 1994*-Continued

PARAMETER	UNITS	STD	MAX	AVG	# OF SAMP	YEAR	LOCATION
Gross Alpha (suspended)	µCi E-9/ml	NA	3	1.25	4	1990	INCOMING
Gross Alpha (suspended)	µCi E-9/ml	NA	5	1.43	14	1994	INCOMING
Gross Alpha (suspended)	µCi E-9/ml	NA	6	1.58	12	1991	INCOMING
Gross Alpha (suspended)	µCi E-9/ml	NA	2	0.2	13	1993	Lagoon
Gross Alpha (suspended)	µCi E-9/ml	NA	1	0.29	14	1994	Lagoon
Gross Alpha (suspended)	µCi E-9/ml	NA	4	2	5	1993	OW–WR–01
Gross Alpha (suspended)	µCi E-9/ml	NA	7	2.86	7	1991	OW–WR–01
Gross Alpha (suspended)	µCi E-9/ml	NA	17	9.67	3	1994	OW–WR–01
Gross Alpha (suspended)	µCi E-9/ml	NA	8	6	2	1991	OW–WR–24
Gross Alpha (suspended)	µCi E-9/ml	NA	2	0.2	5	1991	OW–WR–27
Gross Alpha (suspended)	µCi E-9/ml	NA	5	3.4	5	1994	OW–WR–27
Gross Alpha (suspended)	µCi E-9/ml	NA	1	1	4	1993	OW–WR–34
Gross Alpha (suspended)	µCi E-9/ml	NA	12	8.5	4	1994	OW–WR–34
Gross Alpha (suspended)	µCi E-9/ml	NA	8	5	2	1991	OW–WR–36
Gross Alpha (suspended)	µCi E-9/ml	NA	39	18.7	3	1993	OW–WR–36
Gross Alpha (suspended)	µCi E-9/ml	NA	1	0.33	3	1994	Z–12–EN
Gross Alpha (suspended)	µCi E-9/ml	NA	3	1.6	5	1991	Z–12–EN
Gross Alpha (suspended)	µCi E-9/ml	NA	7	5	2	1993	Z–12–EN
Gross Alpha (suspended)	µCi E-9/ml	NA	3	0.9	8	1993	Z–12–S
Gross Alpha (suspended)	µCi E-9/ml	NA	5	2.32	7	1994	Z–12–S
Gross Alpha (suspended)	µCi E-9/ml	NA	17	4.08	12	1991	Z–12–S
Gross Alpha (suspended)	µCi E-9/ml	NA	7	0.5	12	1991	Z–12–W
Gross Alpha (suspended)	µCi E-9/ml	NA	2	0.74	9	1994	Z–12–W
Gross Alpha (suspended)	µCi E-9/ml	NA	2	1	6	1993	Z–12–W
Gross Beta (dissolved)	µCi E-9/ml	NA	2	NA	1	1990	11–20
Gross Beta (dissolved)	µCi E-9/ml	NA	9	9	1	1993	11–50
Gross Beta (dissolved)	µCi E-9/ml	NA	7	NA	2	1990	12–43
Gross Beta (dissolved)	µCi E-9/ml	NA	9	7.5	2	1993	12–43
Gross Beta (dissolved)	µCi E-9/ml	NA	16	7.8	6	1993	16–1
Gross Beta (dissolved)	µCi E-9/ml	NA	13	8.75	8	1991	16–1
Gross Beta (dissolved)	µCi E-9/ml	NA	37	12.14	7	1994	16–1
Gross Beta (dissolved)	µCi E-9/ml	NA	13	NA	2	1990	DAC
Gross Beta (dissolved)	µCi E-9/ml	NA	17	11.5	14	1993	DAC
Gross Beta (dissolved)	µCi E-9/ml	NA	46	13.2	15	1994	DAC
Gross Beta (dissolved)	µCi E-9/ml	NA	16	9.92	12	1991	DACAUTO

TABLE C.1.2–4.—*Contaminants with Values Greater than or without Defined Water Quality Criteria for Surface Water Sampling Locations at Permitted Outfalls and Pantex Playas for 1990 to 1994*-Continued

PARAMETER	UNITS	STD	MAX	AVG	# OF SAMP	YEAR	LOCATION
Gross Alpha (dissolved)	µCi E-9/ml	NA	12	6.2	13	1993	INCOMING
Gross Alpha (dissolved)	µCi E-9/ml	NA	9	6.2	13	1993	Lagoon
Gross Alpha (dissolved)	µCi E-9/ml	NA	13	6.93	14	1994	Lagoon
Gross Alpha (dissolved)	µCi E-9/ml	NA	3	2	3	1994	OW–WR–01
Gross Alpha (dissolved)	µCi E-9/ml	NA	11	2.43	7	1991	OW–WR–01
Gross Alpha (dissolved)	µCi E-9/ml	NA	12	5	5	1993	OW–WR–01
Gross Alpha (dissolved)	µCi E-9/ml	NA	1	1	1	1994	OW–WR–24
Gross Alpha (dissolved)	µCi E-9/ml	NA	3	1.5	2	1991	OW–WR–24
Gross Alpha (dissolved)	µCi E-9/ml	NA	2	NA	5	1991	OW–WR–27
Gross Alpha (dissolved)	µCi E-9/ml	NA	3	1.4	5	1994	OW–WR–27
Gross Alpha (dissolved)	µCi E-9/ml	NA	1	0.8	4	1993	OW–WR–34
Gross Alpha (dissolved)	µCi E-9/ml	NA	2	1.5	4	1994	OW–WR–34
Gross Alpha (dissolved)	µCi E-9/ml	NA	2	1	3	1993	OW–WR–36
Gross Alpha (dissolved)	µCi E-9/ml	NA	1	NA	5	1991	Z–12–EN
Gross Alpha (dissolved)	µCi E-9/ml	NA	1	0.33	3	1994	Z–12–EN
Gross Alpha (dissolved)	µCi E-9/ml	NA	2	1.5	2	1993	Z–12–EN
Gross Alpha (dissolved)	µCi E-9/ml	NA	2	0.8	7	1994	Z–12–S
Gross Alpha (dissolved)	µCi E-9/ml	NA	7	1.92	12	1991	Z–12–S
Gross Alpha (dissolved)	µCi E-9/ml	NA	8	4.1	8	1993	Z–12–S
Gross Alpha (dissolved)	µCi E-9/ml	NA	4	NA	1	1990	Z–12–W
Gross Alpha (dissolved)	µCi E-9/ml	NA	2	1.03	9	1994	Z–12–W
Gross Alpha (dissolved)	µCi E-9/ml	NA	6	1.92	12	1991	Z–12–W
Gross Alpha (dissolved)	µCi E-9/ml	NA	6	2.7	6	1993	Z–12–W
Gross Alpha (suspended)	µCi E-9/ml	NA	0	NA	1	1990	11–20
Gross Alpha (suspended)	µCi E-9/ml	NA	1	1	1	1993	11–50
Gross Alpha (suspended)	µCi E-9/ml	NA	1	0.5	2	1993	12–43
Gross Alpha (suspended)	µCi E-9/ml	NA	2	1.22	7	1994	16–1
Gross Alpha (suspended)	µCi E-9/ml	NA	2	1.5	6	1993	16–1
Gross Alpha (suspended)	µCi E-9/ml	NA	7	2.5	8	1991	16–1
Gross Alpha (suspended)	µCi E-9/ml	NA	3	NA	2	1990	DAC
Gross Alpha (suspended)	µCi E-9/ml	NA	1	0.1	14	1993	DAC
Gross Alpha (suspended)	µCi E-9/ml	NA	1	0.2	15	1994	DAC
Gross Alpha (suspended)	µCi E-9/ml	NA	12	NA	1	1990	DACAUT(
Gross Alpha (suspended)	µCi E-9/ml	NA	1	0.08	12	1991	DACAUT(
Gross Alpha (suspended)	µCi E-9/ml	NA	3	0.8	13	1993	INCOMIN

TABLE C.1.2–4.—*Contaminants with Values Greater than or without Defined Water Quality Criteria for Surface Water Sampling Locations at Permitted Outfalls and Pantex Playas for 1990 to 1994*-Continued

PARAMETER	UNITS	STD	MAX	AVG	# OF SAMP	YEAR	LOCATION
Gross Beta (dissolved)	µCi E-9/ml	NA	14	10.25	12	1991	INCOMING
Gross Beta (dissolved)	µCi E-9/ml	NA	21	11.2	13	1993	INCOMING
Gross Beta (dissolved)	µCi E-9/ml	NA	13	11.5	4	1990	INCOMING
Gross Beta (dissolved)	µCi E-9/ml	NA	22	11.5	14	1994	INCOMING
Gross Beta (dissolved)	µCi E-9/ml	NA	18	11.2	13	1993	Lagoon
Gross Beta (dissolved)	µCi E-9/ml	NA	18	11.43	14	1994	Lagoon
Gross Beta (dissolved)	µCi E-9/ml	NA	12	9.43	7	1991	OW–WR–01
Gross Beta (dissolved)	µCi E-9/ml	NA	15	11.33	3	1994	OW–WR–01
Gross Beta (dissolved)	µCi E-9/ml	NA	16	11.8	5	1993	OW–WR–01
Gross Beta (dissolved)	µCi E-9/ml	NA	8	8	1	1994	OW–WR–24
Gross Beta (dissolved)	µCi E-9/ml	NA	19	17	2	1991	OW–WR–24
Gross Beta (dissolved)	µCi E-9/ml	NA	15	12.2	5	1991	OW–WR–27
Gross Beta (dissolved)	µCi E-9/ml	NA	24	17	5	1994	OW–WR–27
Gross Beta (dissolved)	µCi E-9/ml	NA	62	29.5	4	1994	OW–WR–34
Gross Beta (dissolved)	µCi E-9/ml	NA	40	38.3	4	1993	OW–WR–34
Gross Beta (dissolved)	µCi E-9/ml	NA	25	13.5	2	1991	OW–WR–36
Gross Beta (dissolved)	µCi E-9/ml	NA	18	13.7	3	1993	OW–WR–36
Gross Beta (dissolved)	µCi E-9/ml	NA	8	7	5	1991	Z–12–EN
Gross Beta (dissolved)	µCi E-9/ml	NA	9	7.67	3	1994	Z–12–EN
Gross Beta (dissolved)	µCi E-9/ml	NA	12	10.5	2	1993	Z–12–EN
Gross Beta (dissolved)	µCi E-9/ml	NA	11	5.44	7	1994	Z–12–S
Gross Beta (dissolved)	µCi E-9/ml	NA	13	6.42	12	1991	Z–12–S
Gross Beta (dissolved)	µCi E-9/ml	NA	11	7	8	1993	Z–12–S
Gross Beta (dissolved)	µCi E-9/ml	NA	8	NA	1	1990	Z–12–W
Gross Beta (dissolved)	µCi E-9/ml	NA	14	NA	12	1991	Z–12–W
Gross Beta (dissolved)	µCi E-9/ml	NA	11	7.7	6	1993	Z–12–W
Gross Beta (dissolved)	µCi E-9/ml	NA	20	8.26	9	1994	Z–12–W
Gross Beta (suspended)	µCi E-9/ml	NA	2	2	1	1993	11–50
Gross Beta (suspended)	µCi E-9/ml	NA	2	1	2	1993	12–43
Gross Beta (suspended)	µCi E-9/ml	NA	4	2.42	7	1994	16–1
Gross Beta (suspended)	µCi E-9/ml	NA	7	3.8	6	1993	16–1
Gross Beta (suspended)	µCi E-9/ml	NA	16	4.63	8	1991	16–1
Gross Beta (suspended)	µCi E-9/ml	NA	2	NA	2	1990	DAC
Gross Beta (suspended)	µCi E-9/ml	NA	3	1.2	14	1993	DAC
Gross Beta (suspended)	µCi E-9/ml	NA	3	1.27	15	1994	DAC

TABLE C.1.2–4.—*Contaminants with Values Greater than or without Defined Water Quality Criteria for Surface Water Sampling Locations at Permitted Outfalls and Pantex Playas for 1990 to 1994*-Continued

PARAMETER	UNITS	STD	MAX	AVG	# OF SAMP	YEAR	LOCATION
Gross Beta (suspended)	µCi E-9/ml	NA	3.5	NA	1	1990	DACAUTO
Gross Beta (suspended)	µCi E-9/ml	NA	4	0.92	12	1991	DACAUTO
Gross Beta (suspended)	µCi E-9/ml	NA	5	0.92	12	1991	INCOMING
Gross Beta (suspended)	µCi E-9/ml	NA	2	1.07	14	1994	INCOMING
Gross Beta (suspended)	µCi E-9/ml	NA	3	1.1	13	1993	INCOMING
Gross Beta (suspended)	µCi E-9/ml	NA	3	1.75	4	1990	INCOMING
Gross Beta (suspended)	µCi E-9/ml	NA	4	1.64	14	1994	Lagoon
Gross Beta (suspended)	µCi E-9/ml	NA	4	1.7	13	1993	Lagoon
Gross Beta (suspended)	µCi E-9/ml	NA	8	4.8	5	1993	OW–WR–01
Gross Beta (suspended)	µCi E-9/ml	NA	14	5.14	7	1991	OW–WR–01
Gross Beta (suspended)	µCi E-9/ml	NA	24	14	3	1994	OW–WR–01
Gross Beta (suspended)	µCi E-9/ml	NA	13	8	2	1991	OW–WR–24
Gross Beta (suspended)	µCi E-9/ml	NA	2	0.6	5	1991	OW–WR–27
Gross Beta (suspended)	µCi E-9/ml	NA	14	10.4	5	1994	OW–WR–27
Gross Beta (suspended)	µCi E-9/ml	NA	4	3.5	4	1993	OW–WR–34
Gross Beta (suspended)	µCi E-9/ml	NA	16	13.3	4	1994	OW–WR–34
Gross Beta (suspended)	µCi E-9/ml	NA	12	10.5	2	1991	OW–WR–36
Gross Beta (suspended)	µCi E-9/ml	NA	93	48	3	1993	OW–WR–36
Gross Beta (suspended)	µCi E-9/ml	NA	5	2.67	3	1994	Z–12–EN
Gross Beta (suspended)	µCi E-9/ml	NA	9	3.4	5	1991	Z–12–EN
Gross Beta (suspended)	µCi E-9/ml	NA	14	8.5	2	1993	Z–12–EN
Gross Beta (suspended)	µCi E-9/ml	NA	11	4.1	8	1993	Z–12–S
Gross Beta (suspended)	µCi E-9/ml	NA	12	4.33	12	1991	Z–12–S
Gross Beta (suspended)	µCi E-9/ml	NA	8	4.48	7	1994	Z–12–S
Gross Beta (suspended)	µCi E-9/ml	NA	1	NA	1	1990	Z–12–W
Gross Beta (suspended)	µCi E-9/ml	NA	5	0.67	12	1991	Z–12–W
Gross Beta (suspended)	µCi E-9/ml	NA	3	1.45	9	1994	Z–12–W
Gross Beta (suspended)	µCi E-9/ml	NA	5	3	6	1993	Z–12–W
Mercury	mg/L	0.0024	0.0033	0.0033	1	1990	NDITCH
Methylene Chloride	mg/L	NA	0.031	0.0075	15	1994	INCOMING
Methylene Chloride	mg/L	NA	0.006	0.0058	6	1994	Z–12–S
Nickel	mg/L	0.03	2.2	2.2	1	1990	11–20
Oil & Grease	mg/L	15	160	24.38	13	1994	INCOMING
Oil & Grease	mg/L	15	30	16	2	1990	Z–12–S
Oil & Grease	mg/L	15	16	16	1	1990	Z–12–W

TABLE C.1.2–4.—*Contaminants with Values Greater than or without Defined Water Quality Criteria for Surface Water Sampling Locations at Permitted Outfalls and Pantex Playas for 1990 to 1994*-Continued

PARAMETER	UNITS	STD	MAX	AVG	# OF SAMP	YEAR	LOCATION
Orthophosphate	mg/L	NA	0.2	0.2	1	1990	11–20
PETN	mg/L	0.8	0.79	0.426	11	1993	11–50
RDX	mg/L	NA	0.019	0.017	5	1993	OW–WR–01
RDX	mg/L	NA	0.014	0.018	3	1994	OW–WR–01
Selenium	mg/L	0.02	0.034	0.034	1	1990	12–19–N
Selenium	mg/L	0.02	0.056	0.04	4	1990	NDITCH
Tetrahydrofuran	mg/L	NA	0.62	0.093	7	1993	12–43
Tetrahydrofuran	mg/L	NA	330	124	10	1990	12–43
Tetrahydrofuran	mg/L	NA	0.084	0.0138	9	1994	INCOMING
Total Suspended Solids	mg/L	NA	260	158.7	7	1993	OW–WR–01
Total Suspended Solids	mg/L	NA	330	195	3	1991	OW–WR–01
Total Suspended Solids	mg/L	NA	600	465	2	1994	OW–WR–01
Total Suspended Solids	mg/L	NA	255	191.67	3	1994	OW–WR–2
Total Suspended Solids	mg/L	NA	557	280.33	6	1994	OW–WR–3
Total Suspended Solids	mg/L	NA	2900	1316	5	1993	OW–WR–3
Zinc	mg/L	0.144	0.7	0.165	8	1991	12–17–N
Zinc	mg/L	0.144	0.47	0.47	1	1990	12–43
Zinc	mg/L	0.144	0.44	0.24	3	1993	OW–WR–3

Note: The Wastewater Treatment Facility (Outfall 001) includes the following specific effluent sampling locations: Influent into the Wastewater Treatment facility (INCOMING), treatment lagoon, composite sampler at chlorinator (DACAUTO), and effluent. It should be noted that wastewater influent collected at the inlet weir (INCOMING) to the Wastewater Treatment Facility and the treatment lagoon have not undergone wastewater treatment and, therefore, would not be expected to meet the effluent discharge limitations.

Constituent abbreviations:

BOD - Biological oxygen demand

PETN- pentaerythritohetranitrate

RDX - Research development explosive

NA - Not Applicable

Sources: MH 1991; Battelle 1992; Battelle 1993; DOE 1994a; DOE 1995

TABLE C.2.1–1.—*Pantex Plant Well Information*[1]

WELL ID NUMBER	ALSO KNOWN AS	AQUIFER	TYPE OF WELL	STATUS
1114–MW1	MW–1 Zone 11 PM–101	Perched	Monitoring	Active
1114–MW2	MW–2 Zone 11 PM–102	Perched	Monitoring	Active
1114–MW3	MW–3 Zone 11 PM–103	Perched	Monitoring	Active
1114–MW4	MW–4 Zone 11 PM–104	Perched	Monitoring	Active
15–16	OW–WR–18 PM–18 CA–630 PR–18 DA–06–44–211 Well 16	Ogallala	Production	Active
15–17	1–69 Well 17 PR–02 DA–06–44–210 OW–WR–02	Ogallala	Production	Active
15–20	Well 20 3–70 PR–16 OW–WR–16	Ogallala	Production	Active
15–26	Well 26 PR–41 OW–WR–41	Ogallala	Production	Active
15–32	PR–120	Ogallala	Production	Inactive
15–6	PR–06 DA–06–44–213 Well 11 OW–WR–06	Ogallala	Production	Active
BEG–PTX2	OM–105 OW–WR–105	Ogallala	Observation	Active
BEG–PTX3	PM–106 OW–WR–106	Perched	Observation	Active
MW–01A	FPOP–MW–01A	Perched	Monitoring	Unknown
MW–02	CR–102–MW FPOP–MW–02	Perched	Monitoring	Unknown
MW–03	CR–103–MW FPOP–MW–03	Perched	Monitoring	Unknown
MW–04B	FPOP–MW–04B	Perched	Monitoring	Unknown
MW–05	FPOP–MW–05	Perched	Monitoring	Unknown
MW–06	FPOP–MW–06	Perched	Monitoring	Unknown
OW–WR–19	PM–19	Perched	Monitoring	Active

TABLE C.2.1–1.—*Pantex Plant Well Information*[1]-Continued

WELL ID NUMBER	ALSO KNOWN AS	AQUIFER	TYPE OF WELL	STATUS
PTX08–1003		Perched	Monitoring	Active
PTX08–1004		Perched	Monitoring	Plugged
PTX08–1005		Perched	Monitoring	Active
PTX08–1006		Perched	Monitoring	Active
PTX08–1007		Perched	Monitoring	Active
PTX08–1008		Perched	Monitoring	Active
PTX08–1009		Perched	Monitoring	Active
PTX08–1010		Perched	Monitoring	Active
PTX08–1011		Ogallala	Background Well	Plugged
PTX08–1011A		Ogallala	Monitoring	Unknown
PTX10–1007	PTX10–0007 PM–107	Perched	Monitoring	Active
PTX10–1008	PTX10–0008 PM–108	Perched	Monitoring	Active
PTX10–1013	PTX10–0013 PM–109 PTX09–0013	Perched	Monitoring	Active
PTX10–1014	PTX10–0014 PM–110 PTX09–0014	Perched	Monitoring	Active
W15–11	Well 11 E–6B DA–06–44–214	Ogallala	Production	Plugged
W15–2	Well 2 DA–06–44–212	Ogallala	Production	Plugged
W15–5	Well 5	Ogallala	Production	Plugged
W15–7	Well 7 DA–06–44–215	Ogallala	Production	Plugged
Walco #1	Well 18 70–1	Ogallala	Production	Active
Walco #2	Well 19 70–2	Ogallala	Production	Active
Walco #4	Well 21 70–4	Unknown	Unknown	Abandoned
Walco #5	Well 22 70–5	Unknown	Unknown	Abandoned

[1]Well Locations are displayed on Figure 4.6.1.2 –2.
[2]Neutron probe holes in the unsaturated zone with total depths ranging from 8.5 to 11 meters (28 to 37 feet) below land surface.
Note: Some data inconsistencies may exist from one source to another.
Sources: MH 1992; PC 1994; TBEG 1995; DOE 1991; USCOE 1991; USCOE 1994; TBEG nd; Argonne 1995

TABLE C.2.1–2.—*Hydraulic Parameter Summary of Onsite Wells*

WELL ID NUMBERS	TESTED ZONE	GROUND SURFACE ELEVA-TION (ft)	TOTAL DEPTH OF WELL (ft)	TOP OF SCREEN (ft)	BOTTOM OF SCREEN (ft)	TYPE OF WELL	TRANS. (ft^2/d)	HOR COND. (ft/d)	VERT. COND (ft/d)
15–26	Ogall.	3539.89[1]	763	530 676	656 750	Prod.	1403.7	4.46	NR
15–16	Ogall.	3526.36[1]	727	507	717	Prod.	3008.02	14.32	NR
BEGPTX–02[2]	FGZ	3540[1]	420	375.75	417	Monitor	NR	NR	1.96E-05 to 2.14E-03
BEGPTX–03[2]	Perch. or FGZ	3535[1]	282	230.5	282	Monitor	NR	NR	1.54E-03 to 5.95E-03
OW–WR–19	Perch.	3539.46	350	308	350	Monitor	42.89	NR	NR
OW–WR–20	Perch.	3537.93[1]	350	308	350	Monitor	19.39	NR	NR
OW–WR–38	Perch.	3518.10[1]	230	210	230	Monitor	120.86	NR	NR
OW–WR–44	Perch.	3542.16[1]	298	77.75	297.75	Monitor	85.43	NR	NR
OW–WR–45	Perch.	3544.11[1]	275	249.7	269.7	Monitor	122.72	NR	NR
PTX08–1008[2]	FGZ	3534.22[1]	292	259	289	Monitor	NR	NR	6.14E-03
PTX06–1004[2]	Perch.	3535.9[1]	286	253	283	Monitor	NR	NR	87.87
1114–MW1[3,4]	Perch.	3545.73[1]	290	268	288	Monitor	89–712	6.1–48.3	NR
1114–MW2[3,4]	Perch.	3544.99[1]	294	267	287	Monitor	133–606	9.4–42.6	NR
1114–MW3[3,4]	Perch.	3546.03[1]	287	267	287	Monitor	147–1,146	11.1–80.7	NR
1114–MW4[3,4]	Perch.	3546.34[1]	288	268	288	Monitor	180–722	9.2–47.5	NR
PTX06–1014[5,6]	Perch.	3529.00	290	260	280	Monitor	1149.2–1195.4	57.46–59.77	NR
PTX06–1017[5,6]	Perch.	3529.30	284	NR	NR	Observa-tion	789.4–1774.1	51.26–115.2	NR

Trans. - Transmissivity
Sat. - Saturated thickness
Hor. Cond. - Horizontal hydraulic conductivity
Vert. Cond. - Vertical hydraulic conductivity
FGZ - Fine-Grained Zone
NR - Information not reported
[1]DOE 1991
[2]TBEG 1994
[3]MH 1992
[4]TBEG 1995a
[5]Pantex 1995
[6]PC 1996
For all other information: USCOE 1992

TABLE C.2.2–1.—*Decision Criteria Standards and Risk Reduction Standards Used for the Groundwater Quality Analysis*

PARAMETER	UNITS	DECISION CRITERIA	RRS[5]
1,1-dichloroethane	µg/L	NA	10,200
1,1,1-trichloroethane	µg/L	200 (1)	200
1,2-dichloroethane	µg/L	5 (1)	5
1,3,5-trinitrobenzene	µg/L	NA	5.11
2-amino-4,6-dinitrotoluene	µg/L	NA	NA
2,4-dinitrotoluene	µg/L	NA	204
2,4,6-trinitrotoluene	µg/L	NA	51
2,6-dinitrotoluene	µg/L	NA	10,220
Alkalinity	mg/L	NA	414
Aluminum	µg/L	200 (2)	NA
Ammonia (as N)	µg/L	NA	NA
Arsenic	µg/L	50 (1)	50
Barium	µg/L	2000 (1)	2000
Benzene	µg/L	5 (1)	5
Bicarbonate	mg/L	NA	473
Boron	µg/L	NA	NA
Bromodichloromethane	µg/L	100 (3)	100
Calcium	µg/L	NA	566,000
Carbon tetrachloride	µg/L	5 (1)	5
Chloride	mg/L	300 (2)	1637
Chloroform	µg/L	100 (3)	100
Chromium (total)	µg/L	100 (1)	100
Chromium (hexavalent)	µg/L	NA	100
Cis-1,2-dichloroethane	µg/L	70 (1)	70
Copper	µg/L	1000 (2)	40
Cyanide	µg/L	200 (1)	200
Fluoride	mg/L	4 (1)	5.1
Gross Alpha (dissolved)	µCi E-9/ml	15 (1)	NA
Gross Alpha (suspended)	µCi E-9/ml	NA	NA
Gross Beta (dissolved)	µCi E-9/ml	50 (1)	NA
Gross Beta (suspended)	µCi E-9/ml	NA	NA

TABLE C.2.2–1.—*Decision Criteria Standards and Risk Reduction Standards Used for the Groundwater Quality Analysis*-Continued

PARAMETER	UNITS	DECISION CRITERIA	RRS[5]
Hardness	mg/L	NA	2238
HMX	µg/L	NA	5110
Iron	µg/L	300 (2)	1900
Lead	µg/L	15 (3)	100
Magnesium	µg/L	NA	219,000
Manganese	µg/L	50 (2)	40
Mercury	µg/L	2 (1)	2
Methylene Chloride	µg/L	NA	5
Molybdenum	µg/L	NA	NA
Nickel	µg/L	100 (1)	100
Nitrate (as N)	mg/L	10 (1)	16.2
Nitrite (as N)	mg/L	1,000 (1)	1,000
Nitrobenzene	µg/L	NA	51
Oil and Grease	µg/L	NA	NA
Orthophosphate	µg/L	NA	NA
Phenol	µg/L	NA	61,300
pH		6.5-8.5 (3)	NA
Phosphorous	mg/L	NA	1.0
Potassium	µg/L	NA	13,300
Plutonium - 239/240	µCi E-9/ml	1.2 (4)	NA
Radium - 226	µCi E-9/ml	5	5
Radium - 228	µCi E-9/ml	5	5
RDX	µg/L	NA	26
Selenium	µg/L	50 (1)	50
Silica	µg/L	NA	NA
Silver	ug/L	100 (2)	512
Sodium	µg/L	NA	1,863,000
Specific Conductance	µmho/cm	NA	15,400
Strontium	µg/L	NA	61,300
Sulfate	mg/L	300 (2)	3,750
Sulfite	mg/L	NA	NA
Total Dissolved Solids	mg/L	1000 (2)	8,057

TABLE C.2.2–1.—*Decision Criteria Standards and Risk Reduction Standards Used for the Groundwater Quality Analysis*-Continued

PARAMETER	UNITS	DECISION CRITERIA	RRS[5]
Tetrachloroethylene	µg/L	NA	5
Tetrahydrofuran	µg/L	NA	NA
Tetryl	µg/L	NA	4
Toluene	µg/L	1000 (1)	1000
Total Xylenes	µg/L	10,000 (1)	10,000
Total organic compounds	mg/L	NA	NA
Total organic halogen	mg/L	NA	NA
Trichloroethylene	µg/L	NA	5
Trichlorofluoromethane	µg/L	NA	30,700
Tritium	µCiE-6/ml	20,000 (1)	NA
Total suspended solids	µg/L	NA	NA
Uranium - 234	µCi E-9/ml	20 (4)	NA
Uranium - 238	µCi E-9/ml	24 (4)	NA
Vanadium	µg/L	NA	307
Zinc	µg/L	5,000 (2)	30,700

1) TNRCC Primary Maximum Contaminant (MCL) Level for Drinking Water (TNRCC 1994)
2) TNRCC Secondary Maximum Contaminant (SMCL) Level for Drinking Water (TNRCC 1994)
3) EPA Drinking Water Regulations and Health Advisories (EPA 1994)
4) DOE DCG's (DOE Order 5400.5)
5) RRS, Risk Reduction Standards (DOE, 1994)
Constituent abbreviations:
HMX - High melt explosive
RDX - Research development explosive
NA - Not Available

TABLE C.2.2–2.—*Suspected COCs in Pantex Plant Perched Aquifer Wells, Groundwater Analysis for 1990 to 1994*

LOCATION	DATE	PARAMETER	UNITS	CONCENTRATION OR ACTIVITY	DECISION CRITERIA	RISK REDUCTION STANDARDS	# SAM
PTX06-1005	Spring-94	1,2-dichloroethane	µg/L	5.5	5 (1)	5	
PTX08-1006	Spring-94	1,2-dichloroethane	µg/L	5.7	5 (1)	5	
1114-MW2	Fall-94	1,2-dichloroethane	µg/L	6	5 (1)	5	
PTX06-1005	Fall-93	1,2-dichloroethane	µg/L	6	5 (1)	5	
PTX06-1010	Spring-94	1,2-dichloroethane	µg/L	6.8	5 (1)	5	
PTX06-1008	Fall-93	1,2-dichloroethane	µg/L	8	5 (1)	5	
PTX08-1006	Winter-94	1,2-dichloroethane	µg/L	10	5 (1)	5	
PTX06-1010	Fall-94	1,2-dichloroethane	µg/L	11.9	5 (1)	5	
PTX08-1006	Fall-93	1,2-dichloroethane	µg/L	13	5 (1)	5	
1114-MW2	Spring-94	1,2-dichloroethane	µg/L	14	5 (1)	5	
1114-MW2	Fall-93	1,2-dichloroethane	µg/L	15	5 (1)	5	
PTX06-1010	Fall-93	1,2-dichloroethane	µg/L	20	5 (1)	5	
OW-WR-20	1990	1,2-dichloroethane	µg/L	10	5 (1)	0.005	
OW-WR-20	1991	1,2-dichloroethane	µg/L	6	5 (1)	0.005	
1114-MW2	1994	1,2-dichloroethane	µg/L	140	5 (1)	0.005	
PTX08-1002	Fall-94	1,3,5-trinitrobenzene	µg/L	14	NA	5.11	
PTX08-1002	Fall-93	1,3,5-trinitrobenzene	µg/L	15	NA	5.11	
PTX06-1003	Spring-94	1,3,5-trinitrobenzene	µg/L	17.8	NA	5.11	
PTX08-1002	Spring-94	1,3,5-trinitrobenzene	µg/L	18	NA	5.11	
PTX06-1010	Spring-94	1,3,5-trinitrobenzene	µg/L	30.1	NA	5.11	
PTX06-1003	Winter-94	1,3,5-trinitrobenzene	µg/L	30.3	NA	5.11	
PTX06-1003	Fall-94	1,3,5-trinitrobenzene	µg/L	42.5	NA	5.11	
PTX06-1004	Fall-94	1,3,5-trinitrobenzene	µg/L	368	NA	5.11	
PTX06-1004	Fall-93	1,3,5-trinitrobenzene	µg/L	395	NA	5.11	
PTX06-1004	Winter-94	1,3,5-trinitrobenzene	µg/L	456	NA	5.11	
PTX06-1005	Fall-94	1,3,5-trinitrobenzene	µg/L	738	NA	5.11	
PTX06-1005	Spring-94	1,3,5-trinitrobenzene	µg/L	805	NA	5.11	
PTX06-1005	Fall-93	1,3,5-trinitrobenzene	µg/L	810	NA	5.11	
PTX06-1004	Spring-94	1,3,5-trinitrobenzene	µg/L	1,980	NA	5.11	
PTX06-1005	Winter-94	1,3,5-trinitrobenzene	µg/L	2,230	NA	5.11	
PTX06-1005	Fall-93	2,4,6-trinitrotoluene	µg/L	63	NA	51	
PTX06-1004	Fall-93	2,4,6-trinitrotoluene	µg/L	102	NA	51	

TABLE C.2.2–2.—*Suspected COCs in Pantex Plant Perched Aquifer Wells, Groundwater Analysis for 1990 to 1994*-Continued

LOCATION	DATE	PARAMETER	UNITS	CONCENTRA-TION OR ACTIVITY	DECISION CRITERIA	RISK REDUCTION STANDARDS	# OF SAMPLES
PTX06-1004	Winter-94	2,4,6-trinitrotoluene	µg/L	122	NA	51	NR
PTX06-1005	Winter-94	2,4,6-trinitrotoluene	µg/L	248	NA	51	NR
PTX06-1002A	Winter-94	2-amino-4,6-dinitrotoluene	µg/L	1.32	NA	NR	NR
PTX06-1011	Winter-94	2-amino-4,6-dinitrotoluene	µg/L	2.46	NA	NR	NR
PTX08-1006	Winter-94	2-amino-4,6-dinitrotoluene	µg/L	5.04	NA	NR	NR
OW-WR-38	1992	Ammonia (as N)	mg/L	0.2	NA	NA	12
OW-WR-45	1993	Ammonia (as N)	mg/L	21	NA	NA	16
PTX10-1013	Fall-94	Benzene	µg/L	42.7	5 (1)	5	NR
PTX10-1013	Spring-94	Benzene	µg/L	43.7	5 (1)	5	NR
PTX10-1013	Winter-94	Benzene	µg/L	52.4	5 (1)	5	NR
PTX10-1013	Fall-93	Benzene	µg/L	64	5 (1)	5	NR
PTX08-1001	Winter-94	Chromium	µg/L	109	100 (1)	100	NR
OW-WR-38	Fall-94	Chromium	µg/L	112	100 (1)	100	NR
PTX10-1014	Fall-93	Chromium	µg/L	115	100 (1)	100	NR
PTX06-1007	Fall-93	Chromium	µg/L	119	100 (1)	100	NR
PTX07-1P01	Fall-94	Chromium	µg/L	123	100 (1)	100	NR
PTX06-1003	Spring-94	Chromium	µg/L	130	100 (1)	100	NR
PTX10-1014	Winter-94	Chromium	µg/L	190	100 (1)	100	NR
PTX06-1003	Fall-93	Chromium	µg/L	232	100 (1)	100	NR
PTX06-1011	Fall-94	Chromium	µg/L	260	100 (1)	100	NR
PTX06-1001A	Fall-94	Chromium	µg/L	277	100 (1)	100	NR
PTX06-1011	Winter-94	Chromium	µg/L	283	100 (1)	100	NR
PTX06-1011	Spring-94	Chromium	µg/L	330	100 (1)	100	NR
PTX06-1011	Fall-93	Chromium	µg/L	342	100 (1)	100	NR
OW-WR-20	Fall-93	Chromium	µg/L	560	100 (1)	100	NR
PTX06-1003	Winter-94	Chromium	µg/L	588	100 (1)	100	NR
PTX08-1008	Fall-93	Chromium	µg/L	603	100 (1)	100	NR
PTX08-1008	Winter-94	Chromium	µg/L	621	100 (1)	100	NR
OW-WR-20	Winter-94	Chromium	µg/L	680	100 (1)	100	NR
OW-WR-20	Spring-94	Chromium	µg/L	696	100 (1)	100	NR
PTX10-1014	Fall-94	Chromium	µg/L	710	100 (1)	100	NR

TABLE C.2.2–2.—*Suspected COCs in Pantex Plant Perched Aquifer Wells, Groundwater Analysis for 1990 to 1994*-Continued

LOCATION	DATE	PARAMETER	UNITS	CONCENTRATION OR ACTIVITY	DECISION CRITERIA	RISK REDUCTION STANDARDS	# SAM
PTX08-1008	Spring-94	Chromium	µg/L	850	100 (1)	100	
PTX08-1009	Winter-94	Chromium	µg/L	1,750	100 (1)	100	
OW-WR-20	Fall-94	Chromium	µg/L	1,830	100 (1)	100	
PTX08-1008	Fall-94	Chromium	µg/L	2,090	100 (1)	100	
PTX08-1009	Fall-93	Chromium	µg/L	2,110	100 (1)	100	
PTX06-1010	Fall-93	Chromium	µg/L	2,730	100 (1)	100	
PTX08-1009	Fall-94	Chromium	µg/L	2,760	100 (1)	100	
PTX08-1009	Spring-94	Chromium	µg/L	2,930	100 (1)	100	
PTX06-1010	Spring-94	Chromium	µg/L	4,300	100 (1)	100	
PTX06-1010	Fall-94	Chromium	µg/L	6,040	100 (1)	100	
PTX06-1010	Winter-94	Chromium	µg/L	9,040	100 (1)	100	
OW-WR-20	1990	Chromium	µg/L	120	100 (1)	100	
OW-WR-38	1991	Chromium	µg/L	120	100 (1)	100	
OW-WR-38	1994	Chromium	µg/L	150	100 (1)	100	
OW-WR-20	1992	Chromium	µg/L	230	100 (1)	100	
OW-WR-20	1993	Chromium	µg/L	594	100 (1)	100	
OW-WR-20	1994	Chromium	µg/L	1,950	100 (1)	100	
OW-WR-44	1991	Chromium	µg/L	3,100	100 (1)	100	
PTX08-1009	Spring-94	Chromium (hexavalent)	µg/L	211	NA	100	
PTX06-1011	Winter-94	Chromium (hexavalent)	µg/L	224	NA	100	
PTX06-1011	Fall-94	Chromium (hexavalent)	µg/L	230	NA	100	
PTX06-1011	Fall-93	Chromium (hexavalent)	µg/L	230	NA	100	
PTX06-1011	Spring-94	Chromium (hexavalent)	µg/L	346	NA	100	
PTX08-1008	Fall-93	Chromium (hexavalent)	µg/L	530	NA	100	
PTX08-1008	Winter-94	Chromium (hexavalent)	µg/L	563	NA	100	
PTX08-1008	Spring-94	Chromium (hexavalent)	µg/L	850	NA	100	
PTX08-1009	Winter-94	Chromium (hexavalent)	µg/L	1,770	NA	100	
PTX08-1008	Fall-94	Chromium (hexavalent)	µg/L	1,800	NA	100	
PTX08-1009	Fall-93	Chromium (hexavalent)	µg/L	2,200	NA	100	
PTX06-1010	Winter-94	Chromium (hexavalent)	µg/L	2,220	NA	100	
PTX08-1009	Fall-94	Chromium (hexavalent)	µg/L	2,500	NA	100	
PTX06-1010	Fall-93	Chromium (hexavalent)	µg/L	3,000	NA	100	
OW-WR-20	1991	Chromium (hexavalent)	µg/L	100	NA	100	

TABLE C.2.2–2.—*Suspected COCs in Pantex Plant Perched Aquifer Wells, Groundwater Analysis for 1990 to 1994*-Continued

LOCATION	DATE	PARAMETER	UNITS	CONCENTRA-TION OR ACTIVITY	DECISION CRITERIA	RISK REDUCTION STANDARDS	# OF SAMPLES
OW-WR-20	1992	Chromium (hexavalent)	µg/L	280	NA	100	3
OW-WR-20	1993	Chromium (hexavalent)	µg/L	440	NA	100	1
PTX06-1010	Winter-94	Copper	µg/L	236	1000 (2)	40	NR
OW-WR-44	1990	Gross Alpha (dissolved)	µCi E-9/ml	20	15	NA	11
OW-WR-20	1990	Gross Alpha (dissolved)	µCi E-9/ml	28	15	NA	11
OW-WR-20	1994	Gross Alpha (suspended)	µCi E-9/ml	1	NA	NA	11
OW-WR-45	1994	Gross Alpha (suspended)	µCiE-9/ml	1	NA	NA	9
OW-WR-PTX3	1994	Gross Alpha (suspended)	µCi E-9/ml	1	NA	NA	10
OW-WR-19	1990	Gross Alpha (suspended)	µCi E-9/ml	1	NA	NA	11
OW-WR-20	1991	Gross Alpha (suspended)	µCi E-9/ml	1	NA	NA	10
OW-WR-20	1992	Gross Alpha (suspended)	µCi E-9/ml	1	NA	NA	11
OW-WR-20	1993	Gross Alpha (suspended)	µCi E-9/ml	1	NA	NA	10
OW-WR-38	1991	Gross Alpha (suspended)	µCi E-9/ml	1	NA	NA	10
OW-WR-44	1992	Gross Alpha (suspended)	µCi E-9/ml	1	NA	NA	10
OW-WR-45	1990	Gross Alpha (suspended)	µCi E-9/ml	1	NA	NA	11
OW-WR-45	1991	Gross Alpha (suspended)	µCi E-9/ml	1	NA	NA	9
OW-WR-45	1992	Gross Alpha (suspended)	µCi E-9/ml	1	NA	NA	9
OW-WR-19	1993	Gross Alpha (suspended)	µCi E-9/ml	2	NA	NA	12
OW-WR-38	1990	Gross Alpha (suspended)	µCi E-9/ml	2	NA	NA	11
OW-WR-38	1992	Gross Alpha (suspended)	µCi E-9/ml	2	NA	NA	11
OW-WR-38	1993	Gross Alpha (suspended)	µCi E-9/ml	2	NA	NA	9
OW-WR-44	1991	Gross Alpha (suspended)	µCi E-9/ml	2	NA	NA	10
OW-WR-20	1990	Gross Alpha (suspended)	µCi E-9/ml	5	NA	NA	11
OW-WR-19	1991	Gross Alpha (suspended)	µCi E-9/ml	7	NA	NA	10
OW-WR-19	1992	Gross Alpha (suspended)	µCi E-9/ml	7	NA	NA	10
OW-WR-19	Fall-93	Gross Beta (suspended)	µCi E-9/ml	1	NA	NR	NR
OW-WR-20	Fall-93	Gross Beta (suspended)	µCi E-9/ml	1	NA	NR	NR
OW-WR-20	Fall-94	Gross Beta (suspended)	µCi E-9/ml	1	NA	NR	NR
OW-WR-38	Fall-94	Gross Beta (suspended)	µCi E-9/ml	1	NA	NR	NR
OW-WR-19	Winter-94	Gross Beta (suspended)	µCi E-9/ml	1	NA	NR	NR
OW-WR-20	Winter-94	Gross Beta (suspended)	µCi E-9/ml	1	NA	NR	NR
OW-WR-45	Winter-94	Gross Beta (suspended)	µCi E-9/ml	1	NA	NR	NR
OW-WR-19	1994	Gross Beta (suspended)	µCi E-9/ml	1	NA	NA	11
OW-WR-20	1994	Gross Beta (suspended)	µCi E-9/ml	1	NA	NA	12
OW-WR-38	1994	Gross Beta (suspended)	µCi E-9/ml	1	NA	NA	12
BEG-PTX3	1994	Gross Beta (suspended)	µCi E-9/ml	1	NA	NA	10

TABLE C.2.2–2.—*Suspected COCs in Pantex Plant Perched Aquifer Wells, Groundwater Analysis for 1990 to 1994*-Continued

LOCATION	DATE	PARAMETER	UNITS	CONCENTRATION OR ACTIVITY	DECISION CRITERIA	RISK REDUCTION STANDARDS	#(SAM
OW-WR-19	1991	Gross Beta (suspended)	µCi E-9/ml	1	NA	NA	1
OW-WR-19	1992	Gross Beta (suspended)	µCi E-9/ml	1	NA	NA	1
OW-WR-20	1990	Gross Beta (suspended)	µCi E-9/ml	1	NA	NA	1
OW-WR-38	1992	Gross Beta (suspended)	µCi E-9/ml	1	NA	NA	1
OW-WR-44	1990	Gross Beta (suspended)	µCi E-9/ml	1	NA	NA	1
OW-WR-44	1992	Gross Beta (suspended)	µCi E-9/ml	1	NA	NA	1
OW-WR-45	1993	Gross Beta (suspended)	µCi E-9/ml	1	NA	NA	1
OW-WR-45	1994	Gross Beta (suspended)	µCi E-9/ml	2	NA	NA	1
OW-WR-19	1990	Gross Beta (suspended)	µCi E-9/ml	2	NA	NA	1
OW-WR-20	1991	Gross Beta (suspended)	µCi E-9/ml	2	NA	NA	1
OW-WR-20	1992	Gross Beta (suspended)	µCi E-9/ml	2	NA	NA	1
OW-WR-20	1993	Gross Beta (suspended)	µCi E-9/ml	2	NA	NA	1
OW-WR-44	1993	Gross Beta (suspended)	µCi E-9/ml	2	NA	NA	1
OW-WR-44	1994	Gross Beta (suspended)	µCi E-9/ml	3	NA	NA	1
OW-WR-19	1993	Gross Beta (suspended)	µCi E-9/ml	3	NA	NA	1
OW-WR-38	1993	Gross Beta (suspended)	µCi E-9/ml	3	NA	NA	1
OW-WR-45	1991	Gross Beta (suspended)	µCi E-9/ml	3	NA	NA	1
OW-WR-44	1991	Gross Beta (suspended)	µCi E-9/ml	4	NA	NA	1
OW-WR-45	1992	Gross Beta (suspended)	µCi E-9/ml	4	NA	NA	1
OW-WR-45	1990	Gross Beta (suspended)	µCi E-9/ml	5	NA	NA	1
OW-WR-38	1990	Gross Beta (suspended)	µCi E-9/ml	6	NA	NA	1
OW-WR-38	1991	Gross Beta (suspended)	µCi E-9/ml	6	NA	NA	1
PTX06-1004	Spring-94	HMX	µg/L	11,000	NA	5,110	1
PTX06-1007	Fall-94	Iron	µg/L	300	300 (2)	1,900	1
PTX07-1O02	Fall-94	Iron	µg/L	300	300 (2)	1,900	1
PTX07-1P01	Fall-94	Iron	µg/L	300	300 (2)	1,900	1
PTX06-1001A	Spring-94	Iron	µg/L	300	300 (2)	1,900	1
PTX06-1007	Spring-94	Iron	µg/L	300	300 (2)	1,900	1
OW-WR-20	Spring-94	Iron	µg/L	330	300 (2)	1,900	1
OW-WR-20	Fall-93	Iron	µg/L	340	300 (2)	1,900	1
PTX06-1002A	Winter-94	Iron	µg/L	354	300 (2)	1,900	1
PTX06-1001A	Winter-94	Iron	µg/L	370	300 (2)	1,900	1
PTX06-1011	Winter-94	Iron	µg/L	381	300 (2)	1,900	1
PTX07-1P02	Fall-94	Iron	µg/L	400	300 (2)	1,900	1

TABLE C.2.2–2.—*Suspected COCs in Pantex Plant Perched Aquifer Wells, Groundwater Analysis for 1990 to 1994*-Continued

LOCATION	DATE	PARAMETER	UNITS	CONCENTRATION OR ACTIVITY	DECISION CRITERIA	RISK REDUCTION STANDARDS	# OF SAMPLES
PTX06-1007	Winter-94	Iron	µg/L	414	300 (2)	1,900	NR
PTX08-1001	Fall-93	Iron	µg/L	436	300 (2)	1,900	NR
PTX06-1007	Fall-93	Iron	µg/L	448	300 (2)	1,900	NR
OW-WR-38	Fall-94	Iron	µg/L	520	300 (2)	1,900	NR
PTX07-1O01	Fall-94	Iron	µg/L	600	300 (2)	1,900	NR
PTX10-1014	Fall-93	Iron	µg/L	790	300 (2)	1,900	NR
PTX06-1011	Fall-93	Iron	µg/L	817	300 (2)	1,900	NR
PTX06-1003	Fall-93	Iron	µg/L	888	300 (2)	1,900	NR
PTX07-1Q01	Fall-94	Iron	µg/L	900	300 (2)	1,900	NR
PTX06-1010	Fall-93	Iron	µg/L	1,010	300 (2)	1,900	NR
OW-WR-19	Fall-93	Iron	µg/L	1,020	300 (2)	1,900	NR
PTX07-1P03	Fall-94	Iron	µg/L	1,100	300 (2)	1,900	NR
PTX06-1010	Fall-94	Iron	µg/L	1,300	300 (2)	1,900	NR
PTX06-1003	Spring-94	Iron	µg/L	1,400	300 (2)	1,900	NR
PTX08-1001	Winter-94	Iron	µg/L	1,680	300 (2)	1,900	NR
PTX10-1014	Spring-94	Iron	µg/L	1,700	300 (2)	1,900	NR
PTX10-1014	Fall-94	Iron	µg/L	1,900	300 (2)	1,900	NR
OW-WR-19	Winter-94	Iron	µg/L	2,100	300 (2)	1,900	NR
OW-WR-19	Fall-94	Iron	µg/L	2,160	300 (2)	1,900	NR
OW-WR-19	Spring-94	Iron	µg/L	2,160	300 (2)	1,900	NR
PTX10-1014	Winter-94	Iron	µg/L	2,290	300 (2)	1,900	NR
PTX06-1006	Spring-94	Iron	µg/L	2,600	300 (2)	1,900	NR
PTX06-1010	Spring-94	Iron	µg/L	2,600	300 (2)	1,900	NR
PTX06-1003	Winter-94	Iron	µg/L	2,770	300 (2)	1,900	NR
OW-WR-20	Winter-94	Iron	µg/L	3,550	300 (2)	1,900	NR
PTX06-1001A	Fall-94	Iron	µg/L	4,000	300 (2)	1,900	NR
PTX06-1010	Winter-94	Iron	µg/L	16,200	300 (2)	1,900	NR
OW-WR-38	1992	Iron	µg/L	350	300 (2)	1,900	11
BEG-PTX3	1994	Iron	µg/L	400	300 (2)	1,900	10
OW-WR-45	1993	Iron	µg/L	600	300 (2)	1,900	16

TABLE C.2.2–2.—*Suspected COCs in Pantex Plant Perched Aquifer Wells, Groundwater Analysis for 1990 to 1994*-Continued

LOCATION	DATE	PARAMETER	UNITS	CONCENTRATION OR ACTIVITY	DECISION CRITERIA	RISK REDUCTION STANDARDS	# OF SAMPL
OW-WR-38	1994	Iron	µg/L	950	300 (2)	1,900	1
OW-WR-20	1992	Iron	µg/L	1,200	300 (2)	1,900	1
OW-WR-19	1994	Iron	µg/L	2,160	300 (2)	1,900	1
OW-WR-20	1993	Iron	µg/L	2,300	300 (2)	1,900	1
OW-WR-19	1991	Iron	µg/L	2,500	300 (2)	1,900	1
OW-WR-19	1992	Iron	µg/L	2,500	300 (2)	1,900	1
OW-WR-38	1991	Iron	µg/L	2,500	300 (2)	1,900	1
OW-WR-44	1991	Iron	µg/L	2,500	300 (2)	1,900	1
OW-WR-19	1993	Iron	µg/L	2,600	300 (2)	1,900	1
OW-WR-20	1994	Iron	µg/L	3,550	300 (2)	1,900	1
OW-WR-20	1991	Iron	µg/L	3,700	300 (2)	1,900	1
OW-WR-20	1990	Iron	µg/L	5,000	300 (2)	1,900	1
OW-WR-19	1990	Iron	µg/L	5,500	300 (2)	1,900	1
PTX06-1008	Spring-94	Lead	µg/L	31	15 (3)	100	N
PTX10-1014	Winter-94	Manganese	µg/L	44	50 (2)	40	N
PTX10-1013	Spring-94	Manganese	µg/L	50	50 (2)	40	N
PTX10-1013	Fall-94	Manganese	µg/L	54	50 (2)	40	N
PTX10-1013	Winter-94	Manganese	µg/L	56	50 (2)	40	N
PTX07-1Q01	Fall-94	Manganese	µg/L	57	50 (2)	40	N
PTX06-1010	Fall-93	Manganese	µg/L	64	50 (2)	40	N
PTX07-1P03	Fall-94	Manganese	µg/L	111	50 (2)	40	N
PTX07-1P01	Fall-94	Manganese	µg/L	271	50 (2)	40	N
PTX08-1005	Fall-94	Methylene Chloride	µg/L	5.5	NA	5	N
PTX08-1005	Spring-94	Methylene Chloride	µg/L	6.1	NA	5	N
PTX08-1005	Winter-94	Methylene Chloride	µg/L	11.8	NA	5	N
OW-WR-45	Fall-93	Nickel	µg/L	110	100 (1)	100	N
OW-WR-45	Spring-94	Nickel	µg/L	110	100 (1)	100	N
PTX07-1P02	Fall-94	Nickel	µg/L	113	100 (1)	100	N
OW-WR-45	Spring-94	Nickel	µg/L	120	100 (1)	100	N
PTX06-1003	Fall-94	Nickel	µg/L	122	100 (1)	100	N

TABLE C.2.2–2.—*Suspected COCs in Pantex Plant Perched Aquifer Wells, Groundwater Analysis for 1990 to 1994*-Continued

LOCATION	DATE	PARAMETER	UNITS	CONCENTRATION OR ACTIVITY	DECISION CRITERIA	RISK REDUCTION STANDARDS	# OF SAMPLES
OW-WR-45	Winter-94	Nickel	µg/L	140	100 (1)	100	
OW-WR-45	Fall-94	Nickel	µg/L	159	100 (1)	100	NR
OW-WR-38	Fall-93	Nickel	µg/L	160	100 (1)	100	NR
PTX06-1003	Spring-94	Nickel	µg/L	180	100 (1)	100	NR
PTX06-1007	Spring-94	Nickel	µg/L	180	100 (1)	100	NR
PTX06-1010	Spring-94	Nickel	µg/L	180	100 (1)	100	NR
PTX06-1010	Fall-93	Nickel	µg/L	192	100 (1)	100	NR
PTX07-1P01	Fall-94	Nickel	µg/L	199	100 (1)	100	NR
PTX10-1014	Fall-93	Nickel	µg/L	207	100 (1)	100	NR
PTX06-1003	Winter-94	Nickel	µg/L	214	100 (1)	100	NR
PTX06-1007	Winter-94	Nickel	µg/L	219	100 (1)	100	NR
PTX06-1007	Fall-93	Nickel	µg/L	223	100 (1)	100	NR
PTX06-1003	Fall-93	Nickel	µg/L	229	100 (1)	100	NR
PTX06-1001A	Spring-94	Nickel	µg/L	230	100 (1)	100	NR
OW-WR-38	Winter-94	Nickel	µg/L	230	100 (1)	100	NR
PTX06-1001A	Fall-94	Nickel	µg/L	243	100 (1)	100	NR
PTX10-1014	Spring-94	Nickel	µg/L	250	100 (1)	100	NR
PTX06-1001A	Fall-93	Nickel	µg/L	253	100 (1)	100	NR
OW-WR-38	Spring-94	Nickel	µg/L	270	100 (1)	100	NR
OW-WR-38	Fall-94	Nickel	µg/L	280	100 (1)	100	NR
PTX06-1001A	Winter-94	Nickel	µg/L	286	100 (1)	100	NR
PTX06-1010	Winter-94	Nickel	µg/L	338	100 (1)	100	NR
PTX10-1014	Winter-94	Nickel	µg/L	344	100 (1)	100	NR
PTX10-1014	Fall-94	Nickel	µg/L	356	100 (1)	100	NR
BEG-PTX3	1994	Nickel	µg/L	100	100 (1)	100	10
OW-WR-45	1994	Nickel	µg/L	170	100 (1)	100	10
OW-WR-38	1994	Nickel	µg/L	390	100 (1)	100	12
PTX06-1011	Spring-94	Nitrate (as N)	mg/L	230	10 (1)	16.2	NR
OW-WR-38	1991	Orthophosphate (as P)	mg/L	0.02	NA	NA	5
OW-WR-38	1992	Orthophosphate (as P)	mg/L	0.06	NA	NA	1

TABLE C.2.2–2.—*Suspected COCs in Pantex Plant Perched Aquifer Wells, Groundwater Analysis for 1990 to 1994*-Continued

LOCATION	DATE	PARAMETER	UNITS	CONCENTRA-TION OR ACTIVITY	DECISION CRITERIA	RISK REDUCTION STANDARDS	#0 SAMI
OW-WR-20	1992	Orthophosphate (as P)	mg/L	0.7	NA	NA	
PTX07-1P01	Fall-94	pH	NR	6.49	6.5-8.5 (3)	NA	N
1114-MW1	1994	pH	NR	8.8	6.5-8.5 (3)	NA	
1114-MW2	1994	pH	NR	8.8	6.5-8.5 (3)	NA	
BEG-PTX3	1994	pH	NR	9	6.5-8.5 (3)	NA	
PTX08-1003	Winter-94	Potassium	µg/L	59,950	NA	13,300	
PTX06-1011	Winter-94	RDX	µg/L	27.1	NA	26	
PTX08-1005	Fall-94	RDX	µg/L	29	NA	26	
PTX06-1011	Fall-94	RDX	µg/L	30.7	NA	26	
PTX06-1002A	Fall-93	RDX	µg/L	34	NA	26	
PTX06-1002A	Winter-94	RDX	µg/L	35.1	NA	26	
PTX07-1P02	Fall-94	RDX	µg/L	40	NA	26	
PTX06-1010	Fall-93	RDX	µg/L	40	NA	26	
PTX06-1002A	Fall-94	RDX	µg/L	50.5	NA	26	
PTX06-1010	Winter-94	RDX	µg/L	66.8	NA	26	
PTX07-1003	Fall-94	RDX	µg/L	71.5	NA	26	
PTX07-1001	Fall-94	RDX	µg/L	84.5	NA	26	
PTX08-1002	Fall-93	RDX	µg/L	101	NA	26	
PTX08-1002	Winter-94	RDX	µg/L	154	NA	26	
PTX08-1002	Spring-94	RDX	µg/L	212	NA	26	
PTX06-1010	Fall-94	RDX	µg/L	235	NA	26	
PTX08-1002	Fall-94	RDX	µg/L	287	NA	26	
PTX06-1010	Spring-94	RDX	µg/L	465	NA	26	
OW-WR-20	Fall-93	RDX	µg/L	1,000	NA	26	
PTX06-1005	Fall-94	RDX	µg/L	1,120	NA	26	
PTX06-1005	Spring-94	RDX	µg/L	1,490	NA	26	
PTX06-1004	Fall-94	RDX	µg/L	1,970	NA	26	
PTX06-1005	Fall-93	RDX	µg/L	2,020	NA	26	
PTX06-1004	Winter-94	RDX	µg/L	2,200	NA	26	
PTX06-1005	Winter-94	RDX	µg/L	2,420	NA	26	
PTX06-1004	Fall-93	RDX	µg/L	3,070	NA	26	
PTX06-1004	Spring-94	RDX	µg/L	4,920	NA	26	
OW-WR-44	1992	RDX	µg/L	33	NA	26	
OW-WR-38	1993	RDX	µg/L	34	NA	26	
OW-WR-38	1990	RDX	µg/L	38	NA	26	
OW-WR-20	1992	RDX	µg/L	920	NA	26	
OW-WR-20	1991	RDX	µg/L	950	NA	26	

TABLE C.2.2–2.—*Suspected COCs in Pantex Plant Perched Aquifer Wells, Groundwater Analysis for 1990 to 1994*-Continued

LOCATION	DATE	PARAMETER	UNITS	CONCENTRA-TION OR ACTIVITY	DECISION CRITERIA	RISK REDUCTION STANDARDS	# OF SAMPL
1114-MW2	Fall-93	Trichloroethylene	µg/L	16	NA	5	NR
PTX08-1007	Winter-94	Trichloroethylene	µg/L	16.4	NA	5	NR
PTX08-1003	Fall-93	Trichloroethylene	µg/L	28	NA	5	NR
PTX10-1014	Spring-94	Trichloroethylene	µg/L	35.3	NA	5	NR
PTX10-1014	Fall-94	Trichloroethylene	µg/L	45.6	NA	5	NR
PTX10-1014	Winter-94	Trichloroethylene	µg/L	47.4	NA	5	NR
PTX10-1014	Fall-93	Trichloroethylene	µg/L	51	NA	5	NR
PTX10-1013	Spring-94	Trichloroethylene	µg/L	55.6	NA	5	NR
PTX10-1013	Fall-94	Trichloroethylene	µg/L	59.3	NA	5	NR
PTX10-1013	Winter-94	Trichloroethylene	µg/L	68.1	NA	5	NR
OW-WR-20	Fall-93	Trichloroethylene	µg/L	76	NA	5	NR
PTX10-1013	Fall-93	Trichloroethylene	µg/L	95	NA	5	NR
OW-WR-20	Spring-94	Trichloroethylene	µg/L	95	NA	5	NR
OW-WR-20	Winter-94	Trichloroethylene	µg/L	100	NA	5	NR
OW-WR-20	Fall-94	Trichloroethylene	µg/L	110	NA	5	NR
PTX08-1005	Fall-94	Trichloroethylene	µg/L	260	NA	5	NR
PTX08-1005	Spring-94	Trichloroethylene	µg/L	353	NA	5	NR
PTX08-1005	Winter-94	Trichloroethylene	µg/L	416	NA	5	NR
PTX08-1005	Fall-93	Trichloroethylene	µg/L	617	NA	5	NR
OW-WR-20	1990	Trichloroethylene	µg/L	5	NA	5	
OW-WR-20	1991	Trichloroethylene	µg/L	5	NA	5	
OW-WR-45	1990	Trichloroethylene	µg/L	8	NA	5	
OW-WR-45	1992	Trichloroethylene	µg/L	8	NA	5	
OW-WR-45	1993	Trichloroethylene	µg/L	8	NA	5	
1114-MW1	1994	Trichloroethylene	µg/L	9	NA	5	
OW-WR-45	1991	Trichloroethylene	µg/L	9	NA	5	
OW-WR-45	1994	Trichloroethylene	µg/L	10	NA	5	
1114-MW2	1994	Trichloroethylene	µg/L	15	NA	5	
OW-WR-20	1992	Trichloroethylene	µg/L	22	NA	5	
OW-WR-44	1992	Trichloroethylene	µg/L	22	NA	5	
OW-WR-20	1993	Trichloroethylene	µg/L	93	NA	5	
OW-WR-20	1994	Trichloroethylene	µg/L	150	NA	5	

Constituent abbreviations:

HMX - High melt explosive

RDX - Research development explosive

NA - Not available

NR - Information not reported

Sources: MH 1991; Battelle 1992; Battelle 1993; DOE 1994a; DOE 1995; USCOE 1994a; USCOE 1995; USCOE 1995a

TABLE C.2.2–3.—*Suspected COCs in Pantex Plant Ogallala Aquifer Wells, Groundwater Analysis for 1990 to 1994*

LOCATION	DATE	PARAMETER	UNITS	# OF SAMPLES	VALUE	DECISION CRITERIA	RISK REDUCTION STANDARDS
15-20	1994	Copper	mg/L	2	0.046	1	0.04
15-20	1993	Copper	mg/L	6	0.076	1	0.04
15-20	1990	Copper	mg/L	7	0.28	1	0.04
15-20	1991	Copper	mg/L	2	0.3	1	0.04
15-16	1991	Iron	mg/L	6	0.33	0.3	1.9
OW-WR-40	1993	Iron	mg/L	13	0.53	0.3	1.9
OW-WR-39	1993	Iron	mg/L	13	0.72	0.3	1.9
OW-WR-39	1991	Iron	mg/L	10	0.92	0.3	1.9
OW-WR-40	1991	Iron	mg/L	10	0.97	0.3	1.9
15-26	1991	Iron	mg/L	6	1.1	0.3	1.9
15-26	1992	Iron	mg/L	6	1.1	0.3	1.9
OW-WR-39	1992	Iron	mg/L	10	1.4	0.3	1.9
OW-WR-39	1994	Iron	mg/L	14	1.49	0.3	1.9
OW-WR-40	1990	Iron	mg/L	11	2.1	0.3	1.9
OW-WR-39	1990	Iron	mg/L	11	2.7	0.3	1.9
15-20	1991	Lead	mg/L	2	0.019	0.015	0.1
OW-WR-39	1992	Lead	mg/L	10	0.023	0.015	0.1
OW-WR-39	1993	Lead	mg/L	13	0.029	0.015	0.1
15-20	1992	Lead	mg/L	6	0.031	0.015	0.1
OW-WR-39	1990	Lead	mg/L	11	0.066	0.015	0.1
15-26	1990	Lead	mg/L	5	0.088	0.015	0.1
OW-WR-40	1991	pH		10	8.5	6.5-8.5	NA
OW-WR-39	1990	Zinc	mg/L	11	10	5	30.7

Sources: MH 1991; Battelle 1992; Battelle 1993; DOE 1994a; DOE 1995; USCOE 1994a; USCOE 1995; USCOE 1995a

REFERENCES

42 U.S.C. 6901 — RCRA/Hazardous and Solid Waste Amendments of 1984, 42 United States Code 6901.

Argonne 1995 — Argonne National Laboratory and Battelle Memorial Institute, *Draft RCRA Facility Investigation Report for Groundwater in Zone 12 at the DOE Pantex Plant*, November 1995.

Battelle 1992 — Battelle Pantex and Mason & Hanger-Silas Mason Company, Inc., *Pantex Plant Site Environmental Report for Calendar Year 1991*, prepared by Environmental Monitoring Section Environmental Protection Department, Environment, Safety and Health Division, Amarillo, TX, December 1992.

Battelle 1993 — Battelle Pantex and Mason & Hanger-Silas Mason Company, Inc., *Pantex Plant Site Environmental Report for Calendar Year 1992*, prepared by Environmental Monitoring Section Environmental Protection Department, Environment, Safety and Health Division, Amarillo, TX, December 1993.

DOE 1991 — DOE, *Work Plan RCRA Facilities Investigation,* Volume 1, prepared by the U.S. Army Corps of Engineers, Tulsa District, for the U.S. Department of Energy, Amarillo Area Office, Amarillo, TX, May 1991.

DOE 1994 — DOE, *Risk Reduction Rule Guidance for Pantex Plant RCRA Facility Investigations,* Draft Final, Revision 01, prepared by U.S. Army Corps of Engineers, Tulsa District, and Mason & Hanger-Silas Mason Company, Inc. Battelle Pantex, for the U.S. Department of Energy, Amarillo Area Office Amarillo, TX, April 1994.

DOE 1994a — Mason & Hanger-Silas Mason Company Inc., *1993 Environmental Report fo Pantex Plant,* DOE/AL/65030-9413 UC-702, prepared under contract DE AC09-91AL65030 by Environmental Protection Department, Environmen Safety and Health Division, Amarillo, TX, for U.S. Department of Energy Albuquerque Operations Office, Amarillo Area Office, Amarillo, TX, Jun 1994.

DOE 1995 — Battelle Pantex and Mason & Hanger-Silas Mason Company, Inc., *199 Environmental Report for the Pantex Plant* DOE/AL/65030-9506, prepare under contract DE-AC04-91AL65030, by Environmental Protectic Department, Environment, Safety and Health Division, for U.S. Department Energy, Albuquerque Operations Office, Amarillo Area Office, Amarillo, T June 1995.

DOE Order 5400.5 — DOE, Radiation Protection of the Public and the Environment, Office Environment, Safety, and Health, Washington, DC, 1993.

EPA 1994 — EPA, *Drinking Water Regulations and Health Advisories,* prepared by Office of Water, U.S. Environmental Protection Agency, Washington, DC, M 1994.

EPA 1996 — EPA Region 6, NPDES Permit No. TX0107107, *Authorization to Discharge Under the National Pollutant Discharge Elimination System*, Effective June 1, 1996.

MH 1991 — Mason & Hanger-Silas Mason Company, Inc., *Pantex Plant Site Environment Report for Calendar Year 1990*, MHSMP-91-06, prepared under contract DE-AC04-76DP-00487, by Environmental Monitoring Section, Environmental Protection Department, Environment, Safety and Health Division, Amarillo, TX, July 1991.

MH 1992 — Mason & Hanger-Silas Mason Company, Inc. and Battelle Pantex, *Report of Partial Closure Pantex Plant 11-14 Wastewater Pond*, prepared by Engineering-Science, Inc., Austin, TX, October 1992.

Pantex 1995 — Pantex Environmental Restoration Program, *Draft Aquifer Pumping Test Report for Groundwater Pump and Treat/Soil Vapor Extraction System Pantex Zone 12 Treatability Study*, Amarillo, TX, November 9, 1995.

Pantex 1996a — Pantex Plant, *1995 Environmental Report for Pantex Plant*, DOE/AL/65030-9602, Prepared by the Environmental Protection Department, Environment, Safety and Health Division, Amarillo, TX, May 1996.

PC 1994 — Brady, R. "Well Log Header Information," Memo from R. Brady, Pantex Plant, Amarillo, TX, to M. Lincoln, Battele Pantex, June 30, 1994.

PC 1996 — Jagucki, P., Battelle Pantex Environmental Restoration, Task 4, Regarding Subcontract No. CFF000001, BCO Proposal/Project No. CP0282981G456128, Correspondence From Philip Jagucki To Rodger K. Soderberg, June 14, 1996.

TBEG nd — Texas Bureau of Economic Geology, *Groundwater Input Data from TBEG (Texas Bureau of Economic Geology)*, Austin TX, nd.

TBEG 1992 — Gustavson, T.C., *Moisture Retention and Hydraulic Conductivity of Unsaturated Soils—Preliminary Results*, prepared by the Bureau of Economic Geology, University of Texas, Austin, TX, May 1, 1992.

TBEG 1994 — Mullican, W.F., III, A.E. Fryar and N.D. Johns, *Vertical Transport of Contaminants through Perched Aquifers to the Ogallala Aquifer, Pantex Plant Area, Southern Plains, Texas*, prepared by the Bureau of Economic Geology, University of Texas, Austin, TX, 1994.

TBEG 1995 — Texas Bureau of Economic Geology, *Milestone Report on Potentiometric Surfaces and Vertical Hydraulic Conductivity Measurements for Perched Aquifers at the Pantex Plant, Carson County, Texas*, (Activity No. 4 of Appendix C, Supplement to Scope of Work, 1993–1994) Austin, TX, January 1995.

TBEG 1995a — Texas Bureau of Economic Geology, *Hydrogeologic and Hydrochemical Results from Pumping Tests Conducted at the 11-14 Pond, Pantex Plant, Texas*, Austin, TX, May 1995.

TNRCC 1994 — Texas Natural Resource Conservation Commission, *Drinking Water Standards Governing Drinking Water Quality and Reporting Requirements, 30 TAC 290.101-290.119*, Effective April 15, 1994.

TNRCC 1996 — Texas Natural Resource Conservation Commission, *Permit to Dispose o Wastes Under Provisions of Chapter 26 of the Texas Water Code*, Permit No 02296, Corresponds to NPDES Permit No. TX0107107, Effective June 14 1996.

TWC 1991 — Texas Water Commission, *Permanent Rule Changes, Chapter 307, Texa Surface Water Quality Standards, 307.2-307.10*, Effective July 1991.

USCOE 1991 — U.S. Army Corps of Engineers, *Work Plan RCRA Facility Investigations at AD 1198, ADS 1200, ADS 1203, ADS 1205, ADS 1207, ADS 1212, ADS 1216, AD 1219, ADS 1220, ADS 1222, ADS 1223, ADS 1227, ADS 1230, ADS 123* Volume 1, prepared for the U.S. Department of Energy, Amarillo Area Offic Amarillo, TX, May 1991.

USCOE 1992 — U.S. Army Corps of Engineers, *Hydrogeologic Assessment for the Pant Plant*, Appendix A: Amarillo Well Field Well Registrations and Drillers Log prepared by the U.S. Army Corps of Engineers, Tulsa District, Tulsa, OK, f the U.S. Department of Energy, Pantex Plant, Amarillo, TX, 1992.

USCOE 1994 — Radian Corporation, *Preliminary Recommendations Memorandum for Fl System No. 6, Pantex RCRA Facility Investigation, Ditches and Playas*, Al 1216, prepared under contract RCN 236-045-19-01, for the U.S. Army Corps Engineers, Tulsa District, Tulsa, OK, April 1994.

USCOE 1994a — U.S. Army Corps of Engineers, *Groundwater Monitoring Quarterly Rep November 1993 Sampling Round*, prepared for the U.S. Department of Ener Pantex Plant, Amarillo, TX, April 1994 (Revised June 1994).

USCOE 1995 — U.S. Army Corps of Engineers, *Groundwater Assessment, Monitor Quarterly Report, November 1994 Sampling Round, Preliminary D Package*, prepared for the U.S. Department of Energy, Pantex Plant, Amar TX, May 1995.

USCOE 1995a — U.S. Army Corps of Engineers, *Groundwater Sampling Report, February/ 1994 Sampling Round, Preliminary Data Package*, prepared for the Department of Energy, Pantex Plant, Amarillo, TX, May 1995.

APPENDIX D

Human Health Analysis

APPENDIX D
HUMAN HEALTH ANALYSIS

D.1 INTRODUCTION

The basic approach used in assessing human health impacts was to first identify the affected environments and establish a baseline representing the risk from current operations. This baseline was primarily established from empirical data (e.g., annual environmental reports, occupational incident rates, and worker exposure records). Next, changes in this baseline risk resulting from the Proposed Action, No Action, and Pit Storage Relocation Alternatives were examined to ascertain the human health impacts of the alternatives.

Radiological impacts on human health are an important consideration in establishing the baseline risk and estimating changes to it. The impact of radiation on human health is the topic of section D.2.

Assessing the human health impacts of the alternatives involved a four-step process. The first step was to identify a broad spectrum of potential accident scenarios. These scenarios were obtained from available, site-specific safety and environmental documents.

The second step in the process used screening techniques to identify the specific scenarios that dominate risk (i.e., scenarios that contribute an appreciable fraction of the total risk). This is described in section D.3.

Due to the large number of potential accident scenarios that could impact human health, it is impractical to evaluate all of them in detail. This is a common problem encountered in risk assessments. The standard approach is to apply scoping calculations during the screening step. Rigorous evaluations (the third step in the process) were only performed for the risk-dominant scenarios identified in step two. Section D.4 addresses the methodology used to evaluate the risk dominant scenarios.

The fourth and final step in assessing the human health impact of the alternatives was to evaluate the risk from normal operations (i.e., the risk if no accidents occur). This is the topic of section D.5. Consequence uncertainties in the assessment are the topic of section D.6.

D.2 RADIOLOGICAL IMPACTS ON HUMAN HEALTH

This section addresses the human health impacts resulting from exposure to radiation. The nature of radiation, its effects on human health, and the sources of radiation pertinent to this EIS are examined.

D.2.1 Nature of Radiation and Its Effects on Humans

For a uniform irradiation of the body, the incidence of cancer varies among organs and tissues; the thyroid and skin demonstrate a greater sensitivity than other organs. However, such cancers also produce relatively low mortality rates because they are relatively amenable to medical treatment. Because of the readily available data for cancer mortality rates and the relative scarcity of prospective epidemiologic studies, somatic effects leading to cancer incidence are presented in this EIS. The number of cancer fatalities can be used to compare the risks among the various alternatives.

The National Research Council's Committee on the Biological Effects of Ionizing Radiations has prepared a series of reports to advise the U.S. Government on the health consequences of radiation exposures. The latest of these reports,

Health Effects of Exposure to Low Levels of Ionizing Radiation BEIR V, published in 1990, provides the most current estimates for excess mortality from leukemia and cancers other than leukemia expected to result from exposure to ionizing radiation (NAP 1990). The BEIR V report updates the models and risk estimates provided in the earlier report of the BEIR III Committee published in 1980. BEIR V models were developed for application to the U.S. population.

D.2.1.1 *Risk Estimates for Doses Received During Normal Operation*

For low doses and dose rates, a linear-quadratic model was found to provide a significantly better fit to the data for leukemia than a linear one, and leukemia risks were based on a linear-quadratic function. This reduces the effects by a factor of two over estimates that are obtained from the linear model. For other cancers, linear models were found to provide an adequate fit to the data, and were used for extrapolation to low doses. However, the BEIR V Committee recommended reducing these linear estimates by a factor between 2 and 10 for doses received at low dose rates. For this EIS, a risk reduction factor of two was adopted for conservatism.

Based on the above discussion, the resulting risk estimator would be equal to half the value observed for accident situations or approximately 500 excess fatal cancers per million person-rem (0.0005 excess fatal cancers per person-rem). This is the risk value used in this EIS to calculate fatal cancers to the general public during normal operations. For workers, a value of 400 excess fatal cancers per million person-rem (0.0004 excess fatal cancers per person-rem) is used. This lower value reflects the absence of children in the workforce.

The risk estimates may be applied to calculate the effects of exposing a population to radiation. For example, in a population of 100,000 people exposed only to natural background radiati (0.3 rem per year), 15 latent cancer fatalities f year would be inferred to be caused by t radiation (100,000 persons x 0.3 rem per yea 0.0005 latent cancer fatalities per person-rem 15 latent cancer fatalities per year).

How should one interpret a nonintegral num of latent cancer fatalities, such as 0.05? T answer is to interpret the result as a statisti estimate. That is, 0.05 is the average numbe deaths that would result if a total dose of 0.(rem were applied to many different groups 100,000 people. In most groups, no persor people) would incur a latent cancer fatality fi the 0.001 rem dose each member would h received. In a small fraction of the groups, latent fatal cancer would result; in exception few groups, two or more latent fatal can would occur. The average number of de over all the groups would be 0.05 latent c cancers (just as the average of 0, 0, 0, and 1 4, or 0.25). The most likely outcome is latent cancer fatalities.

These same concepts apply to estimating effects of radiation exposure on a si individual. Consider the effects, for exampl exposure to background radiation ove lifetime. The "number of latent ca fatalities" corresponding to a single indivic exposure over a (presumed) 72-year lifetir 0.3 rem per year is the following:

1 person x 0.3 rem/year x 72 years

0.0005 latent cancer fatalities/person-re

= 0.011 latent cancer fatalities.

Again, this should be interpreted in a stat sense; that is, the estimated effe background radiation exposure on the ex individual would produce a 1.1 percent c that the individual might incur a fatal c caused by the exposure. Presented anothe this method estimates that approximate

percent of the population might die of cancers induced by background radiation.

Although health risk factors are statistical factors, and therefore not strictly applicable to individuals, they have been used in the past to estimate the incremental risk to an individual from exposure to radiation. Therefore, the factor of 0.0005 and 0.0004 per rem of individual committed effective dose equivalent for a member of the public and for a worker, respectively, have also been used in this EIS to calculate the individual's incremental fatal cancer risk from exposure to radiation.

For the public, the health effects expressed in this EIS are the number of fatal cancers to the population within 80 kilometers (50 miles) from exposure to radioactivity released from the site. For workers, the health effects expressed are the risk to the average worker at a site and the number of fatal cancers to all workers at that site.

D.2.2 Sources of Radiation

The sources of radiation pertinent to this EIS can be classified as background (i.e., the radiation to which workers and the public are exposed exclusive of all radiation sources at Pantex Plant and the alternative sites) or site-specific in origin. With respect to background radiation, on the average, Americans receive a total of about 350 millirem per year from all sources of radiation, both natural and man-made. The sources of radiation can be divided into six different categories: cosmic radiation, external terrestrial radiation, internal radiation, consumer products, medical diagnosis and therapy, and other sources. Each category is discussed below.

Cosmic radiation is ionizing radiation resulting from energetic charged particles from space continuously hitting the earth's atmosphere. These particles and the secondary particles and photons they create are cosmic radiation. Because the atmosphere provides some shielding against cosmic radiation, the intensity of this radiation increases with altitude above sea level.

External terrestrial radiation is the radiation emitted from the radioactive materials in the earth's rocks and soils. The average annual dose from cosmic and external terrestrial radiation is about 55 millirem. The cosmic and external terrestrial radiation for the sites in this EIS ranges from about 70 to 120 millirem per year.

Internal radiation arises from the human body metabolizing natural radioactive material which has entered the body by inhalation or ingestion. Natural radionuclides in the body include isotopes of uranium, thorium, radium, radon, polonium, bismuth, potassium, rubidium, and carbon. The major contributor to the annual dose equivalent for internal radioactivity are the short-lived decay products of radon which contribute about 200 millirem per year. The average dose from other internal radionuclides is about 39 millirem per year.

Consumer products also contain sources of ionizing radiation. In some products, like smoke detectors and airport x-ray machines, the radiation source is essential to the products' operation. In other products, such as television and tobacco, the radiation occurs incidentally to the product function. The average annual dose from all consumer products is about 10 millirem.

Radiation is an important diagnostic medical tool and cancer treatment. Diagnostic x-rays result in an average annual exposure of 39 millirem. Nuclear medical procedures result in an average annual exposure of 14 millirem.

There are a few additional sources of radiation that contribute minor doses to individuals in the U.S. The dose from nuclear fuel cycle facilities such as uranium mines, mills and fuel processing plants, nuclear power plants and transportation routes has been estimated to be

less than 1 millirem per year. Radioactive fallout from atmospheric atomic bomb tests, emissions of radioactive material from DOE facilities, emissions from certain mineral extraction facilities, and transportation of radioactive materials contribute less than 1 millirem per year to the average dose to an individual. Air travel contributes approximately 1 millirem per year to the average dose.

The collective (or population) dose to an exposed population is calculated by summing the estimated doses received by each member of the exposed population. This total dose received by the exposed population is measured in person-rem. For example, if 1,000 people each received a dose of 1 millirem (0.001 rem), the collective dose is 1,000 persons x 0.001 rem = 1.0 person-rem. Alternatively, the same collective dose (1.0 person-rem) results from 500 people each of whom received a dose of 2 millirem (500 persons x 2 millirem = 1 person-rem).

Site-specific sources of radiation are industrial sources and sources associated with nuclear weapons. The industrial sources are used to generate x-rays and gamma rays for non-destructive examinations of weapon components. Exposure to these sources of radiation only poses a potential risk to workers. However, since nondestructive examination using x-rays and gamma rays is a well established industrial practice, this contribution to worker risk is negligible.

The sources of radiation associated with nuclear weapons include tritium, uranium, and plutonium. Tritium is a radioactive form of hydrogen. By itself, its effects on human health are relatively modest. However, tritium can combine with hydrogen and oxygen to form a radioactive molecule that chemically mimics ordinary water. In this form tritium is readily assimilated by living tissue, which is subsequently irradiated as the tritium decays. This represents the most toxic form of tritium, and is especially a concern if the relea involves a fire (which converts most of t tritium into the radioactive form of water).

Uranium is present at Pantex Plant both in t enriched and depleted forms. Enriched urani contains a high percentage (up to 93 percent) the 235 isotope, while depleted uranium mostly the 238 isotope. Although uranium toxic, its toxicity is so low relative to plutoni that its relative risk to workers and the publi negligibly small.

Plutonium is present in pits and radioisot thermoelectric generators (RTGs). predominant plutonium isotope in pits is while the 238 isotope is used as the RTG po source. Due to their highly robust design construction, RTGs pose only a negligible to workers and the public.

Plutonium poses two principal human h risks: direct exposure to workers involve disassembly and transportation activities; a potential inhalation hazard to workers an public if it is accidentally released and disp as respirable particles. To be respir plutonium particles must be smaller tha microns. Particles larger than 10 micron too large to disperse deeply into the lungs. result, they have a relatively short resi time and essentially cause no adverse h effects.

Inhaled plutonium particles smaller tha microns are not cleared from the lun normal bodily processes. This results potentially significant alpha dose to the Moreover, the plutonium will eventually the capillaries into the bloodstream. Once bloodstream, the plutonium even accumulates at the interface between har and the marrow. Hence, the two vulnerable organs to plutonium inhalati the lungs and bone marrow. Both worke the public are vulnerable to plu inhalation if an accident occurs that disp as respirable particles (e.g., a fire or expl

Plutonium inhalation is not a concern during normal operations because the plutonium is always contained.

D.3 SCENARIO SCREENING

Ideally, a complete risk assessment would express the total human health risk as the sum of all potential accident scenarios. Since it is impractical to rigorously quantify all of the terms in the ideal summation, the purpose of a screening methodology is to identify a subset of the terms such that the summation over this subset constitutes a large fraction (e.g., >95 percent) of the total risk.

The basic facility risk screening methodology used for the Pantex EIS is explained in section D.3.1. This basic methodology identifies the risk dominant potential accident scenarios that require a rigorous analysis in the EIS. A description of the methodology application is presented in section D.3.2.

D.3.1 Screening Methodology

Ideally, a complete risk assessment would express the total facility risk for a particular endpoint, R_T, as the summation:

$$R_T = \sum_{n=1}^{N} R_n \qquad \text{(Eq. D–1)}$$

where there are a total of N scenarios contributing to the risk. Rather than rigorously quantify all N terms in Equation D–1, the purpose of the screening methodology was to identify a subset of the N terms such that the summation over this subset, N', satisfies the relation:

$$\sum_{n \in N'} R_n \geq F \sum_{n=1}^{N} R_n \qquad \text{(Eq. D–2)}$$

where F is some large fraction (e.g., >0.95).

Three endpoints for which the screening methods were applied are:

- Potential direct exposure of workers or the public to radiation and hazardous chemicals as a result of continued operations or change in mission.
- Risk from an accidental release of radionuclides or hazardous chemicals as a result of continued operations or change in mission.
- Potential latent cancer fatalities as a result of continued operations or change in mission.

The first endpoint required addressing the quantities of radiation and hazardous chemicals to which workers or the public are exposed, regardless of the health effects associated with the exposure. The risk from accidental releases stated in the second endpoint definition is interpreted as the risk of fatalities. Quantifying the second and third endpoints necessitated examining both the amount of exposure and the health effects (in terms of the likelihood of a resultant fatality) associated with the exposure.

Risks associated with potential accident scenarios were quantified using probabilistic risk assessment (PRA) techniques. These techniques expressed risk as the product of two parameters:

λ_n the frequency (per year) that scenario "n" is expected to occur.

C_n the consequence (e.g., fatal cancers) associated with the occurrence of scenario "n".

The screening methodology used to identify risk dominant potential accident scenarios was predicated upon DOE 1994, DOD 1977, Jones 1988, and DH 1993. Essentially, it involved developing a risk matrix that divided the frequency and consequence ranges into a finite number of categories. The selected frequency categories were from criteria tabulated in DOE 1994:

- Anticipated ($\lambda_n \geq 10^{-2}$ per year).
- Unlikely (10^{-2} per year > $\lambda_n \geq 10^{-4}$ per year).
- Extremely unlikely (10^{-4} per year > $\lambda_n \geq 10^{-6}$ per year).
- Not reasonably foreseeable (10^{-6} per year > λ_n).

DOE 1994 does not address consequence categories. However, the consequence categories cited in DOD 1977, Jones 1988, and DH 1993 are:

- Catastrophic (consequences cause deaths).
- Critical (consequences cause severe injuries or occupational illnesses).
- Marginal (consequences cause minor injuries or occupational illnesses).
- Negligible (consequences corresponding to no injuries nor occupational illnesses).

The definitions in DOD 1977, Jones 1988, and DH 1993 include environmental consequences and facility damage. Although these additional consequences exceed the endpoint definitions, any potential accident scenario that can appreciably impact the environment or damage a facility is capable of contributing to the risk of a human receptor and was included in the screening process.

Figure D.3.1–1 depicts the risk matrix developed from these frequency and consequence categories. Since:

$$R_n = \lambda_n \times C_n \qquad \text{(Eq. D–3)}$$

it is evident from Figure D.3.1–1 that for a giv frequency category, the dominant risk scenari are those assigned to the highest consequen category. This resulted in the following ri screening process:

- Identification of anticipated scenari Those facility-specific, hazard-speci scenarios assigned to the high consequence category were selected risk dominant. This consequence v designated category C' (e.g., the margi category).
- Examination of the unlikely scenarios none of these scenarios belonged t consequence category higher than there are no risk dominant scenarios v unlikely frequencies. If some unlil scenarios belonged to a conseque category higher than C', these facil specific, hazard-specific scenarios v also risk dominant. If some unlil scenarios belonged to a conseque category higher than C', then designated this higher conseque category (e.g., the critical category).
- Examination of the extremely unli scenarios. If none of these scen belonged to a consequence cate higher than C', there were no dominant scenarios with extre unlikely frequencies. If some extre unlikely scenarios belonged t consequence category higher thar these facility-specific, hazard-sp scenarios were also risk dominant some extremely unlikely scen belonged to a consequence cat higher than C', than C' designatec higher consequence category.
- Examination of the not reaso foreseeable scenarios. If none of scenarios belonged to a conseq category higher than C', there we

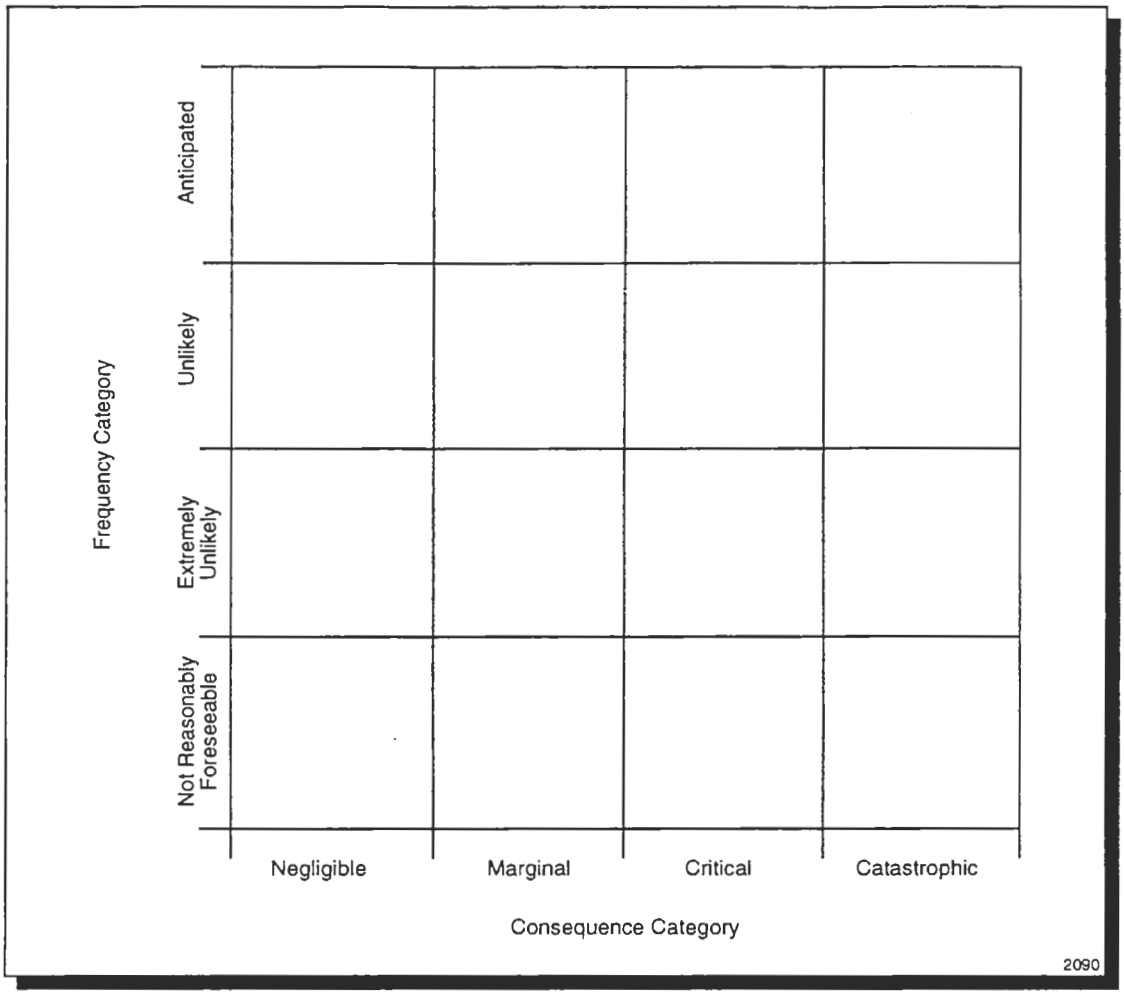


FIGURE D.3.1–1.—*Risk Matrix for Potential Accident Scenario.*

risk dominant scenarios with not reasonably foreseeable frequencies. If some not reasonably foreseeable scenarios belonged to a consequence category higher than C', these facility-specific, hazard-specific scenarios were also risk dominant.

These four steps constitute the process developed for screening risks associated with potential accident scenarios. To the extent practical, frequency categories and consequence categories were assigned using results from applicable risk studies. When applicable PRA results were unavailable, scoping calculations were used to assign scenarios to appropriate frequency and consequence categories.

Figures D.3.1–2 and D.3.1–3 further illustrate the risk screening process. A large X in Figure D.3.1–2 symbolizes that some scenarios have been assigned to a particular risk matrix category. Specifically, Figure D.3.1–2 indicates that:

- All anticipated scenarios have negligible consequences.
- Unlikely scenarios have negligible, marginal, or critical consequences.
- The extremely unlikely scenarios have marginal, critical, or catastrophic consequences.
- All not reasonably foreseeable scenarios belong to either the critical or catastrophic consequence categories.

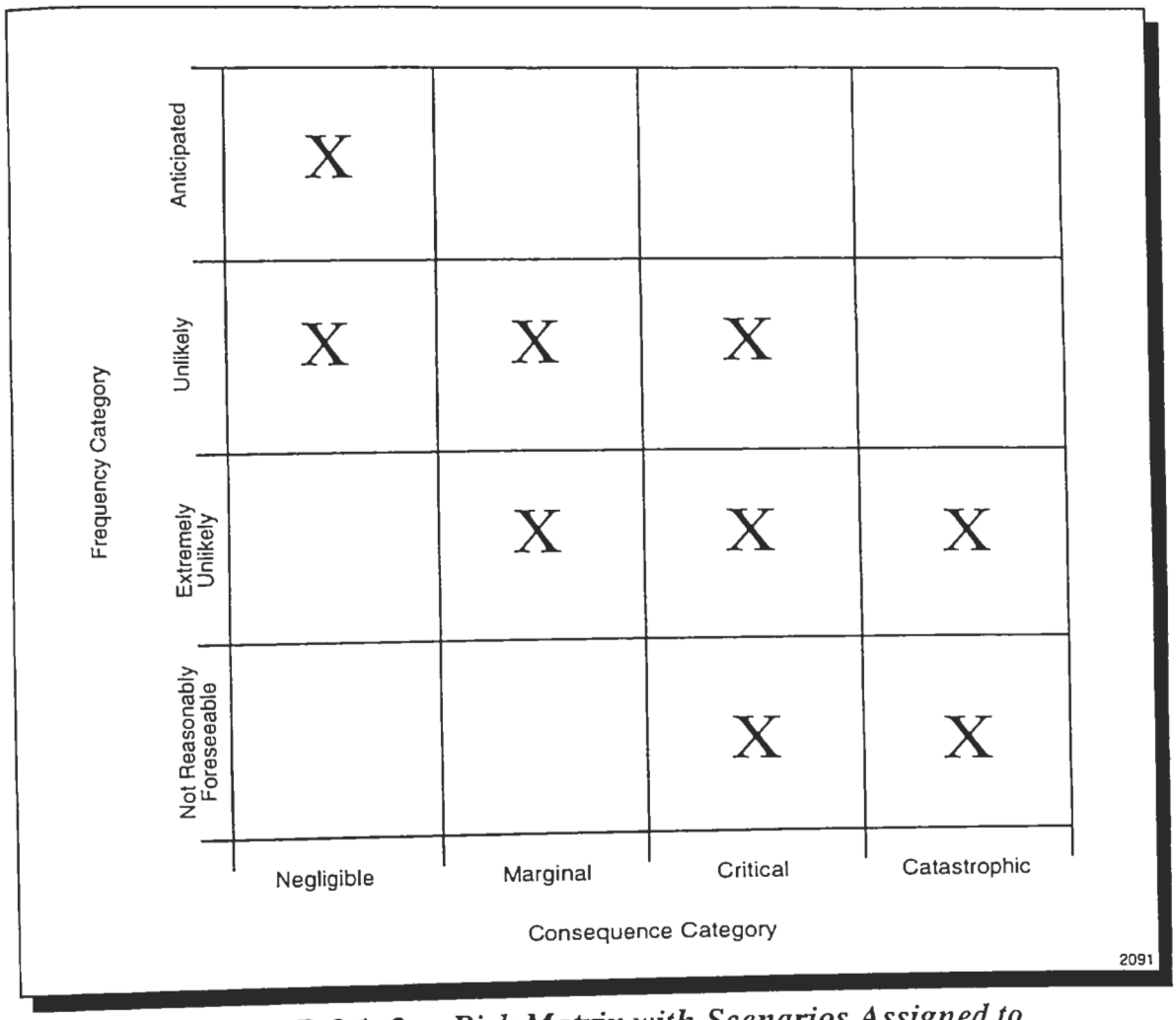


FIGURE D.3.1–2.—***Risk Matrix with Scenarios Assigned to Frequency and Consequence Categories.***

Beginning with the anticipated scenarios, all of them are selected as risk dominant (since they all belong to the same consequence category) using the risk screening process. This selection is depicted by the large circle surrounding the X representing this set of scenarios in Figure D.3.1–3.

Examining the unlikely scenarios disclosed that those assigned to the marginal and critical consequence categories are risk dominant because, even though they are far less likely than the anticipated scenarios, their consequences are greater. However, the unlikely scenarios with negligible consequences are not significant risk contributors. Since each frequency category spans at least two ord magnitude, the frequency of an unl scenario will typically be an order of magr or more less than an anticipated scenario. given an anticipated scenario and an un scenario assigned to the same conseq category, the anticipated scenario ri typically an order of magnitude or more g than the risk from the unlikely scenario.

Applying this same reasoning to the extr unlikely scenarios showed that only thos catastrophic consequences are risk dom None of the scenarios assigned to th reasonably foreseeable frequency catego risk dominant in Figure D.3.1–3.

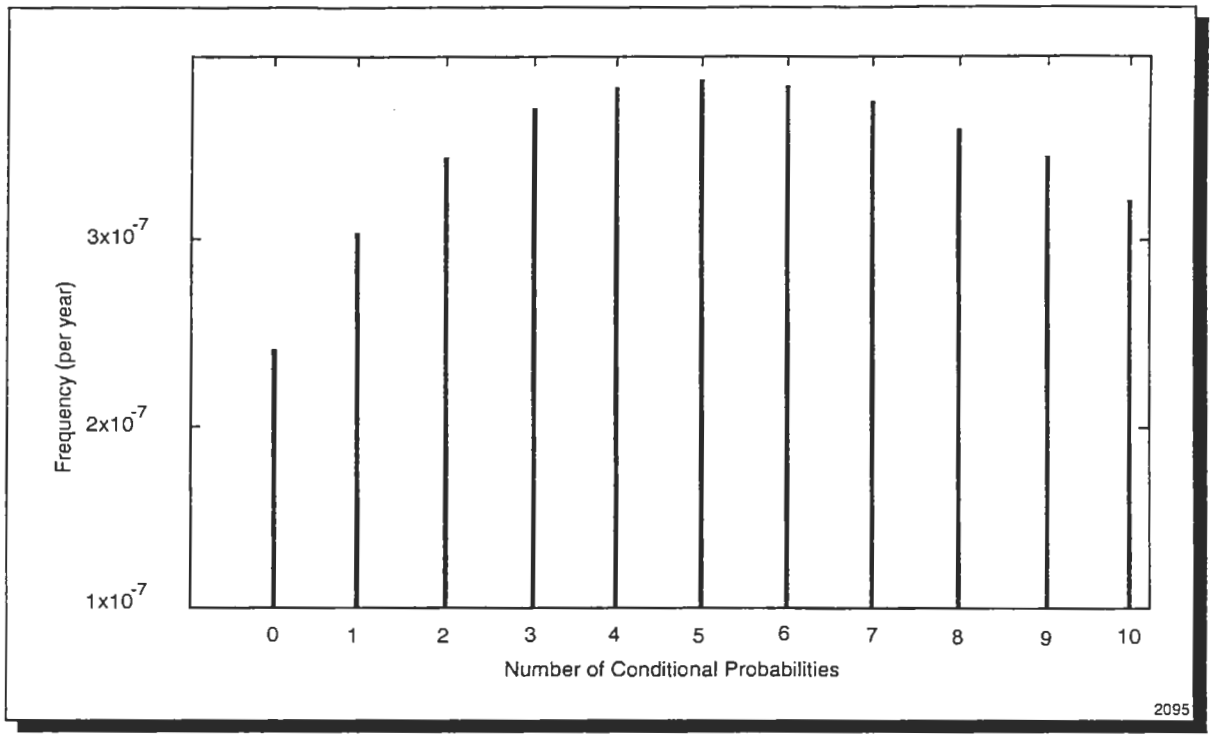


FIGURE D.3.1–4.—*Mean and 95th Percentile for a Product of Probabilities with Uncertainty Factors of 3.*

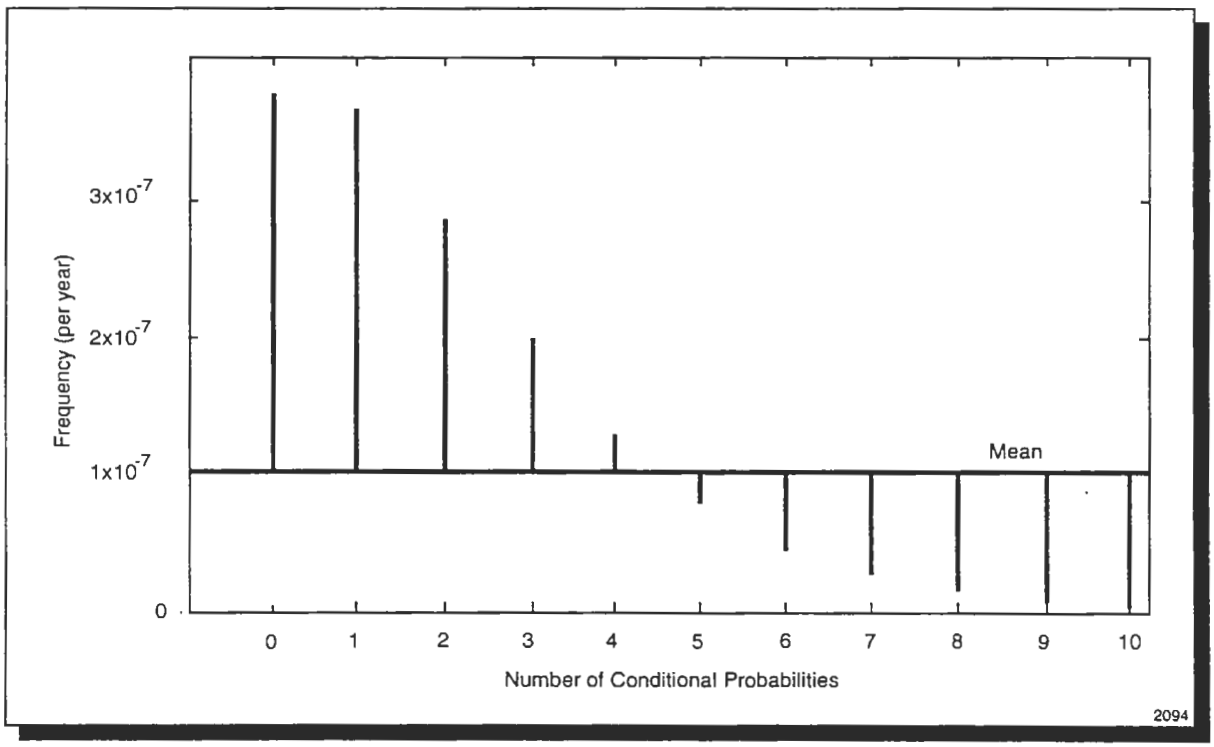


FIGURE D.3.1–5.—*Mean and 95th Percentile for a Product of Probabilities with Uncertainty Factors of 10.*

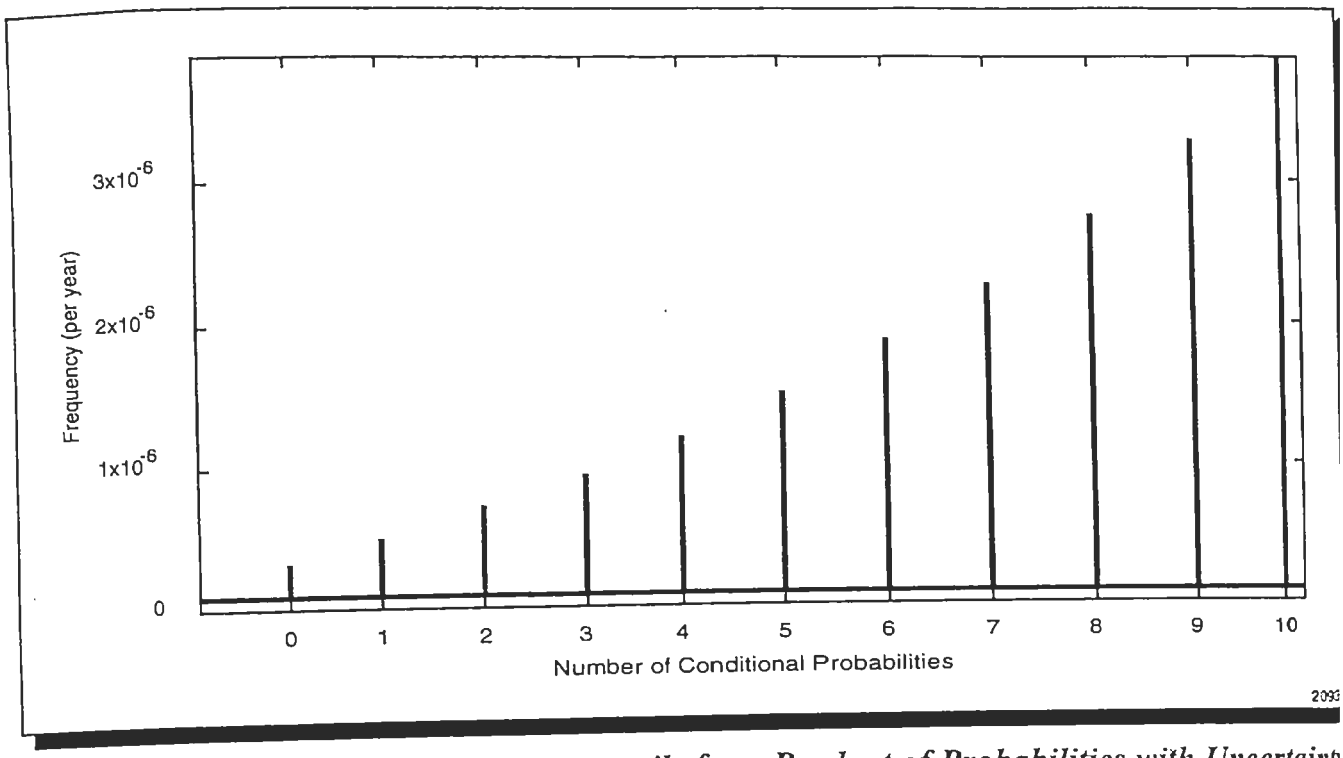


FIGURE D.3.1–6.—*Median and 95th Percentile for a Product of Probabilities with Uncertainty Factors of 3.*

Conclusions obtained from Figures D.3.1–4 through D.3.1–6 are only strictly applicable to situations involving the products of lognormally distributed parameters. Fortunately, such situations are commonly encountered in PRAs. However, caution must be exercised when estimating confidence levels for calculations differing from Equation D–4.

D.3.2 Screening Methodology Application

Table D.3.2–1 contains the risk dominant scenarios for Pantex Plant. These are the scenarios that remained after the section D.3.1 methodology was applied to the candidate scenarios in Table D.3.2–2. Using frequency and consequence estimates from available plant safety and environmental documents, the Table D.3.2–2 scenarios were grouped into the appropriate risk matrix categories. Since it is somewhat difficult to directly compare the consequences of all scenarios togeth candidate scenarios involving radionucli hazards, chemical hazards, and high explosi (HE) hazards were considered separately. T risk dominant scenarios for each of these th hazards appear in Table D.3.2–1 for Pan Plant.

This same process was applied to the alternat sites. Since only relocation of pit storage being considered at these alternative sites, m of the candidate scenarios in Table D.3.2–1 inapplicable. For example, candidate scen C40 in Table D.3.2–2 is applicable to pit stor at an alternative site (although the faci designations in Table D.3.2–2 would have t modified to the appropriate facility at alternative site—e.g., P-Reactor at Savannah River Site). However, candi scenario C2 in Table D.3.2–2 is inapplicab the alternative sites since there will be relocation of tritium. Similarly, candi scenarios involving HE fires and explosior

TABLE D.3.2–1.—*Risk-Dominant Scenarios for Pantex Plant*

SCENARIO	DESCRIPTION
1	HE explosion initiated during normal operation releases tritium and plutonium due to reservoir and pit failure.
2	HE explosion initiated during normal operation without accompanying radionuclide releases.
3	HE explosion initiated by seismic event or aircraft accident releases tritium and plutonium due to reservoir and pit failure.
4	HE explosion initiated by seismic event or aircraft accident without accompanying radionuclide releases.
5	Tritium release resulting from reservoir failure initiated during normal operation.
6	Pit breach with plutonium release initiated during normal operation.
7	Tritium release resulting from reservoir failures caused by a Building 12-42 South Vault fire initiated by a seismic event or aircraft accident.
8	Pit breach with plutonium release caused by seismic event or aircraft accident.
9	Tritium or plutonium release caused by seismic event or aircraft accident.
10	Chlorine release due to failure of system piping and valves, or cylinder caused by seismic event.
11	Chlorine release due to failure of system piping and valves, or cylinder initiated during normal operation.

TABLE D.3.2–2.—*Candidate Accident Scenarios for Pantex Plant*

CANDIDATE SCENARIO	DESCRIPTION[1]
C1	Pit breach with Plutonium release due to operational accidents in 12-64, 12-84, 12-99, and 12-104.
C2	Tritium release due to operational accidents in 12-64, 12-84, 12-99, and 12-104.
C3	Criticality accidents due to operational accidents in 12-64, 12-84, 12-99, and 12-104.
C4	HE explosions due to operational accidents in 12-64, 12-84, 12-99, and 12-104.
C5	HE fires due to operational accidents in 12-64, 12-84, 12-99, and 12-104.
C6	Aircraft initiated accidents involving 12-64, 12-84, 12-99, and 12-104.
C7	Earthquake initiated accidents involving 12-64, 12-84, 12-99, and 12-104.
C8	Tornado and high wind initiated accidents involving 12-64, 12-84, 12-99, and 12-104.
C9	Internal flood initiated accidents involving 12-64, 12-84, 12-99, and 12-104.
C10	Lightning initiated accidents involving 12-64, 12-84, 12-99, and 12-104.
C11	Pit breach with plutonium release due to operational accidents in 12-44, 12-85, 12-96, and 12-98.
C12	Tritium release due to operational accidents in 12-44, 12-85, 12-96, and 12-98.
C13	Criticality accidents due to operational accidents in 12-44, 12-85, 12-96, and 12-98.
C14	HE explosions due to operational accidents in 12-44, 12-85, 12-96, and 12-98.
C15	HE fires due to operational accidents in 12-44, 12-85, 12-96, and 12-98.
C16	Aircraft initiated accidents involving 12-44, 12-85, 12-96, and 12-98.
C17	Earthquake initiated accidents involving 12-44, 12-85, 12-96, and 12-98.

TABLE D.3.2–2.—*Candidate Accident Scenarios for Pantex Plant*-Continued

CANDIDATE SCENARIO	DESCRIPTION[1]
C18	Tornado and high wind initiated accidents involving 12-44, 12-85, 12-96, and 12-98.
C19	Internal flood initiated accidents involving 12-44, 12-85, 12-96, and 12-98.
C20	Lightning initiated accidents involving 12-44, 12-85, 12-96, and 12-98.
C21	Pit breach with Pu release due to operational accidents in 12-26, 12-41, 12-50, 12-60, 12-94, 12-104A; and Bays 27 and 28.
C22	Tritium release due to operational accidents in 12-26, 12-41, 12-50, 12-60, 12-94, 12-104A; and Bays 27 and 28.
C23	Criticality accidents due to operational accidents in 12-26, 12-41, 12-50, 12-60, 12-94, 12-104A; and Bays 27 and 28.
C24	HE explosions due to operational accidents in 12-26, 12-41, 12-50, 12-60, 12-94, 12-104A; and Bays 27 and 28.
C25	HE fires due to operational accidents in 12-26, 12-41, 12-50, 12-60, 12-94, 12-104A; and Bays 27 and 28.
C26	Aircraft initiated accidents involving 12-26, 12-41, 12-50, 12-60, 12-94, 12-104A; and Bays 27 and 28.
C27	Earthquake initiated accidents involving 12-26, 12-41, 12-50, 12-60, 12-94, 12-104A; and Bays 27 and 28.
C28	Tornado and high wind initiated accidents involving 12-26, 12-41, 12-50, 12-60, 12-94, 12-104A; and Bays 27 and 28.
C29	Internal flood initiated accidents involving 12-26, 12-41, 12-50, 12-60, 12-94, 12-104A; and Bays 27 and 28.
C30	Lightning initiated accidents involving 12-26, 12-41, 12-50, 12-60, 12-94, 12-104A; and Bays 27 and 28.
C31	Pit breach with Pu release due to operational accidents in 12-26PV, 12-42SV, 12-42NV, 12-44-8, 12-58 Bays 4 and 5, and 12-116 (Zone 12 Staging).
C32	Tritium release due to operational accidents in 12-26PV, 12-42SV, 12-42NV, 12-44-8, 12-58 Bays 4 and 5, and 12-116 (Zone 12 Staging).
C33	Criticality accidents due to operational accidents in 12-26PV, 12-42SV, 12-42NV, 12-44-8, 12-58 Bays 4 and 5, and 12-116 (Zone 12 Staging).
C34	HE fires due to operational accidents in 12-26PV, 12-42SV, 12-42NV, 12-44-8, 12-58 Bays 4 and 5, and 12-116 (Zone 12 Staging).
C35	Aircraft initiated accidents involving 12-26PV, 12-42SV, 12-42NV, 12-44-8, 12-58 Bays 4 and 5, and 12-116 (Zone 12 Staging).
C36	Earthquake initiated accidents involving 12-26PV, 12-42SV, 12-42NV, 12-44-8, 12-58 Bays 4 and 5, and 12-116 (Zone 12 Staging).
C37	Tornado and high wind initiated accidents involving 12-26PV, 12-42SV, 12-42NV, 12-44-8, 12-58 Bays 4 and 5, and 12-116 (Zone 12 Staging).
C38	Internal flood initiated accidents involving 12-26PV, 12-42SV, 12-42NV, 12-44-8, 12-58 Bays 4 and 5, and 12-116 (Zone 12 Staging).
C39	Lightning initiated accidents involving 12-26PV, 12-42SV, 12-42NV, 12-44-8, 12-58 Bays 4 and 5, and 12-116 (Zone 12 Staging).

TABLE D.3.2–2.—*Candidate Accident Scenarios for Pantex Plant*-Continued

CANDIDATE SCENARIO	DESCRIPTION[1]
C40[2]	Pit breach with plutonium release due to operational accidents in Steel Arch Construction (SAC) and Modified Richmond (MR) magazines (Zone 4 Staging).
C41	Tritium release due to operational accidents in SAC and MR magazines (Zone 4 Staging).
C42[2]	Criticality accidents due to operational accidents in SAC and MR magazines (Zone 4 Staging).
C43	HE explosions due to operational accidents in SAC and MR magazines (Zone 4 Staging).
C44	HE fires due to operational accidents in SAC and MR magazines (Zone 4 Staging).
C45[2]	Aircraft initiated accidents involving SAC and MR magazines (Zone 4 Staging).
C46[2]	Earthquake initiated accidents involving SAC and MR magazines (Zone 4 Staging).
C47[2]	Tornado and high wind initiated accidents involving SAC and MR magazines (Zone 4 Staging).
C48[2]	Internal flood initiated accidents involving SAC and MR magazines (Zone 4 Staging).
C49[2]	Lightning initiated accidents involving SAC and MR magazines (Zone 4 Staging).
C50	HE explosions due to operational accidents in 11-17, 11-22, 11-38, 11-51, 11-55, 11-56, 12-8, 12-19, 12-59, 12-62.
C51	HE fires due to operational accidents in 11-17, 11-22, 11-38, 11-51, 11-55, 11-56, 12-8, 12-19, 12-59, 12-62.
C52	Aircraft initiated accidents involving 11-17, 1-22, 11-38, 11-51, 11-55, 11-56, 12-8, 12-19, 12-59, 12-62.
C53	Earthquake initiated accidents involving 11-17, 11-22, 11-38, 11-51, 11-55, 11-56, 12-8, 12-19, 12-59, 12-62.
C54	Tornado and high wind initiated accidents involving 11-17, 11-22, 11-38, 11-51, 11-55, 11-56, 12-8, 12-19, 12-59, 12-62.
C55	Internal flood initiated accidents involving 11-17, 11-22, 11-38, 11-51, 11-55, 11-56, 12-8, 12-19, 12-59, 12-62.
C56	Lightning initiated accidents involving 11-17, 11-22, 11-38, 11-51, 11-55, 11-56, 12-8, 12-19, 12-59, 12-62.
C57	Chemical hazardous material release due to operational accidents in 11-17, 11-22, 11-38, 11-51, 11-55, 11-56, 12-8, 12-19, 12-59, 12-62.
C58	HE explosions due to operational accidents in 11-20, 11-36, 11-50, 12-17 A and B, 12-63, 12-121.
C59	HE fires due to operational accidents in 11-20, 11-36, 11-50, 12-17 A and B, 12-63, 12-121.
C60	Aircraft initiated accidents involving 11-20, 11-36, 11-50, 12-17 A and B, 12-63, 12-121.
C61	Earthquake initiated accidents involving 11-20, 11-36, 11-50, 12-17 A and B, 12-63, 12-121.
C62	Tornado and high wind initiated accidents involving 11-20, 11-36, 11-50, 12-17 A and B, 12-63, 12-121.
C63	Internal flood initiated accidents involving 11-20, 11-36, 11-50, 12-17 A and B, 12-63, 12-121.
C64	Lightning initiated accidents involving 11-20, 11-36, 11-50, 12-17 A and B, 12-63, 12-121.
C65	HE explosions due to operational accidents in 11-23, 11-25, 11-37, 11-42, 11-45, 11-46, 12-71, 12-92, 12-95.
C66	HE fires due to operational accidents in 11-23, 11-25, 11-37, 11-42, 11-45, 11-46, 12-71, 12-92, 12-95.

TABLE D.3.2–2.—*Candidate Accident Scenarios for Pantex Plant*-Continued

CANDIDATE SCENARIO	DESCRIPTION[1]
C67	Aircraft initiated accidents involving 11-23, 11-25, 11-37, 11-42, 11-45, 11-46, 12-71, 12-92, 12-95.
C68	Earthquake initiated accidents involving 11-23, 11-25, 11-37, 11-42, 11-45, 11-46, 12-71, 12-92, 12-95.
C69	Tornado and high wind initiated accidents involving 11-23, 11-25, 11-37, 11-42, 11-45, 11-46, 12-71, 12-92, 12-95.
C70	Internal flood initiated accidents involving 11-23, 11-25, 11-37, 11-42, 11-45, 11-46, 12-71, 12-92, 12-95.
C71	Lightning initiated accidents involving 11-23, 11-25, 11-37, 11-42, 11-45, 11-46, 12-71, 12-92, 12-95.
C72	Criticality accidents due to operational accidents in 4-45 through 4-75, 12-58, 12-65, 12-83.
C73	HE explosions due to operational accidents in 4-45 through 4-75, 12-58, 12-65, 12-83.
C74	HE fires due to operational accidents in 4-45 through 4-75, 12-58, 12-65, 12-83.
C75	Aircraft initiated accidents involving 4-45 through 4-75, 12-58, 12-65, 12-83.
C76	Earthquake initiated accidents involving 4-45 through 4-75, 12-58, 12-65, 12-83.
C77	Tornado and high wind initiated accidents involving 4-45 through 4-75, 12-58, 12-65, 12-83.
C78	Internal flood initiated accidents involving 4-45 through 4-75, 12-58, 12-65, 12-83.
C79	Lightning initiated accidents involving 4-45 through 4-75, 12-58, 12-65, 12-83.
C80	Pit breach with Pu release due to operational accidents in 12-55.
C81	Cobalt-60 exposure due to operational accidents in 12-55.
C82	Criticality accidents due to operational accidents in 12-55.
C83	HE explosions due to operational accidents in 12-55.
C84	HE fires due to operational accidents in 12-55.
C85	Aircraft initiated accidents involving 12-55.
C86	Earthquake initiated accidents involving 12-55.
C87	Tornado and high wind initiated accidents involving 12-55.
C88	Internal flood initiated accidents involving 12-55.
C89	Lightning initiated accidents involving 12-55.
C90	HE explosions due to operational accidents in 11-5, 11-16, 11-18, Firing sites, 12-21A, 12-32, 12-33, 12-56.
C91	HE fires due to operational accidents in 11-5, 11-16, 11-18, Firing sites, 12-21A, 12-32, 12-33, 12-56.
C92	Aircraft initiated accidents involving 11-5, 11-16, 11-18, Firing sites, 12-21A, 12-32, 12-33, 12-56.
C93	Earthquake initiated accidents involving 11-5, 11-16, 11-18, Firing sites, 12-21A, 12-32, 12-33, 12-56.
C94	Tornado and high wind initiated accidents involving 11-5, 11-16, 11-18, Firing sites, 12-21A, 12-32, 12-33, 12-56.
C95	Internal flood initiated accidents involving 11-5, 11-16, 11-18, Firing sites, 12-21A, 12-32, 12-33, 12-56.
C96	Lightning initiated accidents involving 11-5, 11-16, 11-18, Firing sites, 12-21A, 12-32, 12-33, 12-56.

TABLE D.3.2–2.—*Candidate Accident Scenarios for Pantex Plant*-Continued

CANDIDATE SCENARIO	DESCRIPTION[1]
C97	Criticality accidents due to operational accidents in 12-31.
C98	HE explosions due to operational accidents in 12-31.
C99	HE fires due to operational accidents in 12-31.
C100	Aircraft initiated accidents involving 12-31.
C101	Earthquake initiated accidents involving 12-31.
C102	Tornado and high wind initiated accidents involving 12-31.
C103	Internal flood initiated accidents involving 12-31.
C104	Lightning initiated accidents involving 12-31.
C105	Criticality accidents due to operational accidents in 12-21.
C106	HE explosions due to operational accidents in 12-21.
C107	HE fires due to operational accidents in 12-21.
C108	Aircraft initiated accidents involving 12-21.
C109	Earthquake initiated accidents involving 12-21.
C110	Tornado and high wind initiated accidents involving 12-21.
C111	Internal flood initiated accidents involving 12-21.
C112	Lightning initiated accidents involving 12-21.
C113	Chemical hazardous material release due to operational accidents in 12-21.
C114	HE explosions due to operational accidents in BG-3, BG-4, 12-73 (Disposal).
C115	Aircraft initiated accidents involving BG-3, BG-4, 12-73 (Disposal).
C116	Earthquake initiated accidents involving BG-3, BG-4, 12-73 (Disposal).
C117	Tornado and high wind initiated accidents involving BG-3, BG-4, 12-73 (Disposal).
C118	Internal flood initiated accidents involving BG-3, BG-4, 12-73 (Disposal).
C119	Lightning initiated accidents involving BG-3, BG-4, 12-73 (Disposal).
C120	Criticality accidents due to operational accidents in 12-86.
C121	HE explosions due to operational accidents in 12-86.
C122	HE fires due to operational accidents in 12-86.
C123	Aircraft initiated accidents involving 12-86.
C124	Earthquake initiated accidents involving 12-86.
C125	Tornado and high wind initiated accidents involving12-86.
C126	Internal flood initiated accidents involving 12-86.
C127	Lightning initiated accidents involving 12-86.
C128	Tritium, Plutonium, Uranium releases due to vehicle accidents.
C129	Tritium, Plutonium, Uranium releases due to aircraft initiating accidents involving vehicles.
C130	Tritium, Plutonium, Uranium releases due to severe weather initiating accidents involving vehicles.
C131	HE fires/explosions due to vehicle accidents from differing initiators.
C132	Plutonium dispersion within bay due to weld rod burning through pit during repackaging.

BG - Burning Ground.
[1]Numbers in this column refer to specific buildings.
[2]These scenarios are particularly applicable to the storage pits at the alternative sites.

hazardous chemicals are inapplicable to the alternative sites. Candidate scenarios particularly applicable to pit storage at the alternative sites are footnoted in Table D.3.2–2.

Relative to the hazards considered for Pantex Plant, the only hazardous material applicable to alternative sites is pits. Moreover, the only significant risk to these pits during normal operations is the risk from a forklift accident during transfer operations when the pits are being placed into storage.

All of the external events and natural phenomena considered for Pantex Plant are included in the candidate scenarios for alternative sites. In addition, some site-specific natural phenomena were added. When the relative risks from a forklift accident and candidate scenarios initiated by external events or natural phenomena are compared, the forklift accident is risk dominant at all alternative sites (with the possible exception of earthquakes at Manzano Weapons Storage Area [WSA]).

There are two reasons why forklift accidents are risk dominant at the alternative sites. First, fewer facilities are at risk at the alternative sites than at Pantex. For example, the Zone 4 storage magazines, as well as the Zone 12 bays, cells, and support facilities, are included in the aircraft accident analysis at Pantex Plant. Except for Manzano WSA, the number of facilities at risk, plus the intensity of aircraft traffic (especially aircraft capable of causing facility damage) is significantly higher at Pantex Plant than at the alternative sites.

At Manzano WSA, the rock overburden reduces the likelihood that an aircraft impact could cause a release from the candidate storage facilities to a negligible level (see section E.3.2.2). Therefore, the frequency of a radionuclide release caused by an aircraft impact is significantly lower at the alternative sites. Although the consequences resulting from a radionuclide release initiated by an aircraft impact are potentially greater than the consequences resulting from a forklift accident, the risk (expressed as the product of frequency and consequence) from aircraft impacts at the alternative sites is a small fraction of a percent relative to the risk associated with a forklift accident (with the possible exception of earthquakes at Manzano WSA).

The risk from natural phenomena at Pantex Plant is dominated by earthquakes. This is not a result of potential earthquake damage to storage magazines, but rather is due to the possibility of seismic damage to certain support facilities that were erected in the late 1940's and 1950's (and which could be replaced by proposed facility construction and upgrades at Pantex Plant as described in appendix H). In terms of relative risk, the contribution to the risk at Pantex Plant from external events that threaten the Zone 4 storage magazines is negligible. With respect to pit storage, this low relative risk is due to the robust construction of the magazines and the integrity of the AT–400A shipping containers. A similar situation exists at the alternative storage sites, and is the second reason why forklift accidents are risk dominant at the alternative sites (with the possible exception of earthquakes at Manzano WSA). Figure D.3.2–7 illustrates this concept.

Occurrence of an external event or natural phenomenon is the initiating event in Figure D.3.2–7. Given that the initiating event occurs, a release from the stored pits is only possible if facility damage results from the initiating event. None of the facilities being considered at the alternative sites are vulnerable to external events or natural phenomenon that are within their design basis. Moreover, even for external events or natural phenomenon that exceed the design basis (a low probability event), the onset of facility damage is typically insufficient to breach the AT–400A shipping containers. Of the natural phenomena capable of causing significant facility damage (if the design basis is sufficiently exceeded), earthquakes are the most likely to cause a significant release (relative to other natural phenomena). For this reason,

earthquakes are the risk dominant natural phenomena at the alternative sites.

Preliminary test results demonstrate that an AT–400A shipping container can survive the impact of a half ton mass dropped from a height of 110 feet without any loss of containment capability (PC 1995). Thus, even if the external event or natural phenomenon induced facility damage is severe, there is a high probability that the containers will remain intact. In the context of Figure D.3.2–7, the frequency of a plutonium release is well into the not reasonably foreseeable range defined in section D.3.1. Although the consequences of a plutonium release initiated by an external event or natural phenomenon are potentially high, the relative risk from such scenarios is negligible because of the low frequency that the release can occur.

D.4 Evaluation of Risk-Dominant Scenarios

Both high frequency, low consequence scenarios (such as those occurring during normal operations), and low frequency scenarios having potentially high consequences (i.e., scenarios initiated by natural phenomena or external hazards), are included in Table D.3.2–1. These scenarios were left when the methodology discussed in section D.3 was applied to the Pantex Plant scenarios of Table D.3.2–2. For all scenarios, the frequency and consequence assessments were performed on a site-wide, rather than a facility-specific, basis. This means, for example, that the frequency of a hazardous material release involving a specific handling operation was estimated by first quantifying the probability, per handling operation, that the accident occurs and then multiplying that probability by the total number of handling operations performed annually on site. If the particular handling operation (e.g., involving weapon disassembly) is performed in several separate facilities, then the release frequency incorporates the contribution from all of the individual handling facilities. However, since handling operations typically involve only a single hazardous material unit at a time (e.g., just one pit or one tritium reservoir), the consequences were generally quantified using the release from a single, standard unit in an intact facility (unless the scenario involved an HE explosion).

Aircraft accidents (the risk dominant external hazard for all sites) were modeled somewhat differently. Due to the proximity of Zones 4 and Zone12 to established flight paths and their high inventory of radionuclides, the site-wide risk from aircraft accidents at Pantex Plant is

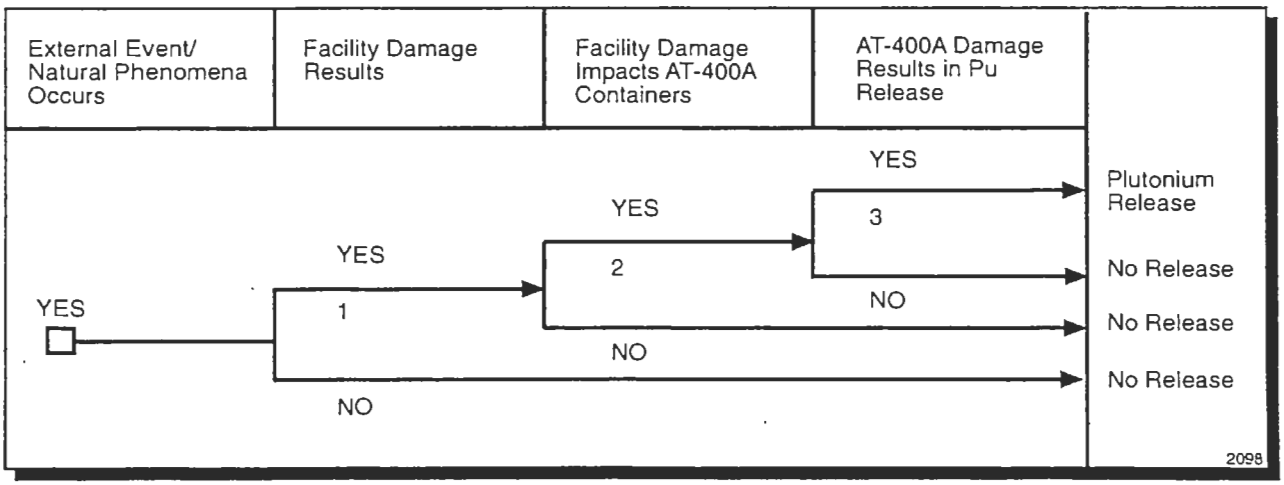


Figure D.3.2–7.—*External Event/Natural Phenomena Event Tree for Pits Stored in AT–400A Shipping Containers.*

governed by these zones. The material at risk from an aircraft accident is the inventory of the facility damaged by the impact. This differs from the consequences of most handling accidents (without an HE detonation) in that, in an aircraft accident, multiple units are involved and the facility can be extensively damaged. For alternative storage sites, the material at risk from an aircraft accident includes the inventory of the alternative pit storage facility.

Earthquakes are the risk dominant natural phenomena for all sites. All of the facilities that contain potentially risk significant quantities of hazardous materials were examined in the Pantex Plant seismic assessment. A unique aspect of this seismic assessment is that all site facilities would be simultaneously subjected to seismic stresses, given that an earthquake occurs. Hence, unlike handling and aircraft accidents, seismic events are truly site-wide and can result in releases from multiple facilities. For alternative storage sites, the material at risk from an earthquake is the inventory of the alternative pit storage facility.

D.4.1 Frequency Assessment

Quantifying the frequencies of risk-dominant scenarios required three distinct types of assessments addressing:

- Internal initiators.
- Aircraft accidents.
- Earthquakes.

The frequency assessment of internal initiators relied almost exclusively on published site-specific, accident-specific safety analyses (see references cited in volume I, section 4.14.2.1 and individual scenario descriptions). The basic methodology equated the scenario frequency to the frequency that an operation is performed (e.g., 2,000 disassemblies per year), multiplied by the probability that an operational error would result in a hazardous material release (e.g., the probability, per disassembly, that an operational error would cause a tritium o plutonium release).

For example, the explosive-driven plutoniu dispersal from an internal event (Scenario 1 could result from operations conducted in bay cells, and special purpose facilities. Th probability (per operation) that an operation error would cause an explosive-drive plutonium release was estimated for eac facility using data from available safet analyses. The frequency (per year) wa quantified by multiplying the probability (pe operation) by the annual number of operation in each facility, and then summing the results.

Appendix E describes the methodology used fo assessing the frequency of aircraft accidents.

The frequency of hazardous material release initiated by earthquakes is predicated upon methodology developed in the DOE Standar for *Natural Phenomena Hazards Design an Evaluation Criteria for Department of Energ Facilities* (DOE 1994:C-8, C-9, C-25 Conceptually, the earthquake assessmer methodology considers two parameters:

- Frequency, per year, that earthquakes o different intensities occur.
- Probability of facility failure (e.g building collapse) given an earthquak with a particular intensity.

For a given earthquake intensity, the product o the earthquake frequency and facility failur probability is the frequency, per year, th earthquakes with the specified intensity woul cause the facility to fail. By summing thes products over the entire range of earthquak intensities, an overall frequency for earthquak induced facility failure is obtained. This basi methodology was directly applicable t earthquakes at the alternative storage sites.

Multiple facilities are at risk from earthquake at Pantex Plant. For the Pantex Plar assessment, it was necessary to multiply th

earthquake frequency by the probability that just one, two, or a specified number of facilities fail in order to determine the frequency, per year, that earthquakes with the specified intensity would cause various combinations of facilities to fail. For a given combination of facility failures, summing these products over the entire range of earthquake intensities gave the overall frequency for earthquake induced facility failures. Considering the overall frequency of multiple facility failures was necessary to quantify the total risk from earthquakes, which threaten all of the facilities onsite.

Facility failure would not necessarily result in a hazardous material release (e.g., it is extremely difficult for a facility failure to breach a shipping container). Using a methodology similar to the one applied for internal initiators, the scenario frequency was determined by multiplying the facility failure frequency (due to an earthquake) by the probability the failure would result in a hazardous material release. For Scenario 7 in Table D.3.2–1, the scenario frequency was determined by multiplying the facility failure frequency (due to an earthquake) by the probability that the failure would result in a fire that would damage the 12–42 South Vault tritium reservoirs.

D.4.2 Radiological Consequence Assessment

Two computer codes were used to assess the consequences of a radionuclide release:

- Melcor Accident Consequence Code System (MACCS) (NRC 1990a, NRC 1990b, NRC 1990).
- Explosive Release Atmospheric Dispersion (ERAD) (DOE 1992).

ERAD was used to quantify the consequences from scenarios in which the radionuclides are dispersed into the atmosphere explosively (i.e., by an HE detonation). All other scenarios involving a radionuclide release were quantified with MACCS. Descriptions of both codes follow.

D.4.2.1 *Application of the Melcor Accident Consequence Code System*

The MACCS computer code models the offsite consequences of an accident that releases a plume of radioactive materials to the atmosphere (NRC 1990a; NRC 1990b; NRC 1990). Should such an accidental release occur, the radioactive gases and aerosols in the plume would be transported by the prevailing wind while dispersing in the atmosphere. The environment would be contaminated by radioactive materials deposited from the plume and the population would be exposed to radiation. The MACCS calculation estimates the range and probability of the health effects induced by radiation exposures (that are not avoided by protective actions). There are two fundamental aspects of the organization of MACCS which are basic to its understanding: the time scale after the accident is divided into various "phases" and the region surrounding the site is divided into a polar-coordinate grid.

The time scale after the accident is divided into three phases: emergency phase, intermediate phase, and long-term phase. The emergency phase begins immediately after the accident and could last up to 7 days following the accident. In this period, the exposure of population to both radioactive clouds and contaminated ground is modeled. Various protective measures can be specified for this phase, including evacuation, sheltering, and dose-dependent relocation.

The intermediate phase is used to represent a period in which evaluations are performed and decisions are made regarding the type of protective actions that need to be taken. In this period, the radioactive clouds are assumed to be gone and the only exposure pathways are those

from the contaminated ground. The protective measure which can be taken during this period is temporary relocation.

The long-term phase represents all time subsequent to the intermediate phase. The only exposure pathways considered here are those resulting from the contaminated ground. A variety of protective measures can be taken in the long-term phase in order to reduce doses to acceptable levels: decontamination, interdiction, and condemnation of property.

The spatial grid used to represent the region is centered on the facility itself. The user specifies the number of radial divisions as well as their endpoint distances. Up to 35 of these divisions may be defined, extending out to a maximum distance of 9,999 kilometers (6,200 miles). The angular divisions used to define the spatial grid correspond to the 16 directions of the compass.

The emergency phase calculations use dose-response models for early fatality and early injury and are performed on a finer grid than the calculations of the intermediate and long-term phases. For this phase, the 16 compass sectors are divided into 3, 5, or 7 user-specified subdivisions in the calculations.

For the analysis of high consequence accidents at the different facilities, the MACCS calculations used the source term data and modeled the dispersion and deposition of radionuclides released from facilities to the atmosphere with a straight-line Gaussian plume. Plume rise and dry and wet deposition were taken into consideration. One year of hourly onsite meteorological data and a weather bin sampling technique were used to represent the dispersion process according to each site's characteristic weather. Downwind concentrations of radionuclides up to a distance of 80 kilometers (50 miles) were calculated for each of 16 directional sectors around the facility.

Radiation doses to an offsite population were calculated in the dosimetry models using the concentrations of radionuclides obtained from the dispersion models. Exposure pathways considered in MACCS for calculating doses received during the period following an accident were direct radiation from the passing plume and from radioactive material deposited on the ground, inhalation from the plume, deposition on skin, and inhalation of resuspended ground contamination. Long-term exposure pathways and liquid exposure pathways were not considered. No credit was taken for short-term actions such as evacuation, sheltering, and relocation.

Resuspension of particulate matter that has settled out of the plume is explicitly modeled in MACCS. The inhalation dose of the emergency phase from the resuspended radionuclides after passage of a plume segment is calculated for each of the fine spatial elements using the following equation:

$$DR_k = \left[\sum_i GC_i \cdot DFI_{ik}\right] \cdot BR \cdot J \cdot RF \cdot SFI \qquad \text{(Eq. D-6)}$$

where:

DR_k = Resuspension inhalation dose (Sv) to organ "k" after passage of a plume segment over a fine spatial element.

GCi = ground concentration (Bq/m^2) of radionuclide "i" under the plume center line at the time that plume leaves the fine spatial element, calculated by the ATMOS module.

DFI_{ik} = inhalation dose conversion factor (Sv/Bq inhaled) to organ "k" for radionuclide "i", MACCS Dose Conversion Factors File.

BR = breathing rate (m^3/s), user-specified.

J = off-center line correction factor (dimensionless), of the fine spatial element.

RF = time-integrated resuspension factor (s/m) defined below.

SFI = inhalation shielding factor (dimensionless), specified by user.

The resuspension factor, RF, is calculated using the following equation:

$$RF = RC \cdot \int_{t_1}^{t_2} e^{-\lambda t} dt = RC \cdot \left(e^{-\lambda t_1} \cdot e^{-\lambda t_2}\right)/\lambda \qquad \text{(Eq. D–7)}$$

where:

RC = the resuspension coefficient that relates ground concentration to air concentration (m^{-1}); user-specified.

λ = the natural log of 2 divided by the resuspension half-life (s^{-1}); user-specified.

t_1 = the time from plume departure to the entrance of the individual into the spatial element (s).

t_2 = the time from plume departure to the departure of the individual from the spatial element (s).

In addition, the chronic exposure model calculates doses from inhalation of resuspended radionuclides. These doses are calculated for all inhabitants living in areas that are not permanently interdicted.

The resuspension inhalation dose of the intermediate or long-term phase for a given time period is calculated for each of the coarse spatial elements using the following equation:

$$DR_k = \sum_i GC_i \cdot DFR_{ik} \cdot SFI \qquad \text{(Eq. D–8)}$$

where:

DR_k = resuspension inhalation dose (Sv) to organ "k" in a spatial element for a given time period.

GC_i = Initial ground concentration (Bq/m^2) of radionuclide "i" in a spatial element.

DFR_{ik}= resuspension inhalation dose factor ($Sv\text{-}m^2/Eq$) to organ "k" for radionuclide "i" for a given time period, defined below.

SFI = inhalation shielding factor (dimensionless).

For the intermediate and long-term phases, the inhalation shielding factor for normal activity (user-specified) is used in the resuspension inhalation dose calculation.

The computation of the resuspension dose factor, DFR_{ik}, for a specific time period t_1 to t_2 requires the evaluation of the following function:

$$DFR_{ik} = BR \cdot DFI_{ik} \cdot \int_{t_1}^{t_2} \left(e^{-\lambda t} \cdot Rw(t)\, dt\right) \qquad \text{(Eq. D–9)}$$

where:

DFI_{ik} = inhalation dose conversion factor (Sv/Bq inhaled) of either acute or lifetime dose to organ "k" for

radionuclide "i", MACCS Dose Conversion Factors File.

BR = breathing rate (m^3/s).

λ_i = decay constant (s^{-1}) of radionuclide i.

Rw(t) = resuspension weathering function, defined below.

If a radionuclide decays to a radioactive daughter, the resuspension inhalation dose resulting from the daughter is added to the resuspension inhalation dose of the parent radionuclide.

The resuspension weathering equation is a multi-term exponential decay function:

$$Rw(t) = \sum_{m=1}^{3} \left(RC_m \cdot e^{-\lambda_m t} \right)$$

(Eq. D–10)

where:

RC_m = resuspension weathering coefficient (m^{-1}) for the m-th term

λ_m = resuspension weathering decay constant (s^{-1}) for the m-th term

D.4.2.2 *Application of the Explosive Release Atmospheric Dispersion Computer Code*

The ERAD code was developed by Sandia National Laboratories (DOE 1992). ERAD provides a three-dimensional numerical simulation for the dispersal of gaseous and particulate airborne source materials in which initial cloud dynamics, turbulent diffusion, and buoyancy effects coupled with elevation-dependent physical and thermodynamic properties of the plume are considered. ERAD's meteorological component implements state-of-the-art scaling derived from Monin-Obukhov similarity theory to model turbulent velocity profiles in the planetary boundary layer. Particle dispersion and depletion are modeled as stochastic processes and simulated using a discrete-time Lagrangian Monte Carlo algorithm. Several thousand individual particle trajectories are traced to determine respirable dosage and deposition contours over the affected area. Particulate resuspension is not modeled in ERAD.

ERAD was developed to give real-time predictions, using field-portable computers, of the radiological hazards resulting from accidents arising in the storage and transportation of nuclear materials and possible acts of terrorism. Actual meteorological data are input to ERAD to model surface friction, thermal turbulence, and mixing height of the planetary boundary layer. These parameters include:

- Effective surface roughness length.
- Relative humidity and atmospheric pressure.
- Vertical profiles of atmospheric temperature, wind direction, and speed.

The menu-driven code has an extensive health physics library that allows the user to select specific radionuclides. Downwind consequences of different types of atmospheric releases of radioactive materials may be analyzed by three programs:

- Non-buoyant—continuous or puff releases.
- Detonation—releases resulting from the detonation of chemical high explosive.
- Fire Plume—continuous releases resulting from fuel fires.

The fire plume model for the ERAD code is currently undergoing verification and was not used for calculations in this EIS.

TABLE D.4.2.2–2.—*Representative and Upper Bound Radiological Consequences to the Non-Involved Worker from Risk-Dominant Scenarios*[1]

SCENARIO	EXPOSURE (PERSON-REM)		FATAL CANCERS	
	REPRESENT-ATIVE	UPPER BOUND	REPRESENT-ATIVE	UPPER BOUND
Pantex 1	2×10^3 (6×10^2)[2]	5×10^3 (1×10^3)[2]	9×10^{-1} (2×10^{-1})[2]	1 (6×10^{-1})[2]
Pantex 3	40 (30)[2]	50 (50)[2]	2×10^{-2} (1×10^{-2})[2]	2×10^{-2} (2×10^{-2})[2]
Pantex 5	3×10^{-1}	5×10^{-1}	1×10^{-4}	2×10^{-4}
Pantex 6	4×10^{-3}	9×10^{-3}	1×10^{-6}	4×10^{-6}
Pantex 7	50	4×10^2	2×10^{-2}	2×10^{-1}
Pantex 8	3×10^3	6×10^3	1	1
Pantex 9	4	9	1×10^{-3}	4×10^{-3}
Nevada Test Site (Handling Accident)	6×10^{-2}	2×10^{-1}	3×10^{-5}	8×10^{-5}
Savannah River Site (Handling Accident)	5×10^{-2}	1×10^{-1}	2×10^{-5}	6×10^{-5}
Manzano WSA (Handling Accident)	5×10^{-2}	1×10^{-1}	2×10^{-5}	6×10^{-5}
Hanford Site (Handling Accident)	6×10^{-5}	2×10^{-4}	3×10^{-8}	6×10^{-8}

[1]The risk to close-in workers from Scenarios 1 and 3 is dominated by HE blast effects. The risk to more distant workers (i.e., beyond the range where human health effects are dominated by the blast) contain large uncertainties associated with evacuation and/or sheltering. The consequences cited in Table D.4.2.2–2 are conservative in that they ignore both evacuation and sheltering.
[2]Values in parentheses are for Configuration 2, as described in section 4.14.2.1 of Volume I.

conditions and then identifies the mean and upper bound consequences.

ERAD lacks the Monte Carlo capabilities of MACCS. For ERAD calculations, the typical consequences cited in Tables D.4.2.2–1 and D.4.2.2–2 use mean meteorological parameters obtained from upper air soundings recorded at the Amarillo International Airport. Upper bound consequences obtained from ERAD are for upper bound meteorological conditions being used in developing Pantex Plant safety documents.

For example, the consequence of Scenario 1 is the arithmetic mean for the consequences associated with explosive driven plutonium releases from internal events in bays, cells, and special purpose facilities. This involved three sets of calculations. First, consequences were calculated for the case in which Scenario 1 occurs in a bay. Next, consequences were calculated for the case in which Scenario 1 occurs in a cell. Finally, consequences (both the exposure and excess fatal cancers) were calculated for the case in which Scenario 1 occurs in a special purpose facility.

The arithmetic mean of these consequences is the probability that Scenario 1 occurs in a bay, multiplied by the consequences of the case in which Scenario 1 occurs in a bay; plus the probability that Scenario 1 occurs in a cell, multiplied by the consequences for the case in which Scenario 1 occurs in a cell; plus the probability that Scenario 1 occurs in a special purpose facility, multiplied by the consequences for the case in which Scenario 1 occurs in a special purpose facility. The probability used

for each facility was the ratio of the frequency (i.e., the probability per operation that an error causes a release from the facility, multiplied by the annual number of operations in the facility) that Scenario 1 occurs in the facility, divided by the frequency of Scenario 1 (i.e., 1.1×10^{-5} per year.)

Tables D.4.2.2–1 and D.4.2.2–2 give the representative and upper bound consequences for each risk dominant scenario that involves a radionuclide release. Table D.4.2.2–3 gives the source terms (i.e., curies of respirable plutonium and tritium released to the atmosphere as a result of a potential accident) used to quantify the representative public and non-involved worker consequences in Tables D.4.2.2–1 and D.4.2.2–2. The source term used for a handling accident at an alternative site is 9.2×10^{-5} curies of plutouium.

Table D.4.2.2–4 gives the representative upper bound consequences to the maximally exposed offsite individual for each risk dominant scenario that involves a radionuclide release. This hypothetical individual is located at the site boundary closest to the radiological release. The wind is assumed to blow the radiological release directly towards this individual. For scenarios such as Scenario 1 in which more than one facility has been modeled, results for the facility giving the highest consequence at the site boundary are presented in Table D.4.2.2–4.

The fatal cancer consequences presented in Table D.4.2.2–1 are the excess fatal cancers expected to occur over a 50-year period following the accident in the population in the Region of Influence (ROI). For Pantex Plant, the population in the ROI is 267,107 people. As stated previously, 20 percent of this population is expected to succumb to fatal cancer from all other causes ($0.2 \times 267{,}107 = 5.3 \times 10^4$ fatal cancers). For the fatal cancer consequences presented in Table D.4.2.2–2, the non-involved worker is defined as a receptor 100 meters (328 feet) downwind from the release point, along the plume center line.

Table D.3.2–1 identifies Scenarios 1 and 3 as involving radionuclide releases associated with HE explosions. In Scenario 1, the HE explosion is initiated during normal operations. A seismic event or aircraft accident initiates the HE explosion considered in Scenario 3.

Sensitivity studies using ERAD disclose that the consequences of scenarios involving HE explosions vary with the ratio of plutonium to HE. In assessing the consequences presented in Tables D.4.2.2–1 and D.4.2.2–2, the ratio of plutonium to HE was varied to determine the maximum consequences to the public.

TABLE D.4.2.2–3.—*Representative Source Terms*

SCENARIO	Pu RELEASE (Ci)	TRITIUM RELEASE (Ci)
Pantex 1	300 (270)[1]	3.0×10^5 (3.0×10^5)[1]
Pantex 3	9.4×10^3 (4.0×10^3)[1]	2.5×10^5 (2.5×10^5)[1]
Pantex 5	0	1.8×10^5
Pantex 6	1.8×10^{-5}	0
Pantex 7	0	4.0×10^7
Pantex 8	50	0
Pantex 9	1.2×10^{-2}	3.0×10^5

[1]Values in parentheses are for Configuration 2, as described in section 4.14.2.1 of Volume 1.
Ci - Curie

TABLE D.4.2.2–4.—*Representative and Upper Bound Radiological Consequences to the Maximally Exposed Offsite Individual from Risk-Dominant Scenarios*

SCENARIO	EXPOSURE (REM)		FATAL CANCERS	
	REPRESENT-ATIVE	UPPER BOUND	REPRESENT-ATIVE	UPPER BOUND
Pantex 1	50 (30)[1]	100 (80)[1]	2×10^{-2} (2×10^{-2})[1]	7×10^{-2} (4×10^{-2})[1]
Pantex 3	60 (30)[1]	1×10^{2} (80)[1]	3×10^{-2} (2×10^{-2})[1]	6×10^{-2} (4×10^{-2})[1]
Pantex 5	1×10^{-2}	4×10^{-2}	5×10^{-6}	2×10^{-5}
Pantex 6	1×10^{-4}	3×10^{-4}	5×10^{-8}	1×10^{-7}
Pantex 7	7×10^{-1}	5	4×10^{-4}	3×10^{-3}
Pantex 8	30	60	2×10^{-2}	3×10^{-2}
Pantex 9	2	3	1×10^{-3}	2×10^{-3}
Nevada Test Site (Handling Accident)	4×10^{-5}	1×10^{-4}	2×10^{-8}	5×10^{-8}
Savannah River Site (Handling Accident)	1×10^{-5}	3×10^{-5}	5×10^{-9}	1×10^{-8}
Manzano WSA (Handling Accident)	2×10^{-3}	5×10^{-3}	8×10^{-7}	3×10^{-6}
Hanford Site (Handling Accident)	5×10^{-8}	1×10^{-7}	3×10^{-11}	6×10^{-11}

[1]Values in parentheses are for Configuration 2, as described in section 4.14.2.1 of Volume I.

The impacts of accidents presented are meant to bound the consequences that would occur in the unlikely event of a serious accident at Pantex Plant. For example, the upper bound dose to the maximally exposed offsite individual (MEOI) from the bay explosion event within Scenario 1 varies significantly based on the high explosive charge to plutonium mass ratio of specific weapon systems that could be present in bays. When the upper bound MEOI dose is calculated for differing charge to mass ratios, the MEOI dose varies from 6 rem to approximately 100 rem (DOE 1996i). The upper bound dose numbers for the MEOI presented in Table D.4.2.2–4 are based on the worst case weapon system for MEOI exposures and as such bound the consequence from an accident involving the majority of weapons systems that could be present within the bays.

The representative consequences cited in Tables D.4.2.2–1 and D.4.2.2–2 were used for scenario screening and estimating risk. These typical values are utilized because they correspond to a greater level of human health risk than the upper bound values (which are included to indicate uncertainty levels). Except for Scenario 3, the representative and upper bound consequence assessments in Tables D.4.2.2–1 and D.4.2.2–2 rely on the MACCS software described in section D.2.1.2. Based on the Monte Carlo sampling used in MACCS, the probability of a potential accident scenario actually producing consequences equal to or exceeding the upper bound value is less than 0.05 (i.e., one chance in twenty). Thus, the frequency of an accident corresponding to the upper bound consequences is about a factor of 20 below the expected accident frequency.

Consider the first Pantex Plant scenario in Table D.4.2.2–1. If λ_1 denotes its expected frequency and $R_{T,1}$ represents its representative risk, then:

$$R_{T,1} = 1 \times 10^3 \lambda_1 \left(\frac{\text{person-rem}}{\text{year}}\right)$$

(Eq. D–11)

However, the risk associated with the upper bound value, $R_{U,1}$, is:

$$R_{U,1} = \frac{9 \times 10^3 \lambda_1}{20} \left(\frac{\text{person-rem}}{\text{year}}\right) = 0.45 R_{T,1}$$

(Eq. D–12)

This same conclusion applies to the other scenarios whose consequence assessments rely on MACCS.

The consequence assessment for Scenario 3 at Pantex uses ERAD calculations exclusively. A conservative estimate is that there is less than a 5 percent chance that Scenario 3 would produce consequences that exceed the upper bound values. If λ_3 denotes the expected frequency of Scenario 3 and $R_{T,3}$ represents its typical risk, then:

$$R_{T,3} = 2 \times 10^4 \lambda_3 \left(\frac{\text{person-rem}}{\text{year}}\right)$$

(Eq. D–13)

However, the risk associated with the upper bound value, $R_{U,3}$, is

$$R_{U3} < 3 \times 10^5 \times 0.05 \times \lambda_3 \left(\frac{\text{person-rem}}{\text{year}}\right) < R_{T,3}$$

(Eq. D–14)

Here again, the upper bound risk is less than the representative risk impact on human health. The single exception in Table D.4.2.2-1 is for Scenario 3 Configuration 2 at Pantex. Using the actual exposure estimates (4.4 x 10^3person-rem [representative] and 8.9 x 10^4 person-rem [upper bound]), the upper bound risk may exceed the typical risk by approximately 1 percent.

Direct comparisons between the scenarios assessed for the alternative sites and Pantex Plant can be misleading. Although Scenario 6 at Pantex Plant includes a pit breach initiated by a forklift accident, the risk from this scenario is dominated by handling accidents in bays and special purpose facilities. Thus, a number of different events contribute to the risk and consequences from Scenario 6 at Pantex Plant, as opposed to the single event (i.e., forklift accident) that dominates the risk at the alternative sites.

D.5 Evaluation of the Risk from Normal Operations

Human health impacts from hazardous chemicals are only a concern at Pantex Plant, since relocating pit storage does not alter the human health impacts from hazardous chemicals at the receiving sites. Air quality analyses using the Industrial Source Complex Short-Term (ISCST2) Model quantified the air concentrations of chemical releases during normal operations (EPA 1987a; EPA 1987). These concentrations were evaluated for all chemicals considered to be carcinogenic and having associated risk factors. Using the chemical concentration results and the risk factors, an estimate of the cancer risk to workers

and a qualitative evaluation of public risk was determined.

Toxic, noncarcinogenic chemicals were evaluated for offsite effects using a hazard index, as shown in volume I, chapter 4, Table 4.14.1.2–2. Chemical concentrations onsite were compared to published threshold limit values for chemical substances to determine the extent of potential human health impacts. None of the threshold limit values are exceeded onsite.

Radiation exposure during normal operations is dominated by external exposure to radiation workers. To quantify changes in worker exposure for different disassembly and assembly rates, As Low As Reasonably Achievable goals were used to estimate an average exposure per operation (PC 1994). This average exposure was then multiplied by the number of operations per year.

Radiation exposure to the public is predominantly from air emissions. The majority of these radiological air emissions are the result of off gassing from Cell 1 and not from normal operations. However, environmental monitoring data establish that these radiological air emissions contribute approximately a factor of one in a billion to the annual radiation dose to an average individual in the vicinity of Pantex Plant.

D.6 UNCERTAINTIES

The sequence of analyses performed to generate the radiological impact estimates from normal operation and facility accidents include: (1) selection of normal operational modes and accident sequences, (2) estimation of source terms, (3) estimation of environmental transport and uptake of radionuclides, (4) calculation of radiation doses to exposed individuals, and (5) estimation of health effects. There are uncertainties associated with each of these steps. Uncertainties exist in the way the physical systems being analyzed are represented by computational models and in the data required to exercise the models (due to measurement errors, sampling errors, or natural variability).

In principle, one can estimate the uncertainty associated with each source and predict the remaining uncertainty in the results of each set of calculations. Thus, one can propagate the uncertainties from one set of calculations to the next and estimate the uncertainties in the final results. However, conducting such a full-scale quantitative uncertainty analysis is neither practical nor a standard practice for a study of this type. Instead, the analysis is designed to ensure—through judicious selection of release scenarios, models, and parameters—that the results represent the potential risks.

This is accomplished by making assumptions in the calculations at each step. The models, parameters, and release scenarios used in calculations are selected in such a way that most intermediate results and consequently, the final estimates of impacts are greater than what would be expected. As a result, even though the range of uncertainty in a quantity might be large, the value calculated for the quantity is close to one of the extremes in the range of possible values, so that the chance of the actual quantity being greater than the calculated value is low (or the chance of the quantity being less than the calculated value if the criteria are such that the quantity has to be maximized). This has been the goal of the radiological assessment for normal operation and facility accidents in this study (i.e., to produce results that are conservative).

The degree of conservatism in the calculated results is closely related to the range of possible values the quantity can have. This range is determined by what can be expected to realistically occur. Thus, the only processes, events, and accidents considered are those credible for the conditions under which the physical system being modeled operates. This consideration has also been employed for both normal operation and facility accident analyses.

REFERENCES

DH 1993 — San Diego County Department of Health Services, *Hazardous Materials Management Division Risk Management and Prevention Program Requirements and Guidelines*, August 1993.

DOD 1977 — DOD, *System Safety Program Requirements*, MIL-STD-882B, prepared by the U.S. Department of Defense, June 1977.

DOE 1992 — DOE, *Description and Validation of ERAD: An Atmospheric Dispersion Model for High Explosive Detonations,* SAND92-2069, prepared by Sandia National Laboratories, for the U.S. Department of Energy, Albuquerque, NM, October 1992.

DOE 1992a — DOE, *Final Safety Analysis Report Pantex Plant Zone 4 Staging and Interim Storage for Nuclear Weapons and Components*, Pantex Plant, Amarillo, TX, December 1992.

DOE 1994 — DOE, *DOE Standard, Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*, prepared under Contract Number DOE-STD-1020-94 by the U.S. Department of Energy, April 1994.

EPA 1987 — EPA, *Industrial Source Complex (ISC) Dispersion Model User's Guide,* Volume 2, Second Edition, Revised, EPA-450/4-88.002b, prepared by the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, December 1987.

EPA 1987a — EPA, *Industrial Source Complex (ISC) Dispersion Model User's Guide,* Volume 1, Second Edition, Revised, EPA-450/4-88.002a, prepared by the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, December 1987.

Jones 1988 — Jones, J.V., *Engineering Design Reliability, Maintainability, and Testability,* TAB Books, Inc., Blue Ridge Summit, PA, 1988.

NAP 1990 — *Health Effects of Exposures to Low Levels of Ionizing Radiation BEIR V*, National Academy Press, Washington, D.C. 1990.

NRC 1990 — U.S. Nuclear Regulatory Commission, *Quality Assurance and Verification of the MACCS Code, Version 1.5,* NUREG/CR-5376, prepared by Idaho National Engineering Laboratory, Idaho Falls, ID, February 1990.

NRC 1990a U.S. Nuclear Regulatory Commission, *MELCOR Accident Consequence Code System (MACCS) User's Guide*, Volume 1, NUREG/CR-4691, prepared by Sandia National Laboratories, Albuquerque, NM, February 1990.

NRC 1990b U.S. Nuclear Regulatory Commission, *MELCOR Accident Consequence Code System (MACCS) User's Guide,* Volume 2, NUREG/CR-4691, prepared by Sandia National Laboratories, Albuquerque, NM, February 1990.

PC 1994 Cole, D.J., "1995 ALARA Goals", Memo from D.J. Cole to W.A. Weinreich, Mason & Hanger-Silas Mason Company, Inc., December 21, 1994.

PC 1995 Baca, W., "AT–400A Testing", Telecon from Wendy Baca, DOE Albuquerque Operations Office, Nuclear Explosive Safety Division, to Bret Simpkins, Tetra Tech, Inc., Albuquerque, NM, March 20, 1996.

APPENDIX E

Aircraft Accident Analysis

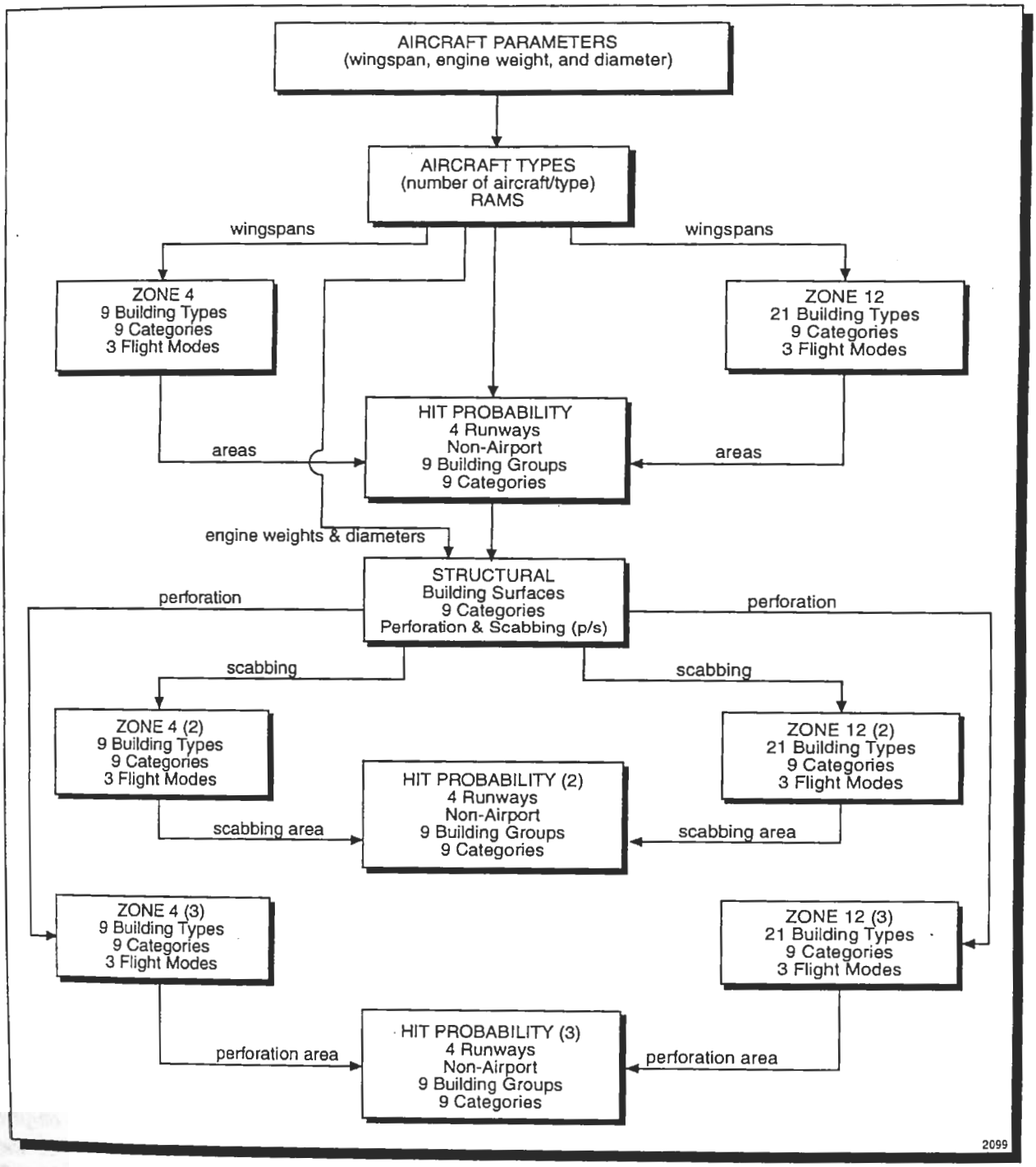


FIGURE E.2–1.—*Calculations Used to Determine Probability for Causing Sufficient Damage to a Facility at Pantex Plant.*

thickness for each aircraft category into the facility using an empirical model.

If an earth overburden exists, the velocity reduction through the earth overburden is calculated prior to the aircraft penetrating the facility. The roofs, walls, and doors of each facility were modeled independently when overburden or structure thickness varied. If scabbing or perforation is not possible, even though the facility can be hit, the material inside cannot be damaged and no further analysis is needed. If scabbing or perforation is possible, additional analysis is needed.

The area calculation is then performed again, eliminating the structural members whose aircraft categories cannot cause scabbing or perforation in a facility. After the area of a facility vulnerable to scabbing or perforation is determined, the probability of hitting a facility and causing either scabbing or perforation is calculated with the reduced area by using the same equation as described in section E.2.1. (This represents a conservative upper bound for causing an explosion in a facility since either a scabbed piece of concrete or a missile that has perforated a facility can cause an explosion.)

The area calculation is redone a third time, eliminating the structural members whose aircraft categories can only cause perforation, but not scabbing in a facility. After the area of a facility vulnerable only to perforation is determined, the probability of hitting a facility and causing perforation is calculated for the reduced area by using the same equation as described in section E.2.1. This represents a conservative upper bound for causing a fire in a facility since only a perforation can allow for sufficient amount of combustible materials to enter a facility. If the probability of hitting a facility and causing either scabbing or perforation is greater than 10^{-7}, a consequence analysis is performed.

E.2.1 Calculation of Aircraft Crash Probability

The Near Airport Model is used to estimate the probability of an aircraft crash for aircraft in the take-off and landing modes; in-flight aircraft crash probabilities are determined using the Non-Airport Model (DOE 1996g:41). The Near-Airport Model uses an aircraft mode and category-specific probability density distribution to estimate the possibility of an aircraft crashing into a particular location surrounding the airport. The Non-Airport Model uses DOE site-specific information to estimate the possibility of an aircraft crashing into a particular location surrounding the airport. In both models, the calculated probability includes all types of postulated impacts, whether slight or severe in consequence (i.e., to be conservative a touch is considered a hit).

A set of indices is used in the analysis to differentiate flight modes, aircraft categories, and flight sources. These indices are designated (i), (j), and (k), respectively. The index (i) differentiates the mode of operations (e.g., landing, in-flight, take-off) and can be equal to the following values:

i = 1	Landing
i = 2	In-Flight
i = 3	Take-off

The index (j) divides the aircraft types into categories. These categories included the following values (DOE 1996g:39):

j = 1	Commercial: Air Carrier
j = 2	Commercial: Air Taxi
j = 3	Military: Large (Bomber, Cargo, and Tanker aircraft)
j = 4	Military: Small (Attack, Fighter, and Trainer aircraft)

j = 5	Military: Rotary-wing (Helicopter)
j = 6	General: Fixed-wing, reciprocating, single-engine
j = 7	General: Fixed-wing, reciprocating, multi-engine
j = 8	General: Fixed-wing, turboprop
j = 9	General: Fixed-wing, turbojet
j = 10	Rotary-wing, reciprocating engine (Helicopter)
j = 11	Rotary-wing, turbine engine (Helicopter)

The index (k) describes the flight source and can take on the following characteristics:

k = 1...n	Runways
k = n+1	Non-Airport operations (high-altitude overflights, and local helicopter flights)

An approximation of the total probability per year (F) that any aircraft in any flight path, category, or mode of operation will impact structures is given by the four-factor formula:

$$F = \sum_{i,j,k} N_{ijk} \cdot P_{ijk} \cdot f_{ijk}(x,y) \cdot A_{ij}$$

where:

F	is the estimated total annual aircraft crash impact frequency for the facility of interest (number per year)
N_{ijk}	is the number of annual operations in flight mode (i), aircraft category (j), and flight source (k) (number per year, site dependent)
A_{ij}	is the effective Plant area for an aircraft of mode (i) and flight category (j) (site and aircraft dependent)
$f_{ijk}(x,y)$	is the generic aircraft crash location probability function evaluated at the facility location for each applicable summation parameter (per square mile for Near-Airport and Non-Airport operations)
P_{ijk}	is the generic aircraft crash probability (per take-off or landing for Near-Airport and Non-Airport operations) for each applicable aircraft category, flight mode, and flight source.

Table E.2.1–1 (tables are presented following the text) presents a listing of the values for aircraft crash rates, P_{ijk}.

The four-factor formula is implemented in two different ways depending of the flight phase:

- For Near-Airport operations, take-offs (i = 1) and landings (i = 3), the four-factor equation is implemented through the use of site-specific information and data contained in the Draft DOE Standard (DOE 1996g).
- For Non-Airport operations, (i = 2), DOE site-specific values for the expected number of crashes per square mile per year in the vicinity of selected DOE sites have been established. The value of the product NPf(x,y) is provided in the Draft DOE Standard for each aircraft category. The four-factor formula is implemented by multiplying this value by the facility effective area to assess hit probability.

The analysis of the impact frequency of Non-Airport operations for all categories of aircraft uses the same four-factor equation as for Near-Airport operations. The frequency, F_j, for the jth class of aircraft is

reinforced concrete and steel constructed facilities.

E.2.3.1 *Reinforced Concrete Targets*

Local impacts to facilities include penetration, perforation, and scabbing. Penetration occurs when the missile striking a facility intrudes into the outer surface of the structure. Perforation occurs when the missile punctures a hole all the way through the concrete or steel surface. Scabbing occurs when the missile does not perforate, but does cause concrete to be ejected from the inside face of the target into the facility.

The local response equations used for this calculation are referred to as the Chang equations for rigid missile penetration of reinforced concrete targets (DOE 1996g:60).

Scabbing

$$t_s = [1.84 \cdot (U \div V)^{0.13}] \cdot \{(MV^2)^{0.4} \div [D^{0.2} \cdot (f'_c)^{0.4}]\}$$

where:

U = reference velocity = 200 ft/sec

V = missile impact velocity (ft/sec)

M = mass of missile = W/g

where W = missile weight (lb) and

g = 32.2 ft/sec^2

D = effective missile diameter (ft)

f'_c = ultimate compressive strength of concrete (lb/ft^2)

t_s = scabbing thickness (ft)

To prevent scabbing, the minimum thickness of the concrete should be $\geq 1.1t_s$ (DOE 1996g:62). Because the missiles considered in this analysis are aircraft engines, they are considered non-rigid. As a result, and in accordance with the Draft DOE Standard, the value obtained for rigid missiles can be reduced to 60 percent (DOE 1996g:64).

Perforation

$$t_p = (U \div V)^{0.25} \cdot (MV^2 \div Df'_c)^{0.5}$$

To prevent perforation, the minimum thickness of the concrete should be $\geq 1.2t_p$ (DOE 1996g:62). Similarly, because the missiles in this analysis are aircraft engines which are considered non-rigid, the value obtained for rigid missiles can be reduced to 70 percent (DOE 1996g:64).

E.2.3.2 *Steel Targets*

The equation used for this calculation is the Ballistic Research Laboratory (BRL) formula for rigid missile penetration of steel targets (DOE 1996g:65).

Perforation

$$T^{1.5} = 0.5MV^2 \div 17{,}400K_sD^{1.5}$$

where:

T = perforation depth (in)

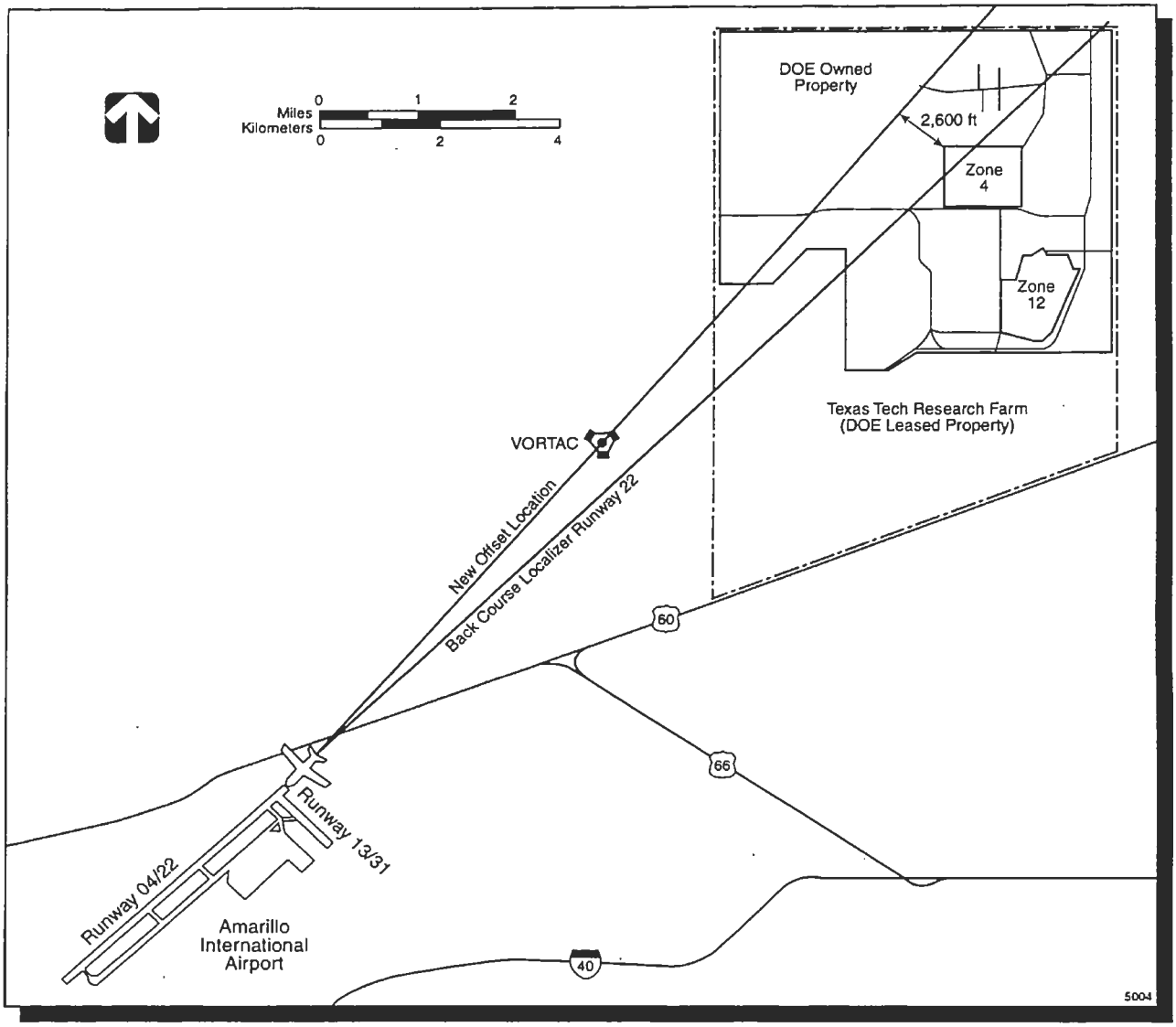
M = W/g missile mass (lbs-sec^2/ft)

V = missile impact velocity (ft/sec)

K_s = constant depending on the grade of steel (usually ≈ 1)

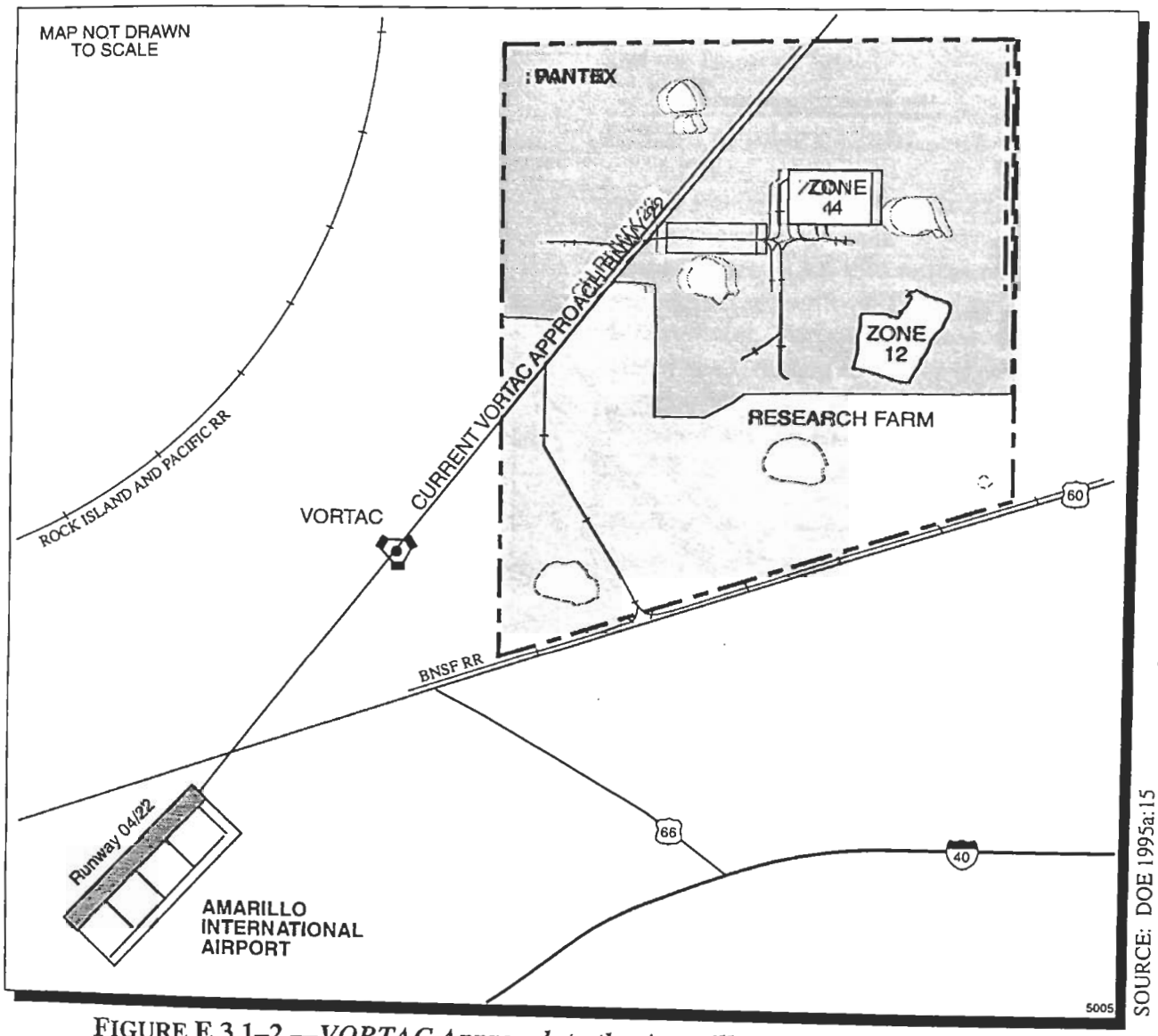
D = missile diameter (in)

To prevent perforation of steel targets, the minimum thickness t_d should be > 1.25T (DOE 1996g:65).



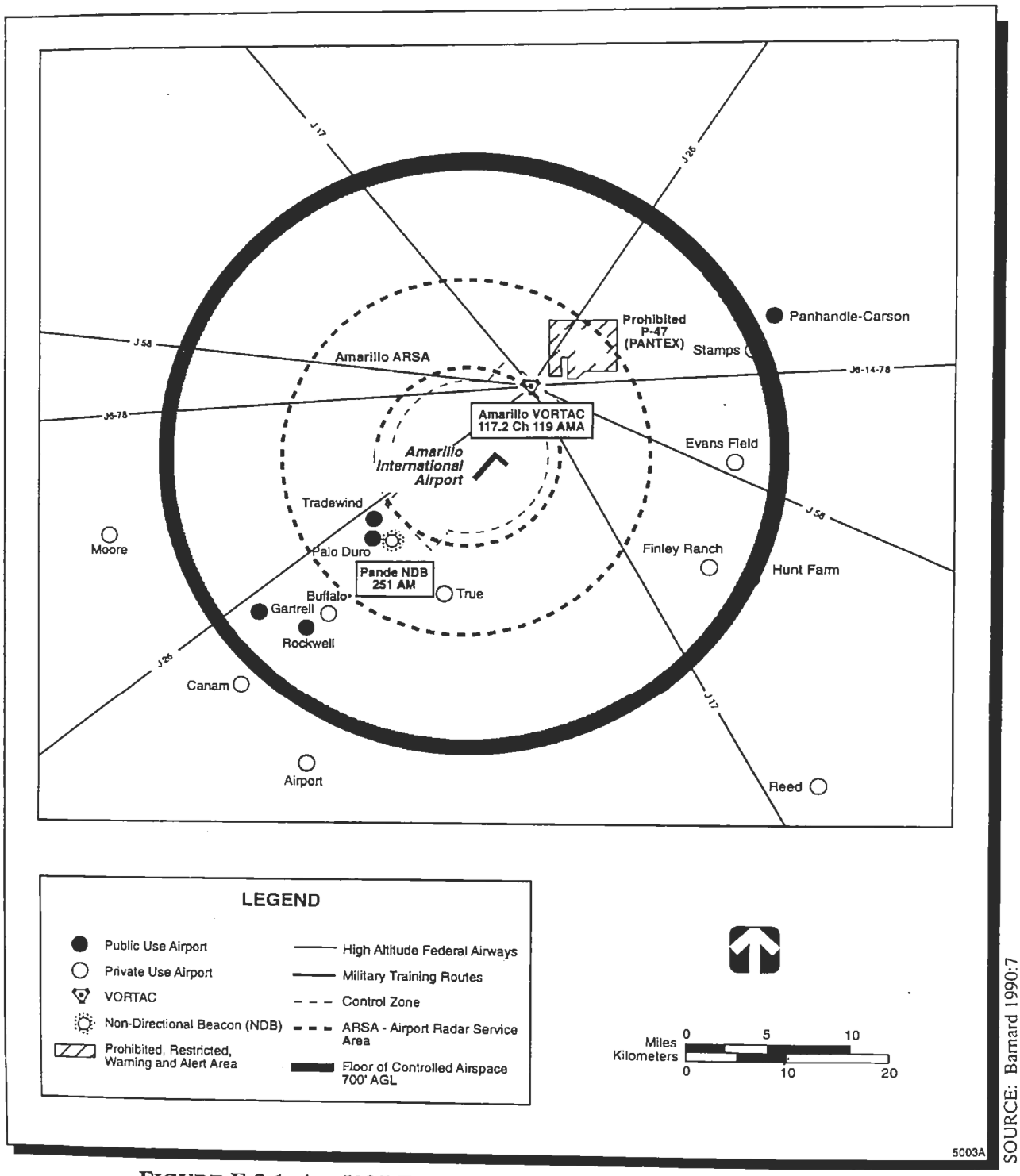
SOURCE: DOE 1995a:15

FIGURE E.3.1–1.—*Back Course Localizer Approach to the Amarillo International Airport.*



SOURCE: DOE 1995a:15

FIGURE E.3.1–2.—*VORTAC Approach to the Amarillo International Airport.*



SOURCE: Barnard 1990:7

FIGURE E.3.1–4.—*VORTAC and High-Altitude Federal Airways.*

north of the Plant near Borger. Aircraft flying in this high-altitude air corridor were included in data collected for Pantex Plant.

DOE and the Federal Aviation Administration (FAA) have signed a Memorandum of Understanding (MOU) to take several actions to reduce the number of flights directly over Pantex Plant. Some of these steps include establishing a Global Positioning System (GPS) route around Pantex Plant, moving the holding pattern for commercial aircraft away from the Plant, and moving the high-altitude VORTAC closer to the airport. The estimated reduction in risk for these changes is discussed in section E.3.1.7.

An estimate of an aircraft crash into any of the Zone 4 magazines and Zone 12 buildings at Pantex Plant was generated using the probability equations defined in section E.2.1, the effective areas defined in section E.2.2, and the structural response in section E.2.3.

E.3.1.1 *Radar Airspace Monitoring System Project*

The RAMS project is based at the Amarillo International Airport and consists of a computer system that records radar data from various aircraft overflights in the area. This radar data is then translated into data points that represent aircraft positions in relation to the airport and Pantex Plant. RAMS data include individual aircraft types that were divided into the aircraft categories defined in section E.2.1 to ratio the number of aircraft operations at the airport. The RAMS data was used to categorize the aircraft in more detail than the four categories i.e., Air Carrier, Air Taxi, Military, and General Aviation) supplied by FAA.

E.3.1.2 *Operations Near Pantex Plant*

An adjustment to the Near-Airport Model consisted of manipulation of the aircraft modes (i), aircraft categories (j), and flight sources (k) to model Pantex Plant conditions. The aircraft mode, i, was summed over three phases:

i = 1	Take-off
i = 2	In-Flight
i = 3	Landing

The aircraft categories are very similar to those presented in section E.2.1.

j = 1	Commercial: Air Carrier
j = 2	Commercial: Air Taxi
j = 3	Military: Large (Bomber, Cargo, and Tanker aircraft)
j = 4	Military: Small (Attack, Fighter, and Trainer aircraft)
j = 5	General: Fixed-wing, reciprocating, single-engine
j = 6	General: Fixed-wing, reciprocating, multi-engine
j = 7	General: Fixed-wing, turboprop
j = 8	General: Fixed-wing, turbojet
j = 9	Helicopters

The flight source, k, was set equal to five flight sources.

k = 1	Runway 22
k = 2	Runway 04
k = 3	Runway 31

k = 4 Runway 13

k = 5 Non-Airport Aircraft

It was determined that the following commercial aircraft are used at the Amarillo International Airport:

- American Airlines
  - — F100 (Fokker 100; 90+ passenger capacity)
  - — SF340 (Saab; approximately 35-passenger capacity)
  - — AT72 (ATR72; approximately 66-passenger capacity)
- Delta Air Lines
  - — AT72 (ATR72; approximately 66-passenger capacity)
  - — E120 (Brasilia; approximately 30-passenger capacity)
- United Airlines
  - — E120 (Brasilia; approximately 30-passenger capacity)
- Southwest Airlines
  - — 737 (Boeing; 100+ passenger capacity)

In this analysis, 1995 data obtained from the FAA indicate that there are approximately 74,911 operations per year at the Amarillo International Airport. The FAA supplied data for air carrier, air taxi, military, and general aviation aircraft, with 11,122; 7,134; 30,386; and 26,269 operations, respectively (PC 1995). Based on RAMS data, there were 233 helicopter operations in 1995.

Since the number of annual aircraft operations has been as high as 88,489 in 1992, the maximum number of operations from 1990 to 1996 were used in the analysis for each FAA aircraft category. Maximum values for air carrier, air taxi, military, general aviation, and helicopter operations are 13,174 (1990); 9,938 (1993); 40,638 (1993); 29,134 (1992); and 233 (1995), respectively.

FAA commercial and general aviation operations numbers do not include the number of times a commercial or general aviation may circle during a holding pattern, but holding patterns have been included in the crash rates for commercial and general aviation. The FAA number for military operations includes touch-and-go operations (PC 1995c). RAMS data were used to divide military and general aviation FAA data into aircraft categories (i.e., large or small military, and single-engine, multi-engine, turboprop, or turbojet general aviation).

Approximately 12 months of RAMS data were used to identify and categorize aircraft by type (DOT 1994; DOT 1985; LLNL 1995). The percentage of operations, using the RAMS data, was derived from the four sets of FAA data (i.e., air carrier, air taxi, military, and general aviation). The total number of operations was obtained by multiplying the percentage of RAMS operations for each aircraft category by the FAA data for each category.

The total number of operations that could occur on Runway 31 is the same as the total number of operations for each category except for air carrier and large military, which include aircraft that are too heavy to use Runway 31. The percentage of operations that occur on Runway 31 (6.8 percent) was obtained by evaluating a statistical sample of RAMS data and counting the number of operations on each runway (PC 1995a). The percentage of operations that land on Runway 22 (64.1 percent) versus take-off on Runway 04 (35.9 percent) was determined based on prevailing winds (Figure 4.7.1.1–1 in volume I). Table E.3.1.2–1 presents the number of operations for each aircraft category for Runways 04, 22, and 31.

In addition to FAA operations data, in the Near-Airport Model, in-flight aircraft at high altitudes were considered as Non-Airport operations in the Draft DOE Standard (DOE 1996g) methodology. The evolution of high-altitude aircraft is based on the DOE Standard NPf(x,y)

values for Pantex Plant. All high-altitude overflights are assumed to be in-flight. The calculation of this impact frequency is performed using the equation discussed in section E.2.1.

E.3.1.3 *Crash Density Function Near Pantex Plant*

Because Zones 4 and 12 are within the aircraft category dependent exclusion distance from the Amarillo International Airport, the air operations of interest for this analysis are take-off, landing, and in-flight modes (i.e., i =1, 2, 3). Therefore, the probability equation becomes:

$$F = \Sigma_{i=1,3}\Sigma_{i=1,9}\Sigma_{k=1,5}\, N_{ijk} \cdot A_{ij} \cdot f_{ijk}(x,y) \cdot P_{ijk}$$

The length of Runway 04/22 at the Amarillo International Airport is 4.12 kilometers (2.56 miles). It was assumed from the direction of the prevailing winds that Runway 22 is used 64.1 percent of the time (Figure 4.7.1.1–1 in volume I). Due to the aircraft category dependent exclusion distance, all aircraft considered as an airport operation on Runway 04/22 were either in the take-off or landing mode. For all runways, the pattern side for military operations was conservatively assumed to be the value for the side with the larger probability density function (pdf), since there is no dominant pattern at the Amarillo International Airport. For all runways, 50 percent of operations are take-off and 50 percent are landing.

The length of Runway 13/31 is 2.41 kilometers (1.50 miles). Approximately 6.8 percent of daily operations occur on Runway 13/31. Because Runway 13 has only about one operation per day, all operations on the runway were assumed to occur on Runway 31. Due to weight restrictions, air carrier and large military aircraft cannot use Runway 31. For this runway, all aircraft considered as an airport operation were either in the take-off or landing mode.

The center-line and perpendicular distances from the geometric center of the runway to specific points of concern in Zones 4 and 12 were determined as shown in Figure E.3.1.3–1 (USGS 1953; USGS 1953a; USGS 1973; USGS 1956). Because Pantex Plant resides within the aircraft category dependent exclusion distances, a Near-Airport Analysis was required and probability density function values were used in this analysis.

Figure E.3.1.3–1 (not to scale) represents the location of Pantex Plant facilities in relation to Runways 22/04 and 31/13 at the Amarillo International Airport. There are two key areas on this figure that are considered in assessing the aircraft impact probability:

- A 1-mile by 1-mile grid area encompassing most of Zone 4 West located south-east of the runway center-line.
- A 1-mile by 1-mile grid area adjacent to the first and encompassing all of Zone 12.

The aircraft impact probability assessment focuses on accidents in the vicinity of these areas; in particular the nearest facility for each of these zone areas. The assessment was performed by separating the displacement vector from the geometric center of the runway to specific points in the zone grids into two orthogonal components:

- Vector coincident with a direct projection of the center-line of the runway.
- Vector perpendicular to the first that extends from the first vector to the nearest impact point in the area. For Pantex Plant, this point represents the plutonium centroid of Zones 4 and 12 (refer to Figure E.3.1.3–1).

The lengths of these two vector components were used to implement the Near-Airport Model methodology. It was assumed for simplicity that all of the Zone 4 West magazines reside in the grid under consideration.

The NPf(x,y) values provided in the Draft DOE Standard (DOE 1996g) for the various aircraft categories reflect the crashes per square mile, per year, centered at a given site for non-airport operations. In this analysis, the following NPf(x,y) values for Pantex Plant were used (DOE 1996g:B-24, B-25):

NPf(x,y) General Aviation = 7×10^{-5}

NPf(x,y) Air Carrier = 6×10^{-8}

NPf(x,y) Air Taxi = 4×10^{-7}

NPf(x,y) Large Military = 1×10^{-7}

NPf(x,y) Small Military = 5×10^{-6}

The NPf(x,y) value for general aviation was split between the four general aviation categories for Pantex Plant based on the RAMS data. The value was divided up based on the following percentages:

Single-engine piston = 43.8% $\Rightarrow 3.1 \times 10^{-5}$

Multi-engine piston = 19.8% $\Rightarrow 1.4 \times 10^{-5}$

Turboprop = 17.0% $\Rightarrow 1.2 \times 10^{-5}$

Turbojet = 19.4% $\Rightarrow 1.4 \times 10^{-5}$

According to the Draft DOE Standard, it has been shown, based on helicopter crash data, that the contribution to impact frequency from non-local helicopter overflights is insignificant and need not be considered in the impact frequency calculations (DOE 1996g:45). However, it is necessary to consider local helicopter flights that consist of planned overflights dealing with facility operations, or flights dealing with area operations (e.g., Southwestern Public Service

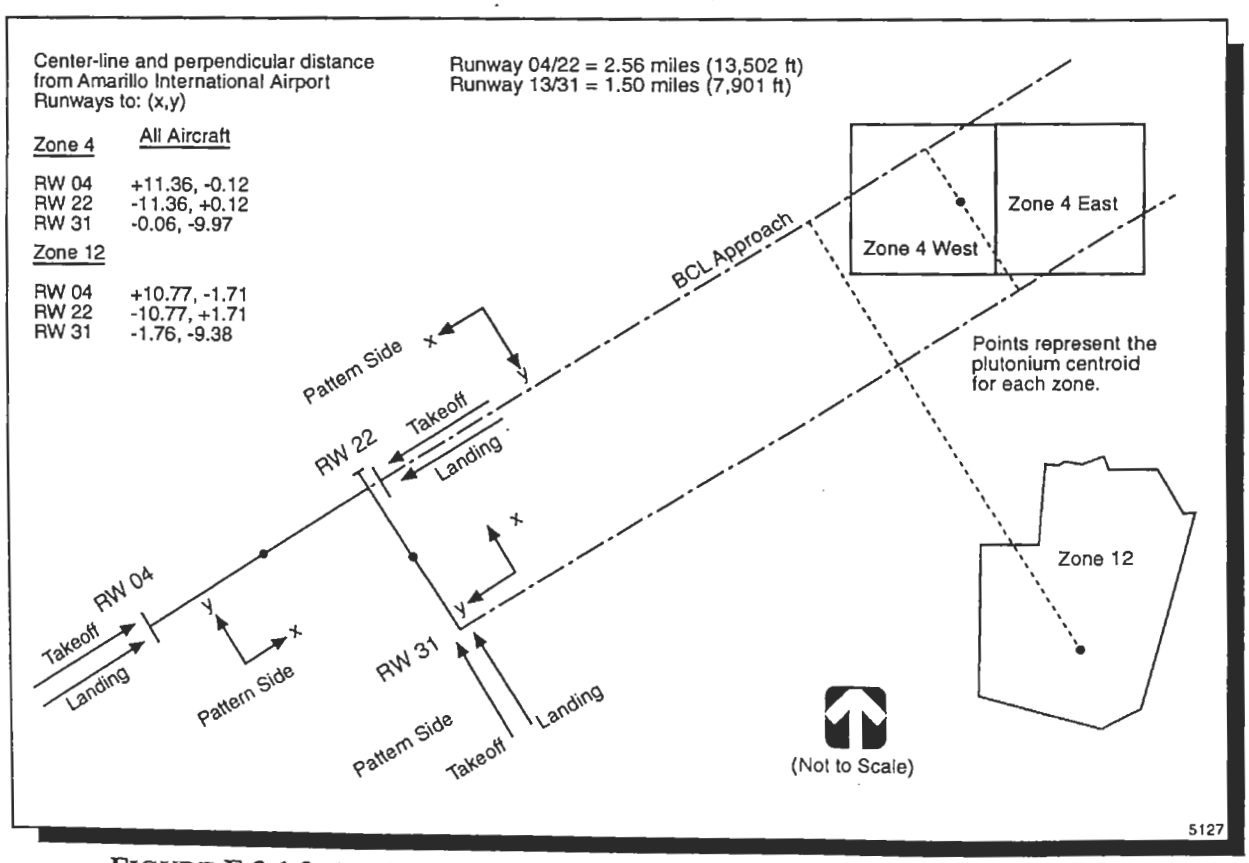


FIGURE E.3.1.3–1.—*Pantex Plant and the Amarillo International Airport.*

powerline maintenance flights), using the equation discussed in section E.2.1.

E.3.1.4 *Zone 4*

In this analysis, only facilities that contain plutonium and large amounts of tritium were considered, as determined in previous hazard assessments, since these materials have possible offsite consequences (Jacobs 1993; Jacobs 1993a; Jacobs 1992).

Area Calculation

To estimate the overall probability of aircraft impact into any magazine in Zone 4, the probability of striking an individual magazine or group of magazines is summed appropriately over the individual magazines or groups of magazines analyzed (i.e., 18 Modified Richmond (MR) magazines, 9 groups of 3 Steel Arch Construction (SAC) magazines, and 3 groups of 5 SAC magazines). The total effective area is the sum of the true areas (the magazine base area adjusted for aircraft dimension), the shadow areas (defined by the magazine height and the angle of postulated impact), and the skid areas (the area covered by a skidding aircraft after impact with the ground) posed by all 60 magazines in Zone 4.

The MR magazines were considered as single structures (18 total), while the SAC magazines were analyzed as 9 groups of 3 (27 total) and 3 groups of 5 (15 total). The distance between the SAC magazines in the groups was included in the value used for the length of the group because this length gave a better representation of the possible area of impact.

The following section illustrates the calculation of the individual areas and the effective area for the groups of three SAC magazines. In this calculation, the magazines were assumed to be in a position (e.g., east row on Figure 4.15.1.1–1 in volume I) that allows the longest skid distance prior to impact with a magazine.

An aircraft that impacts the ground prior to reaching a line of magazines, (i.e., in a skid mode) can impact one line of magazines, but is precluded from reaching the second. The effective areas for one line of magazines (and the five isolated MR magazines) were estimated using the mean skid distances presented in the Draft DOE Standard (DOE 1996g:B-29). However, the skid distances for magazines in the second line were reduced to no more than the distance between the two rows of magazines (125 meters [410 feet]) (Figure 4.15.1.1–1 in volume I). This reduced distance affects commercial and military aircraft only. In addition, the shadow area of the first row was eliminated since it is part of the skid area of the second row. The angle of impact was chosen based on the values presented in the Draft DOE Standard (DOE 1996g:B-29).

A total effective area for the Zone 4 magazines was then computed by combining the effective areas in the following manner. The effective area for magazines in the east row is the sum of the effective areas for three groups of three SAC magazines, three groups of five SAC magazines, and six MR magazines. The effective area for magazines in the west row is the sum of the effective areas for six groups of three SAC magazines and seven MR magazines. All of these effective areas were computed using the 125-meter (410-foot) inter-row separation as the skid distance for air carrier and military aircraft. The total effective area for Zone 4 is the sum of the effective areas for the east and west rows plus the effective areas of the five MR magazines on the west side of Zone 4. Table E.3.1.4–1 presents the Zone 4 building dimensions.

Table E.3.1.4–2 presents the aircraft operational data used for the Zone 4 analysis. In this table, both the Draft DOE Standard and representative wingspans for aircraft in the vicinity of Pantex Plant are given. Representative wingspans were determined by examining RAMS data and selecting aircraft for each category that

Local response structural calculations were performed for five different sets of overburdens and building thicknesses. These include the MR magazine roof and walls, the SAC magazine roof and walls, and the front doors of both magazine types. Since only the magazine entry barrier was modeled, doors for the SAC and MR magazines are the same. The roof and walls for both types of facilities were modeled separately since there is substantially greater overburden on the walls compared to the roof. The front face was modeled assuming the large security barrier was in place. Table E.3.1.4–8 presents the results for either perforation or scabbing for each of the five different sets. Similarly, Table E.3.1.4–9 presents the results for perforation.

Perforation and Scabbing Probability Calculations

For facilities with high explosives (HE) (weapons), the bounding accident is a perforation or scab leading to an explosion. For facilities without HE, the bounding accident is a perforation leading to a fire. Scabbing leading to an explosion is not possible in Zone 4 since material with HE is stored in SACs which cannot scab. The areas for the facilities were reduced using the structural analysis results. The reduced areas were then used to recalculate perforation and scabbing probabilities. These areas are shown in Table E.3.1.4–10, and used to calculate the perforation leading to a fire probabilities shown in Table E.3.1.4–11 and the perforation leading to an explosion probabilities shown in Table E.3.1.4–12.

The combined perforation and scabbing probabilities were used to calculate an explosion probability, since either perforation or scabbing could cause an explosion. For the case where no HE is present, the model was used to calculate the probability of a perforation leading to a fire. The true, shadow, and skid areas for the Zone 4 facilities were reduced for perforation or scabbing based on the following (see Tables E.3.1.4–8 and E.3.1.4–9):

- If the MR magazine roof is "ND" (no damage), then the true and shadow areas are reduced to 0.0.
- If the MR magazine walls are "ND", then the shadow and skid areas are reduced to the width of the building times the skid distance (damage can only occur through the front wall).
- Similarly, if the SAC magazine roof is "ND", then the true and shadow areas are reduced to 0.0.
- Similarly, if the SAC magazine walls are "ND", then the shadow and skid areas are reduced to the width of the building times the skid distance (damage can only occur through the front wall).
- If the MR or SAC magazine front door is "ND", then the skid area is 0.0.

E.3.1.5 *Zone 12*

The analysis performed for Zone 12 of Pantex Plant was virtually identical to that for Zone 4. The number of airport operations on Runways 22, 04, and 31 discussed in section E.3.1.4 and aircraft wingspans and crash rates used in the Zone 4 analysis were used in the Zone 12 analysis. Zone 12 facilities of concern to aircraft crash are those containing plutonium and large amounts of tritium as determined in previous hazard assessments, since these materials have possible offsite consequences (Jacobs 1993; Jacobs 1993a; Jacobs 1992).

Area Calculation

The following section illustrates the calculation of the individual areas and the effective area for the Zone 12 buildings. In this calculation, the buildings were assumed to be in a position that allows the longest skid distance prior to impact with a building (see Figure 4.15.1.1–2 in volume I). As an exception to using the skid distances provided in the Draft DOE Standard (DOE 1996g), for Zone 12, the skid distance was reduced to the maximum distance to nearby

ildings when nearby buildings shield the rticular facility. The skid distances are esented in Table E.3.1.5–1, as well as the luced skid distances to account for shielding.

total effective area for the Zone 12 buildings as then computed by combining the effective eas. The angle of impact was assumed to be at given in the Draft DOE Standard for the rious aircraft types. Table E.3.1.5–2 presents e Zone 12 building dimensions.

able E.3.1.5–3 presents the aircraft operational ta used for the Zone 12 analysis. In this table, th the Draft DOE Standard and representative ngspans for aircraft in the vicinity of Pantex ant are provided. Representative wingspans ere determined by examining RAMS data and lecting aircraft for each category that presented the average of the aircraft (for the mmercial and military aircraft categories, er 96 percent of the aircraft were presented). Weighted average wingspans ere then used in the calculations. The skid ngth used corresponds to the mean skid stances presented in the Draft DOE Standard OE 1996g:B-29).

it Probability Calculation

sing the coordinate convention, the center-line distance) and perpendicular (y distance) stances to the plutonium centroid for Zone 12 e:

Zone 12	All Aircraft
Runway 04	10.77 mi, -1.71 mi
Runway 22	-10.77 mi, 1.71 mi
Runway 31	-1.65 mi, -9.38 mi

ased on the above distances, all aircraft using e Amarillo International Airport were nalyzed with the Near-Airport Model. The rash location probabilities for Runway 22 are resented in Table E.3.1.5–4 (DOE 1996g:B-2–B-23). Air carrier and air taxi crash location probabilities are identical because their crash density location probabilities are grouped into a commercial category. The crash location probabilities are zero for Runway 22 take-offs because in this analysis all take-offs are in a direction away from Pantex Plant, and thus are not a threat to Plant facilities.

The crash location probabilities for Runway 04 are presented in Table E.3.1.5–5 (DOE 1996g:B-12–B-23). The air carrier and air taxi crash density location probabilities are identical because their crash location probabilities are grouped into a commercial category.

The crash location probabilities for Runway 31 are presented in Table E.3.1.5–6 (DOE 1996g:B-12–B-23). Similarly, both the air carrier and air taxi crash density location probabilities are identical because their crash location probabilities are also grouped into a single commercial category.

The impact probability was obtained for the entire Zone 12 operations area by multiplying the number of flights, the impact area, the crash rate, and the crash density function for each category. With substitution of the above data into the probability equation for the specific aircraft type, the impact probabilities for Zone 12 were calculated. Table E.3.1.5–7 contains the crash probabilities for Runway 22 landings, Runway 04 take-offs, Runway 04 landings and the non-airport aircraft. Runway 31 crash probabilities are omitted because they are all zero.

Structural Calculation

The same local response equations for concrete and steel structures used in the Zone 4 analysis were used in this analysis. Building 12–60 is a steel arch construction building and was treated as such. Building 12–41 is constructed with clay tile walls and perforation was assumed to occur for all aircraft types.

Local response structural calculations were performed for 15 different sets (roofs and walls modeled separately) of overburdens and building thicknesses. These include 12-64, 12-84 West (grouped with 12-99 and 12-104), 12-84 East, 12-44 (grouped with 12-85, 12-96, and 12-98), 12-41, 12-50, 12-60, 12-94, 12-104A, 12-26 Pit Vault, 12-42 North Vault, 12-42 South Vault, 12-44 Cell 8, 12-58, and 12-116. Table E.3.1.5–8 presents the results for either perforation or scabbing and Table E.3.1.5–9 provides the results for perforation.

Perforation and Scabbing Probability Calculations

For facilities with HE (weapons), the bounding accident is a perforation or scab leading to an explosion. For facilities without HE, the bounding accident is a perforation leading to a fire. The areas for the facilities were reduced using the structural analysis results. The reduced areas were then used to recalculate perforation and scabbing probabilities. These areas are shown in Table E.3.1.5–10, and used to calculate the scabbing leading to an explosion probabilities shown in Table E.3.1.5–11, the perforation leading to an explosion probabilities shown in Table E.3.1.5–12, and the perforation leading to a fire probabilities shown in Table E.3.1.5–13.

The combined perforation and scabbing probabilities are used to calculate an explosion probability, since either perforation or scabbing could cause an explosion. For the case where no HE is present, the model was used to calculate the probability of a perforation leading to a fire. The true, shadow, and skid areas for the Zone 12 facilities were reduced for perforation or scabbing based on the following ("ND" denotes no damage. See Tables E.3.1.5–8 and E.3.1.5–9):

- If the 12–64, 12–84 W, 12–99, 12–104 roofs are "ND", then the true and shadow areas are reduced to 0.0.
- If the 12–64 walls are "ND", then the skid area is reduced to the width of the building times the skid distance (damage can only occur through the front).
- If the 12–84 E roof and walls are "ND", then the true and shadow areas are reduced to 0.0 and the skid area is reduced to the width of the building times the skid distance (damage can only occur through the front).
- If the 12–44, 12–85, 12–96, 12–98 roofs and walls are "ND", then the true, shadow and skid areas are reduced to 0.0.
- If the 12–50 roof is "ND", then the true and shadow areas are reduced to 0.0.
- If the 12–50 walls is "ND", then the skid area is reduced to 0.0 (there are no doors exposed to the skid direction).
- If the 12–60 roof is "ND", then the true and shadow areas are reduced to 0.0.
- If the 12–60 walls is "ND", then the skid area is reduced to 0.0 (there are no doors exposed to the skid direction).
- If the 12–41 roof and walls are "ND", then the true, shadow and skid areas are reduced to 0.0 (since this was a clay tile structure the facility was modeled as having no depth to assure that perforation occurs).
- If the 12–94 roof and walls are "ND", then the true, shadow and skid areas are reduced to 0.0.
- If the Cell 8 roof and walls are "ND", then the true, shadow and skid areas are reduced to 0.0.
- If the 12–26 Pit Vault, 12–42 North Vault, and 12–42 South Vault roofs and walls are "ND", then the true, shadow and skid areas are reduced to 0.0.
- If the 12-116 roofs and walls are "ND", then the true, shadow and skid areas are reduced to 0.0.
- If the 12-58 roofs and walls are "ND", then the true, shadow and skid areas are reduced to 0.0.

If the 12-104A roofs and walls are "ND", then the true, shadow and skid areas are reduced to 0.0.

.6 *Consequence Analysis*

obability of an aircraft hitting a facility in ı and Zone 12 is 1.3×10^{-5} and 1.8×10^{-5}, tively, for a total of 3.1×10^{-5}. The ›ility of damaging a facility by scabbing g to an explosion in Zone 4 is 0.0 because ng is only possible in MR magazines. magazines are preferentially occupied by no HE present), whereas the SAC ines are incapable of scabbing because s no concrete in the roof and walls. In 12, the probability of scabbing is $.0^{-7}$, however, a study conducted by Jeff : of Mason & Hanger indicates that :d material from the missiles of concern possess the energy to cause a detonation Zone 12 (PC 1996).

›robability of damaging a facility by ation leading to an explosion in Zone 4 Zone 12 is 6.8×10^{-7} and 2.3×10^{-6}, tively, for a total of 3.0×10^{-6}. The ›ility of damaging a facility by perforation g to fire for Zone 4 and Zone 12 is $.0^{-7}$ and 4.7×10^{-7}, respectively, for a of 9.9×10^{-7}. This represents a vative upper bound for the probability of g a fire or explosion resulting in ium dispersal. This conservative upper includes the probability that plutonium or ı is in the facility, that all of the containers at a fire occurs, and that the contents are :d to the fire. All four of these ›ilities are known to be less than 1 but ›een conservatively assumed to be 1 for lculation.

tent with the Draft DOE Standard (DOE), a consequence analysis has been med for this accident. The consequence is is similar to the consequence analysis for other accidents and is provided for Scenarios 3 and 8 in Table 4.14.2.1–3, volume I.

E.3.1.7 *Risk Reduction Due to Overflight Working Group Initiatives*

Recommendations of the Overflight Working Group are presented in volume I, section 4.15.1.3. DOE has committed to implement the risk reduction measures proposed by this group. Based on the discussion in volume I, section 4.15.7, it is not possible to fully characterize the risk reduction that would result with implementation of the Overflight Working Group initiatives using the current methodology. However, it is estimated that implementation of the MOU, the offset localizer, relocation of the VORTAC, and 65 percent use of GPS non-precision approach tracks would result in an 82 percent cumulative risk reduction (DOE 1995:22). This 82 percent reduction was estimated using the Solomon model. Fortification of areas and structures in which nuclear materials are handled and stored could further reduce the impact of aircraft accidents.

E.3.2 Manzano Weapons Storage Area

The Manzano WSA is located near the Albuquerque International Airport, a major airport whose routine flight operations include many heavy aircraft. The methodology used to assess the aircraft impact probability is very similar to the analysis performed for the Pantex Plant, but in much less detail because there is only one building type to be analyzed.

The Manzano WSA is located in the foothills of the Manzano Mountains, approximately 6.5 kilometers (4 miles) southeast of the main (east-west) runway of the Albuquerque International Airport, one of three airports in the vicinity the Manzano WSA. The Albuquerque International

Airport is the major commercial airfield in the State of New Mexico; it is the only airport with regular commercial jet service. In addition to its role as a commercial airfield, the Albuquerque International Airport is used by military aircraft at KAFB. In 1994, the Albuquerque International Airport had 220,914 aircraft operations (take-offs and landings) (PC 1996a).

In addition to the Albuquerque International Airport, there are two other airports in the Albuquerque area. Coronado Airport, approximately 19 kilometers (12 miles) to the north-northwest, has two runways used only by general aviation aircraft. Similarly, Alameda Airport, approximately 24 kilometers (15 miles) to the northwest, has two runways used only by general aviation aircraft.

A description of the x and y coordinate system, the category of aircraft operations that occur, and a screening of the probability density function values for the three airports is presented in Table E.3.2–1. An initial screening of the probability density function values for the type of aircraft operations eliminated the Coronado and Alameda Airports. Both of these airports are outside the probability density function boundary for general aviation aircraft and, therefore, were not included in the aircraft crash analysis. Only the Albuquerque International Airport and non-airport (in-flight) aircraft were included in the analysis as required by the Draft DOE Standard (DOE 1996g).

In the history of the Manzano WSA facility, there have been three aircraft crashes. One of the crashes involved an F-100C. The crash occurred east of the Manzano WSA administration area. Another crash involved a B-29 in the northern portion of the site. The aircraft departed from KAFB and crashed after approximately three minutes in flight, killing the crew. The third crash also occurred in the northern portion of the site and involved an EC-135 (KAFB 1993:69,73,74).

A major advantage offered by the Manzano WSA storage facilities is the amount of rock overburden that would shield the stored pits from damage due to aircraft accidents. This overburden is needed because the candidate storage facilities lack an automatic fire suppression system and cannot rely on prompt response from local fire fighters (due to remote facility location and lack of automatic fire detection capability).

If DOE chooses to relocate pits to the Manzano WSA, the pits would be stored in Type D magazines. Type D magazines (as shown in Figure 5.5.1.12–1 in volume I) have access tunnels that vary in length from 20 meters to over 30 meters (65 feet to over 100 feet). The main chambers are approximately 19 meters (61 feet) long and have the capacity to store up to 800 pit containers each in a Stage Right configuration. The main chamber is protected by two vault-like steel doors at both ends of the access tunnel.

Type D facilities are tunneled into the mountainside and thus, provide significant earth overburden protection from penetrating aircraft. As many as 35 magazines have overburden greater than 9 meters (30 feet) and are potentially available for pit storage.

For the 20,000 pit storage option, approximately 25 Type D magazines would be utilized. For the 8,000 pit storage option, approximately 10 Type D magazines would be utilized. The frequency of an aircraft impact at the Manzano WSA is relatively high compared with other potential storage sites. However, the earth overburden of Type D magazine provides significant protection against potential damage from aircraft impacts.

E.3.2.1 *Aircraft Crash Affected Environment*

An adjustment to the Near-Airport and Non-Airport Models consisted of manipulation of the

ɔdes (i), aircraft categories (j), and ɔurces (k) to fit the Manzano WSA site. t mode, i, was set equal to three flight

i = 1 Take-off

i = 2 In-flight

i = 3 Landing

raft categories are very similar to 'lant, except helicopters have been ɔecause they are not shown to be ıg missiles.

j = 1 Commercial: Air Carrier

j = 2 Commercial: Air Taxi

j = 3 Military: Large (Bomber, Cargo, and Tanker aircraft)

j = 4 Military: Small (Attack, Fighter, and Trainer aircraft)

j = 5 General: Fixed-wing, reciprocating, single-engine

j = 6 General: Fixed-wing, reciprocating, multi-engine

j = 7 General: Fixed-wing, turboprop

j = 8 General: Fixed-wing, turbojet

ıircraft sources, k, was summed over es

k = 1 Albuquerque International Airport Runway 1

k = 2 Albuquerque International Airport Runway 2

k = 3 Non-Airport Aircraft

Figure E.3.2.1–1 (not to scale, adapted from JDRC nd) represents the location of the Manzano WSA storage facilities in relation to east-west runway at the Albuquerque International Airport. There are three key points on Figure E.3.2.1–1 that were considered in assessing the aircraft impact probability:

1. Point 1, located at the geometric center of the east-west runway;
2. Point 2, located at the northern-most end of the candidate storage area;
3. Point 3, located at the south western end of the candidate storage area.

The aircraft impact probability assessment focuses on accidents in between points 2 and 3. The assessment was performed by separating the displacement vector from point 1 to both points 2 and 3 into two orthogonal components, a:

1. Vector coincident with a direct projection of the center-line of the runway; and
2. Vector, perpendicular to the first that extends from the first vector to the impact point (i.e., point 2 or point 3).

The lengths of these two vector components were used to determine the crash probability density. The length of the east-west runway at the Albuquerque International Airport is 4.2 kilometers (2.6 miles) (Smith 1995:9). Using this information, it was determined that the center-line and perpendicular distances from point 1 (the midpoint of the runway) to (JDRC nd):

	Runway 1 (east-west)	Runway 2 (north-south)
Point 2	5.88 miles, -0.22 miles	-0.22 miles, -5.88 miles
Point 3	4.71 miles, -2.78 miles	-2.78 miles, -4.71 miles

in volume

E.3.2.4 *Structural Calculation*

Given that an aircraft impacts into a Manzano WSA storage facility, there is only a risk to human health if the storage facility is penetrated and the storage containers are damaged sufficiently to release plutonium into the environment. Since the pits will be stored in AT-400A, a certified Type B shipping container, minor damage to the storage facility is not anticipated to cause container failure. However, significant damage to the storage facility is likely to damage containers sufficiently enough to cause a plutonium release.

A survey of Manzano WSA contour maps reveals that the minimum overburden for a facility is approximately 9 meters (30 feet). Therefore, the approach proposed for estimating the penetration probability is to determine if the velocity of the aircraft in take-off and landing modes is sufficient to penetrate 9 meters (30 feet) of rock, and then quantify the probability that the impact is sufficient to cause penetration.

A local response structural analysis was performed according to the Draft DOE Standard (DOE 1996g) for a facility with a 9 meter (30 feet) overburden. The analysis was performed for the maximum penetrator missile for each of the eight aircraft categories. The aircraft penetrators modeled, and if they penetrate the facility, are shown in Table E.3.2.4–1. None of the eight aircraft missiles were capable of penetrating the facility; therefore, the frequency of releasing material from one of the 25 Type D magazines was 0. Since the frequency of releasing material is less than 10^{-7}, in accordance with the Draft DOE Standard, no further analysis was required.

E.3.2.5 *Consequence Calculation*

The probability of an aircraft hitting a facility at Manzano WSA is 8.8×10^{-5}. The probability of damaging a facility by perforation is 0. Consistent with the Draft DOE Standard (DOE 1996g), a consequence analysis was not necessary.

E.3.3 Nevada Test Site

The airspace above NTS, designated as R4808, is a Special-Use Airspace identified by FAA regulations. This designation applies to all aircraft and is unlimited in height. Clearance to penetrate the restricted airspace above NTS must be obtained from DOE. Aircraft desiring to fly over NTS airspace are required to contact the DOE Operations Coordination Center at NTS. Requesters must provide information regarding the type of aircraft and nature of flight into the restricted airspace. DOE has approval authority for flights into the restricted airspace.

Based on penetration calculations performed for Manzano WSA and 9 meters (30 meters) of soil and rock, the proposed pit storage location inside of P-Tunnel at NTS is immune from aircraft accidents, since its location is approximately 240 meters (800 feet) below the mesa. Therefore, pits stored in P-Tunnel could not be affected by an aircraft crash (PC 1995b).

There are four airports and five landing strips in the vicinity of the Device Assembly Facility (DAF) and P-Tunnel. Las Vegas McCarran International Airport is the major commercial airfield in the State of Nevada. The airport, located approximately 122 kilometers (76 miles) southeast of NTS, is used by commercial, military, and general aviation aircraft. In 1994, McCarran International Airport had 488,347 aircraft operations (take-offs and landings).

Another airport located just north of McCarran International is the North Las Vegas Airport. This airport is used by commercial air taxi, military, and general aviation aircraft. In 1994, North Las Vegas Airport had 188,707 air taxi, military, and general aviation aircraft operations (PC 1996a). Nellis Air Force Base, located approximately 107 kilometers (67 miles)

southeast of NTS, is also north of McCarran International Airport and is used by only military aircraft. The closest airfield to NTS is Indian Springs Auxiliary Field. This airfield, approximately 48 kilometers (30 miles) southeast of the DAF, has two runways used only by military aircraft. Beatty Airfield, approximately 67 kilometers (42 miles) west of the DAF, has one runway and is used by general aviation aircraft.

There are five landing strips located on or near NTS. The most frequently used is the Desert Rock Airstrip, located in Area 22 southwest of Mercury. Desert Rock Airstrip has a single runway and is 30 kilometers (19 miles) south of the DAF. Two unnamed, single runway airstrips are located on NTS; one 6 kilometers (4 miles) north at Yucca Lake in Area 6, and the other 27 kilometers (17 miles) south in Area 22. Similarly, two unnamed, single-runway airstrips are located west of NTS; one 62 kilometers (39 miles) west-northwest and the other 78 kilometers (49 miles) north-northwest.

A description of the x and y coordinate system, the category of aircraft operations that occur, and a screening of the probability density function values for the four airports and five landing strips is presented in Table E.3.3–1. All nine airports are either outside the probability density function boundary for all categories of aircraft or the activity at the facility was sufficiently low so it was bounded by the in-flight activity. These airports, therefore, were not included in aircraft crash analysis. Only on-airport (in-flight) aircraft were included in the analysis as required by the Draft DOE Standard (DOE 1996g).

E.3.3.1 *Aircraft Crash Affected Environment*

An adjustment to the Near-Airport and Non-Airport Models consisted of manipulation of the flight modes (i), aircraft categories (j), and aircraft sources (k) to fit the NTS. The flight mode, i, was set equal to one flight mode.

i = 1 In-flight

The aircraft categories are very similar to Pantex Plant except helicopters have been omitted because they are not shown to be penetrating missiles.

j = 1 Commercial: Air Carrier

j = 2 Commercial: Air Taxi

j = 3 Military: Large (Bomber, Cargo, and Tanker aircraft)

j = 4 Military: Small (Attack, Fighter, and Trainer aircraft)

j = 5 General: Fixed-wing, reciprocating, single-engine

j = 6 General: Fixed-wing, reciprocating, multi-engine

j = 7 General: Fixed-wing, turboprop

j = 8 General: Fixed-wing, turbojet

Here the aircraft source, k, was summed over one phase

k = 1 Non-Airport Aircraft

An estimate of an aircraft crash into the DAF was generated using the probability equation defined in Section E.2.1. Using this information, the probability equation becomes:

$$F = \Sigma_{i=1}\Sigma_{j=1,8}\Sigma_{k=1} N_{ijk} \cdot A_{ij} \cdot f_{ijk}(x,y) \cdot P_{ijk}$$

The model for the aircraft in-flight was changed from a Solomon Model basis in the July 1995 version of the Draft DOE Standard (DOE

1995z) to the curve-fitted empirical Non-Airport Model in the July 1996 version of the Draft DOE Standard (DOE 1996g) based on crashes that have occurred throughout the country. The July 1996 Draft DOE Standard includes NPf(x,y) values for each DOE site. Only the area of the facility is calculated. The crash rate probabilities per square mile for NTS are provided in Table E.3.3.1–1.

E.3.3.2 *Area Calculation*

The DAF was modeled conservatively as a single facility with a length of 201 meters (659 feet), a width of 76 meters (250 feet), and a height of 9 meters (30 feet). (PC 1994). Using the methodology developed above for Pantex Plant for a rectangular facility:

$$A_t = (2 \cdot L \cdot W \cdot WS) \div R + (L \cdot W)$$

$$A_{sh} = (WS+R) \cdot H \cot\phi$$

$$R = (L^2 + W^2)^{0.5}$$

$$A_{sk} = (WS + R) \cdot S$$

An impact angle, ϕ, dependent on the aircraft category and the flight mode was used here as was done in the Pantex Plant analysis. Also, the representative maximum wingspan dimensions, WS, for each aircraft category used are also the same.

The total area for the structures includes the contribution from the skid area with the skid distances from the Draft DOE Standard (DOE 1996g). For large military aircraft, the take-off skid distance was used for in-flight aircraft since it was conservative. Table E.3.3.2–1 presents aircraft operational data for in-flight aircraft.

E.3.3.3 *Impact Probability Calculation*

With substitution of the above data into the probability equation, the impact probabilities listed in Table E.3.3.3–1 were obtained. Since the frequency of hitting the DAF, 1.5×10^{-6}, was greater than 10^{-7}, in accordance with the Draft DOE Standard (DOE 1996g) further analysis was required.

E.3.3.4 *Structural Calculation*

Given that an aircraft impacts into the DAF, there is only a risk to human health if the storage facility is penetrated and the storage containers are damaged sufficiently to release plutonium into the environment. Since the pits will be stored in AT–400A, a certified Type B shipping container, minor damage to the storage facility is not anticipated to cause container failure. However, significant damage to the storage facility may damage containers sufficiently enough to cause a plutonium release.

A local response structural analysis for the facility was performed according to the Draft DOE Standard, using a wall thickness of 46 centimeters (18 inches) (DOE 1986). This wall thickness was selected since it is the minimum thickness for the bays and cells where plutonium would be stored. An overburden of 1.5 meters (5 feet) was included for three sides and the roof of the facility. On the fourth side of the facility only the wall was modeled. The analysis was performed for the maximum penetrator missile for each of the eight aircraft categories. Commercial air carrier, large military, and small military aircraft were the only three aircraft that could produce missiles capable of penetrating the side of the facility without an overburden. The aircraft penetrators modeled, and if they penetrate the facility, are presented in Table E.3.3.4–1.

E.3.3.5 *Release Probability Calculation*

The impact probability calculation was repeated for the commercial air carrier, large military, and small military aircraft categories to

determine the release probability. Only the side of the facility without an overburden was included. With substitution of the above data into the probability equation, the release probabilities were 1.3×10^{-8}, 3.7×10^{-9}, and 6.3×10^{-8}, respectively.

E.3.3.6 *Consequence Calculation*

The probability of an aircraft hitting the DAF at NTS is 1.5×10^{-6}. The probability of damaging the DAF due to perforation is 8.1×10^{-8}. The P-Tunnel was not analyzed since pits stored there would be immune from aircraft accidents. Consistent with the Draft DOE Standard (DOE 1996g), a consequence analysis has not been performed for this site.

E.3.4 Savannah River Site

There are four airports in the vicinity of the P-Reactor at SRS. Bush Field, the major commercial airfield in the area, has two runways and is approximately 38 kilometers (24 miles) west-northwest of the P-Reactor. The airport is used by commercial, military, and general aviation aircraft. In 1994, Bush Field had 39,461 aircraft operations (take-offs and landings) (PC 1996a). The closest airport, the county airport near Barnwell, has three runways used by general aviation aircraft, and is approximately 18 kilometers (11 miles) east of P-Reactor. Similarly, Aiken Airport, near Aiken, is approximately 46 kilometers (29 miles) north-northwest and has three runways used by general aviation aircraft. The North Army Base is approximately 61 kilometers (38 miles) northeast and has one runway used by military aircraft.

description of the x and y coordinate system, e category of aircraft operations that occur, nd a screening of the probability density nction values for the four airports is presented Table E.3.4–1. All four airports are outside e probability density function boundary for all tegories of aircraft and therefore were not included in the aircraft crash analysis. Only non-airport (in-flight) aircraft were included in the analysis as required by the Draft DOE Standard (DOE 1996g).

E.3.4.1 *Aircraft Crash Affected Environment*

An adjustment to the Near-Airport and Non-Airport Models consisted of manipulation of the flight modes (i), aircraft categories (j), and aircraft sources (k) to fit the SRS. The flight modes, i, was set equal to one flight mode.

i = 1 In-flight

The aircraft categories are very similar to Pantex Plant, except helicopters have been omitted because they are not shown to produce penetrating missiles.

j = 1 Commercial: Air Carrier

j = 2 Commercial: Air Taxi

j = 3 Military: Large (Bomber, Cargo, and Tanker aircraft)

j = 4 Military: Small (Attack, Fighter, and Trainer aircraft)

j = 5 General: Fixed-wing, reciprocating, single-engine

j = 6 General: Fixed-wing, reciprocating, multi-engine

j = 7 General: Fixed-wing, turboprop

j = 8 General: Fixed-wing, turbojet

Here the aircraft source, k, was summed over one phase

k = 1 Non-Airport Aircraft

An estimate of an aircraft crash into the P-Reactor was generated using the probability equation defined in Section E.2.1. Using this information, the probability equation becomes:

$$F = \Sigma_{i=1}\Sigma_{j=1,8}\Sigma_{k=1} N_{ijk} \cdot A_{ij} \cdot f_{ijk}(x,y) \cdot P_{ijk}$$

The model for the aircraft in-flight was changed from a Solomon Model basis in the July 1995 version of the Draft DOE Standard (DOE 1995z) to the curve-fitted empirical Non-Airport Model in the July 1996 version of the Draft DOE Standard (DOE 1996g) based on crashes that have occurred throughout the country. The July 1996 Draft DOE Standard includes NPf(x,y) values for each DOE site. Only the area of the facility is calculated. The crash rate probability per square mile for SRS is provided in Table E.3.4.1–1.

E.3.4.2 *Area Calculation*

The P-Reactor was modeled conservatively as a facility with a length of 69 meters (225 feet), a width of 57 meters (187 feet), and a height of 9 meters (30 feet). (PC 1996b). Using the methodology developed above for Pantex Plant for a rectangular facility:

$$A_t = (2 \cdot L \cdot W \cdot WS) \div R + (L \cdot W)$$

$$A_{sh} = (WS+R) \cdot H\cot\phi$$

$$R = (L^2 + W^2)^{0.5}$$

$$A_{sk} = (WS + R) \cdot S$$

An impact angle, ϕ, dependent on the aircraft category and the flight mode was used here, as was done in the Pantex Plant analysis. The representative maximum wingspan dimensions, WS, for each aircraft category used are also the same.

The total area for the structures includes the contribution from the skid area with the skid distances from the Draft DOE Standard (DOE 1996g). For large military aircraft, the take-off skid distance was used for in-flight aircraft since it was conservative. Table E.3.4.2–1 presents aircraft operational data for in-flight aircraft.

E.3.4.3 *Impact Probability Calculation*

With substitution of the above data into the probability equation, the impact probabilities listed in Table E.3.4.3–1 were obtained. Since the frequency of hitting the P-Reactor, 1.2×10^{-6}, is greater than 10^{-7}, in accordance with the Draft DOE Standard (DOE 1996g), further analysis was required.

E.3.4.4 *Structural Calculation*

Given that an aircraft crashes into the P-Reactor, there is only a risk to human health if the storage facility is penetrated and the storage containers are damaged sufficiently to release plutonium into the environment. Since the pits will be stored in AT-400A, a certified Type B shipping container, minor damage to the storage facility is not anticipated to cause container failure. However, significant damage to the storage facility may damage containers sufficiently enough to cause a plutonium release.

A local response structural analysis for the facility was performed according to the Draft DOE Standard (DOE 1996g) using a wall thickness of 76 centimeters (30 inches). The analysis was performed for the maximum penetrator missile for each of the eight aircraft categories. Commercial air carrier and large military aircraft were the only two aircraft capable of producing missiles capable of penetrating the facility. The aircraft penetrators modeled, and if they penetrate the facility, are presented in Table E.3.3.4–1.

E.3.4.5 *Release Probability Calculation*

The impact probability calculation was repeated for the commercial air carrier and large military aircraft categories to determine the release probability. With substitution of the above data into the probability equation, the release probabilities were 7.1×10^{-9} and 2.2×10^{-9}, respectively.

E.3.4.6 *Consequence Calculation*

The probability of an aircraft hitting the P-Reactor at SRS is 1.2×10^{-6}. The probability of damaging the P-Reactor by perforation is 9.2×10^{-9}. Consistent with the Draft DOE Standard (DOE 1996g), a consequence analysis has not been performed for this site.

E.3.5 Hanford Site

The FAA maintains a Very High Frequency Omni-Directional Radio Range navigation aid at the Tri-Cities Airport. Several Federal airways pass in proximity of the Fuels and Materials Examination Facility (FMEF). However, the FAA reports that these routes have low usage (WHC 1991). There are no military installations or training routes that would place military aircraft in the vicinity of FMEF.

There are five airports and one landing strip in the vicinity of the FMEF. The Tri-Cities Airport, the major commercial airfield in the area, is approximately 27 kilometers (17 miles) southeast of the FMEF. The airport's two runways are used by commercial, military, and general aviation aircraft. In 1994, the Tri-Cities Airport had 81,867 aircraft operations (take-offs and landings) (PC 1996a). The closest airport, the Richland Airport, is approximately 13 kilometers (8 miles) southeast of FMEF, and has three runways used only by general aviation aircraft. Vista Field in Kennewick, approximately 26 kilometers (16 miles) south-southeast, has two runways used only by general aviation aircraft. Beardsley Field near Prosser, approximately 42 kilometers (26 miles) southwest, has one runway used only by general aviation aircraft. Sunnyside Airport, 48 kilometers (30 miles) west-southwest, has one runway used by general aviation aircraft. There is an unnamed landing strip near Horse Heaven Hills, approximately 32 kilometers (20 miles) south-southwest, which has one runway, and is used only by general aviation aircraft.

A description of the x and y coordinate system, the category of aircraft operations that occur, and a screening of the probability density function values for the five airports and one landing strip is presented in Table E.3.5-1. All four general aviation airports and the landing strip are outside the probability density function boundary for general aviation aircraft and, therefore, were not included in the aircraft crash analysis. For the Tri-Cities Airport, only small military aircraft in the landing mode had a nonzero probability density function value. Therefore, only these aircraft in the landing mode at the Tri-Cities Airport and non-airport (in-flight) aircraft were included in the analysis as required by the Draft DOE Standard (DOE 1996g).

E.3.5.1 *Aircraft Crash Affected Environment*

An adjustment to the Near-Airport and Non-Airport Models consisted of manipulation of the flight modes (i), aircraft categories (j), and aircraft sources (k) to fit the Hanford Site. The flight mode, i, was set equal to two flight modes.

$i = 1$ In-flight

$i = 2$ Landing

The aircraft categories are very similar to Pantex Plant, except helicopters have been

1995z) to the curve-fitted empirical Non-Airport Model in the July 1996 version of the Draft DOE Standard (DOE 1996g) based on crashes that have occurred throughout the country. The July 1996 Draft DOE Standard includes NPf(x,y) values for each DOE site. Only the area of the facility is calculated. The crash rate probability per square mile for Hanford are provided in Table E.3.5.1–4.

E.3.5.2 *Area Calculation*

The FMEF was modeled conservatively as a facility with a length of 98 meters (320 feet), a width of 47 meters (155 feet), and a height of 21 meters (70 feet). (DOE 1994). Using the methodology developed above for Pantex Plant for a rectangular facility:

$$A_t = (2 \cdot L \cdot W \cdot WS) \div R + (L \cdot W)$$

$$A_{sh} = (WS+R) \cdot H\cot\phi$$

$$R = (L^2 + W^2)^{0.5}$$

$$A_{sk} = (WS + R) \cdot S$$

An impact angle, ϕ, dependent on the aircraft category and the flight mode was used here as was done in the Pantex Plant analysis. The representative maximum wingspan dimensions, WS, for each aircraft category used are also the same.

The total area for the structures includes the contribution from the skid area with the skid distances from the Draft DOE Standard (DOE 1996g). For large military aircraft, the take-off skid distance was used for in-flight aircraft since it was conservative. Table E.3.5.2–1 presents aircraft operational data for in-flight aircraft and landings.

E.3.5.3 *Impact Probability Calculation*

With substitution of the above data into the probability equation, the impact probabilities listed in Table E.3.5.3–1 were obtained. Since the frequency of hitting the FMEF, 1.2×10^{-6}, was greater than 10^{-7}, in accordance with the Draft DOE Standard (DOE 1996g), further analysis was required.

E.3.5.4 *Structural Calculation*

Given that an aircraft impacts into the FMEF, there is only a risk to human health if the storage facility is penetrated and the storage containers are damaged sufficiently to release plutonium into the environment. Since the pits will be stored in AT–400A, a certified Type B shipping container, minor damage to the storage facility is not anticipated to cause container failure. However, significant damage to the storage facility may damage containers sufficiently enough to cause a plutonium release.

A local response structural analysis for the facility was performed according to the Draft DOE Standard (DOE 1996g), using a wall thickness of 122 centimeters (48 inches). The analysis was performed for the maximum penetrator missile for each of the eight aircraft categories. None of the eight aircraft missiles were capable of penetrating the facility; therefore, the frequency of releasing material from the FMEF was 0. The aircraft penetrators modeled, and if they penetrate the facility are presented in Table E.3.5.4–1.

E.3.5.5 *Consequence Calculation*

The probability of an aircraft hitting the FMEF at Hanford is 1.2×10^{-6}. The probability of damaging the FMEF by perforation is 0. Consistent with the Draft DOE Standard (DOE 1996g), a consequence analysis is not necessary for this site.

REFERENCES

ANPP 1975 — Solomon, K.A., *Estimate of the Probability That an Aircraft Will Impact the PVNGS,* Revision 1, NUS-1416, prepared by NUS Corporation, Sherman Oaks, California, for Arizona Nuclear Power Project, July 25, 1975.

Barnard 1990 — Barnard Dunkelberg and Company, *Airport Master Plan Update, Amarillo International Airport*, Prepared for the City of Amarillo, Amarillo, TX, October 1990.

DOE 1986 — DOE, *Preliminary Safety Analysis Report, Device Assembly Facility,* Nevada Test Site, January 1986.

DOE 1994 — DOE, *FMEF Feasibility Assessment for Plutonium Storage*, February 23, 1994.

DOE 1995a — DOE, *Summary Report of the Overflight Working Group on Recommended Measures to Reduce Overflights of the Pantex Plant*, prepared by the Department of Energy, February 1995.

DOE 1995z — DOE, Draft Final DOE Standard, *Accident Analysis for Aircraft Crash into Hazardous Facilities*, SAFT-0030 prepared under Contract DOE-STD-3014-96, for the U.S. Department of Energy, Washington, DC, July 1995.

DOE 1996 — DOE, Draft Final DOE Standard, *Accident Analysis for Aircraft Crash into Hazardous Facilities*, SAFT-0030 prepared under Contract DOE-STD-3014-96, for the U.S. Department of Energy, Washington, DC, July 1996.

DOT 1985 — National Air Traffic Training Program, *Cooperative Education Student Reference Manual*, Module B Course 55322, Aircraft Identification, U.S. Department of Transportation, Federal Aviation Administration, MB-SRM-2, April 1985.

DOT 1994 — 7110.65H Air Traffic Control, Change 1 Appendix A, B, & C, U.S. Department of Transportation, Federal Aviation Administration, January 6, 1994.

Drake 1994 — Drake, James R., *Aircraft Impacts Effects on Weapons Storage Facilities Final Report*, prepared for Logicon by R&D Associates, Los Angeles, CA, March 1994.

Jacobs 1992 — Pantex Plant, *Hazardous Materials Hazards Assessment for Pantex Radiological Hazards Assessment for Pantex Plant, Amarillo, TX*, prepared by Jacobs Engineering Group, Inc., Albuquerque, NM, in conjunction with Ogden Environmental and Energy Services Company, Albuquerque, NM, for Pantex Plant, Amarillo, TX, November 1992.

Jacobs 1993 — Pantex Plant, *Recalculation of Potential Deposition Levels and Dose Exposure levels for Pantex Radiological Hazards Assessment for Pantex Plant, Amarillo, TX*, prepared by Jacobs Engineering Group, Inc., Albuquerque, NM in conjunction with Ogden Environmental and Energy Services Company, Albuquerque, NM, for Pantex Plant, Amarillo, TX, October 1993.

Jacobs 1993a — Pantex Plant, *Chemical High Explosives Hazards Assessment for Pantex Radiological Hazards Assessment for Pantex Plant, Amarillo, TX*, prepared by Jacobs Engineering Group, Inc., Albuquerque, NM, in conjunction with Ogden Environmental and Energy Services Company, Albuquerque, NM, for Pantex Plant, Amarillo, TX, October 1993.

Janes 1961-1996 — *All the World's Aircraft*, Janes Information Group, Inc., Alexandria, VA, Editions: 51, 53, 60, 62, 70, 71, 75, 81, 85, 86, for the years 1961-62, 1963-64, 1970-71, 1980-81, 1981-82, 1985-86, 1990-91, 1994-95, 1995-96.

JDRC nd — J.D. Resource Center of Albuquerque, Inc., *Map of Albuquerque, NM*, "NASA Recorded This Unique Perspective from the Landsat 4 Satellite Orbiting 435 Miles In Space."

KAFB 1993 — Los Alamos Technical Associates, Inc., *Phase I Environmental Baseline Survey Manzano Weapons Storage Area*, F29601-89-C-0079 prepared by Los Alamos Technical Associates, Inc., for the Kirtland Air Force Base Research Facilities Engineering Division and Phillips Laboratory, August 1993.

LLNL 1995 — Kimura, C.Y., et. al., *Data Development Technical Support Document for the Aircraft Crash Risk Analysis Methodology (ACRAM) Standard*, Draft Lawrence Livermore National Laboratory, Report, April 1995.

Pantex 1996 — Pantex Plant, *Safety Information Document*, prepared for the U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM, October 1995 (2nd Revision).

PC 1994 — Longmire, P., Warhead Interim Storage Alternative, fax from Paul Longmire, Sandia National Laboratories, Albuquerque, NM, to Harry Season, Department of Energy, Albuquerque Operations Office, Albuquerque, NM, August 19, 1994.

PC 1995 — Burns, R, Fax from Randy Burns, Federal Aviation Administration, Amarillo International Airport, to Bret Simpkins, Tetra Tech, Inc., Amarillo, TX, September 11, 1995.

PC 1995a — Puroff, C.A., Aircraft Overflight Data, SWEIS request for information, supplied by C.A. Puroff, Amarillo International Airport, to Bret Simpkins, Tetra Tech, Inc., Amarillo, TX, September 25, 1995.

PC 1995b — Battelle Pantex and Mason & Hanger-Silas Mason Co., Inc., *1994 Environmental Report for the Pantex Plant*, DOE/AL/65030-9506, prepared under Contract DE-AC04-91AL65030, by Environmental Protection Department, Environment, Safety and Health Division, for U.S. Department of Energy, Albuquerque Operations Office, Amarillo Area Office, Amarillo, TX, June 1995.

PC 1995c — McNolte, M., Military Takeoff on Runway 4, telephone conversation from M. McNolte, September 21, 1995.

PC 1995d — Tripathi, B., Model for Velocity Reduction in Overburdens, Telephone Conversation from B. Tripathi, September 21, 1995.

PC 1995e — McBride, Dave, "Request for Length, Width and Height of Subject Buildings," SWEIS request for information, supplied by Dave McBride to Davin Greenly, Tetra Tech, Inc., Amarillo, TX, June 8, 1995.

PC 1996 — Glover, J., Input for Pantex Plant EIS Document, Internal Memorandum from Jeff Glover, Pantex, Risk Management, to Steve Young, Pantex Risk Management, Amarillo, TX, August 6, 1996.

PC 1996a — Trembley, N., FAA Traffic Control Tower Information, fax from Nancy Trembley, Office of Aviation Policy Plans and Management Analysis, APO-110, to Davin Greenly, Tetra Tech, Inc., Amarillo, TX, May 14, 1996.

PC 1996b — Matthews, R.S., Building Blueprint, fax from R. S. Matthews, SRS, NMP Planning, to Jeff Petraglia, Tetra Tech, Inc., August 1, 1996.

Smith 1995 — Smith D., "Assessment of Jupiter Facility," notes provided to Brett Simpkins, July 18, 1995.

SNL 1976 — Krivokapich, B.E., *An Assessment of the Probability of Aircraft Impact with Pantex Plant Structures,* SAND76-0120, prepared by Sandia National Laboratories, Albuquerque, NM, June 1976.

USGS 1953 — U.S. Geological Survey, *Sevenmile Basin Quadrangle Texas 7.5 Minute Series Topographic Map*, U.S. Department of the Interior, Denver, CO, 1953.

USGS 1953a — U.S. Geological Survey, *Mayer, Texas Quadrangle 7.5 Minute Series Topographic Map*, U.S. Department of the Interior, Denver, CO, 1953.

USGS 1956 — U.S. Geological Survey, *Washburn, Texas Quadrangle 7.5 Minute Series Topographic Map*, U.S. Department of the Interior, Denver, CO, 1956.

USGS 1973 — U.S. Geological Survey, *Pullman, Texas Quadrangle 7.5 Minute Series Topographic Map*, U.S. Department of the Interior, Denver, CO, 1973.

WHC 1991 — Westinghouse Hanford Company, *Aircraft Hazards to the Fast Flux Test Facility,* Richland, WA, November 1991.

USGS 1978 — U.S. Geological Survey, *Albuquerque Quadrangle,* N3500-W10600/30x60, U.S. Department of Interior, Denver, CO, 1978.

TABLE E.2.1–1.—*Aircraft Crash Rates*

AIRCRAFT CATEGORY	CRASH RATE	
	TAKE-OFF (PER TAKE-OFF)	LANDING (PER LANDING)
COMMERCIAL		
Air Carrier	2.0×10^{-7}	2.6×10^{-7}
Air Taxi	1.0×10^{-6}	2.3×10^{-6}
MILITARY		
Large[a]	5.7×10^{-7}	1.6×10^{-6}
Small[b]	1.8×10^{-6}	3.3×10^{-6}
GENERAL AVIATION		
Fixed-wing, single-engine piston	1.1×10^{-5}	2.0×10^{-5}
Fixed-wing, multiple-engine piston	9.3×10^{-6}	2.3×10^{-5}
Fixed-wing, turboprop	3.5×10^{-6}	8.3×10^{-6}
Fixed-wing, turbojet	1.4×10^{-6}	4.7×10^{-6}
HELICOPTERS		
All	2.5×10^{-5}	See Note 1

[a]Large military aircraft include bomber, cargo, and tanker aircraft.
[b]Small military aircraft include fighter, attack, and trainer aircraft
[1]Helicopter crashes are considered per flight crashes and reported under take-off for convenience.
Source: DOE 1996g:B-3

TABLE E.2.1–2.—*DOE Site-Specific Values of NPf(x,y) (in crashes per square mile, per year, centered at the site)*

SITE	AIR CARRIER	AIR TAXI	LARGE MILITARY	SMALL MILITARY	GENERAL AVIATION
Maximum	8×10^{-7}	1×10^{-5}	7×10^{-7}	6×10^{-6}	3×10^{-3}
Minimum	2×10^{-8}	6×10^{-7}	6×10^{-8}	4×10^{-8}	1×10^{-7}
Average CONUS	1×10^{-7}	2×10^{-6}	2×10^{-7}	4×10^{-6}	2×10^{-4}
Argonne National Laboratory	3×10^{-7}	6×10^{-6}	9×10^{-8}	8×10^{-7}	3×10^{-3}
Brookhaven National Laboratory	8×10^{-7}	1×10^{-5}	7×10^{-7}	2×10^{-7}	5×10^{-4}
Hanford Site	5×10^{-8}	2×10^{-6}	1×10^{-7}	4×10^{-8}	1×10^{-4}
Idaho National Engineering Laboratory	2×10^{-8}	6×10^{-7}	9×10^{-8}	7×10^{-7}	9×10^{-5}
Kansas City Plant	1×10^{-7}	2×10^{-6}	2×10^{-7}	1×10^{-6}	7×10^{-4}
Los Alamos National Laboratory	6×10^{-8}	4×10^{-7}	1×10^{-7}	5×10^{-6}	2×10^{-4}
Lawrence Livermore National Laboratory	2×10^{-7}	3×10^{-6}	2×10^{-7}	3×10^{-6}	1×10^{-4}
Mound Plant	2×10^{-7}	5×10^{-6}	1×10^{-7}	2×10^{-6}	3×10^{-4}
Nevada Test Site	2×10^{-7}	3×10^{-6}	2×10^{-7}	6×10^{-6}	8×10^{-5}
Oak Ridge National Laboratory	2×10^{-7}	3×10^{-6}	1×10^{-7}	6×10^{-7}	1×10^{-3}
Pantex Plant	6×10^{-8}	4×10^{-7}	1×10^{-7}	5×10^{-6}	7×10^{-5}
Pinellas Plant	1×10^{-7}	2×10^{-6}	2×10^{-7}	4×10^{-6}	3×10^{-4}
Rocky Flats Plant	6×10^{-8}	9×10^{-7}	9×10^{-8}	9×10^{-7}	2×10^{-3}
Sandia National Laboratories	6×10^{-8}	4×10^{-7}	1×10^{-7}	5×10^{-6}	8×10^{-4}
Savannah River Site	2×10^{-7}	3×10^{-6}	1×10^{-7}	6×10^{-7}	2×10^{-4}

Source: DOE 1996g:B-24, B-25

TABLE E.3.1.2–1.—*Amarillo International Airport Flight Operations by Aircraft Category*

AIRCRAFT CATEGORY	FLIGHT OPERATIONS	RW 22 TAKE-OFFS	RW 22 LAND-INGS	RW 04 TAKE-OFFS	RW 04 LAND-INGS	RW 31 TAKE-OFFS	RW 31 LAND-INGS
Air Carrier	13,174	4,222	4,222	2,365	2,365	0	0
Air Taxi	9,938	2,881	2,881	1,614	1,614	474	474
Large Military	13,494	4,325	4,325	2,422	2,422	0	0
Small Military	27,146	7,870	7,870	4,408	4,408	1,295	1,295
Single-Engine Piston	12,762	3,700	3,700	2,072	2,072	609	609
Multi-Engine Piston	5,766	1,672	1,672	936	936	275	275
Turboprop	4,966	1,440	1,440	806	806	237	237
Turbojet	5,640	1,635	1,635	916	916	269	269
Helicopters	233	0	0	0	0	0	0
Total	93,119	27,745	27,745	15,539	15,539	3,159	3,159

RW - Runway
Source: PC 1996a

TABLE E.3.1.4–1.—*Zone 4 Building Dimensions*

	MRs ROW 1	MRs ROW 2	MRs OTHER	3 SACs ROW 1	5 SACs ROW 1	3 SACs ROW 2
Building Length (ft)	44.7	44.7	44.7	43	43	43
Building Width (ft)	34	34	34	153	278.4	153
Building Height (ft)	15.5	15.5	15.5	17.4	17.4	17.4

MR - Modified Richmond
Source: Pantex 1996

TABLE E.3.1.4–2.—*Zone 4 Aircraft Operational Data: Take-off, In-flight, and Landing*

	AIR CARRIER	AIR TAXI	LARGE MILITARY	SMALL MILITARY	GEN. SINGLE ENGINE	GEN. MULTI-ENGINE	GEN. TURBO-PROP	GEN. TURBO-JET	HELI-COPTERS
DOE Standard Wingspan (ft)	98	59	223	78	50	50	73	50	50
Representative Wingspan (ft)	110.7	65.1	150.9	39.8	43.1	40.7	63.3	45.7	50
Take-off Skid Length (ft)	1,570	1,570	780[a]	246	68	68	68	68	0
Landing Skid Length (ft)	1,570	1,570	368	447[a]	68	68	68	68	0
Mean cotϕ	9.6	9.6	7.4T[a] 9.7 L	8.4T[a] 10.4 L	8.2	8.2	8.2	8.2	0.58
NPf(x,y)	6×10^{-8}	4×10^{-7}	1×10^{-7}	5×10^{-6}	3.1×10^{-5}	1.4×10^{-5}	1.2×10^{-5}	1.4×10^{-5}	N/A
Take-off Effective Areas (mi^2)	0.2893	0.2290	0.2138	0.0577	0.0376	0.0370	0.0430	0.0383	0.0079
Landing Effective Areas (mi^2)	0.2893	0.2290	0.1344	0.0855	0.0376	0.0370	0.0430	0.0383	0.0079
In-flight Effective Areas (mi^2)	0.2725	0.2209	0.2738	0.1108	0.0394	0.0394	0.0455	0.0394	0.0079

NA - Not available
[a]Conservatively used for in-flight.
Source: DOE 1996g

TABLE E.3.1.4–3.—*Zone 4 Aircraft Crash Location Probabilities: Runway 22*

AIRCRAFT CATEGORY	CRASH LOCATION PROBABILITY	
	TAKE-OFF (PER MILE^2)	LANDING (PER MILE^2)
Air Carrier	0.00	2.5×10^{-4}
Air Taxi	0.00	2.5×10^{-4}
Large Military	0.00	1.5×10^{-5}
Small Military	0.00	3.1×10^{-3}
Single-engine piston	0.00	5.0×10^{-4}
Multi-engine piston	0.00	5.0×10^{-4}
Turboprop	0.00	5.0×10^{-4}
Turbojet	0.00	5.0×10^{-4}
Helicopters	N/A	N/A

N/A - not applicable
Source: DOE 1996g:Tables B-2 to B-13

TABLE E.3.1.4–4.—*Zone 4 Aircraft Crash Location Probabilities: Runway 04*

AIRCRAFT CATEGORY	CRASH LOCATION PROBABILITY	
	TAKE-OFF (PER MILE^2)	LANDING (PER MILE^2)
Air Carrier	1.3×10^{-5}	0.00
Air Taxi	1.3×10^{-5}	0.00
Large Military	2.1×10^{-4}	0.00
Small Military	2.4×10^{-4}	0.00
Single-engine piston	0.00	0.00
Multi-engine piston	0.00	0.00
Turboprop	0.00	0.00
Turbojet	0.00	0.00
Helicopters	N/A	N/A

N/A - Not applicable
Source: DOE 1996g:Tables B-2 to B-13

TABLE E.3.1.4–5.—*Zone 4 Aircraft Crash Location Probabilities: Runway 31*

AIRCRAFT CATEGORY	CRASH LOCATION PROBABILITY	
	TAKE-OFF (PER MILE^2)	LANDING (PER MILE^2)
Air Carrier	N/A	N/A
Air Taxi	0.00	0.00
Large Military	N/A	N/A
Small Military	0.00	0.00
Single-engine piston	0.00	0.00
Multi-engine piston	0.00	0.00
Turboprop	0.00	0.00
Turbojet	0.00	0.00
Helicopters	N/A	N/A

N/A = Not applicable for air carrier and large military aircraft because these aircraft do not operate on this runway.
Source: DOE 1996g:Tables B-2 to B-13

TABLE E.3.1.4–6.—*Zone 4 Aircraft Crash Probabilities*

AIRCRAFT CATEGORY	CRASH PROBABILITY (PER YEAR)			
	RW 22 LANDING	RW 04 TAKE-OFF	NON-AIRPORT	TOTAL ZONE 4
Air Carrier	7.9×10^{-8}	1.8×10^{-9}	1.7×10^{-8}	9.8×10^{-8}
Air Taxi	3.8×10^{-7}	4.8×10^{-9}	8.8×10^{-8}	4.7×10^{-7}
Large Military	1.1×10^{-8}	9.6×10^{-8}	2.7×10^{-8}	1.3×10^{-7}
Small Military	6.2×10^{-6}	1.4×10^{-7}	5.5×10^{-7}	6.9×10^{-6}
Single-engine piston	1.4×10^{-6}	0.00	1.2×10^{-6}	2.6×10^{-6}
Multi-engine piston	7.1×10^{-7}	0.00	5.5×10^{-7}	1.3×10^{-6}
Turboprop	2.6×10^{-7}	0.00	5.4×10^{-7}	8.0×10^{-7}
Turbojet	1.5×10^{-7}	0.00	5.3×10^{-7}	6.8×10^{-7}
Helicopters	0.00	0.00	1.4×10^{-7}	1.4×10^{-7}
Total	9.2×10^{-6}	2.4×10^{-7}	3.6×10^{-6}	1.3×10^{-5}

Source: Calculated Values

TABLE E.3.1.4–7.—*Aircraft Missile Characteristics*

AIRCRAFT CATEGORY	IMPACT VELOCITY (FT/SEC)	ENGINE WEIGHT (LB)	ENGINE DIAMETER (IN)
Air Carrier	422	4,746	53
Air Taxi	422	775	28
Large Military	338	4,452	57
Small Military	422	917	28
Single-engine piston	152	408	26
Multi-engine piston	152	466	22
Turboprop	152	365	21
Turbojet	152	654	35
Helicopters	203	158	23

Sources: LLNL 1995; Jane's 1961-1996

TABLE E.3.1.4–10.—*Zone 4 Reduced Effective Areas (in square miles)*

	AIR CARRIER	AIR TAXI	LARGE MILITARY	SMALL MILITARY	GEN. SINGLE ENG.	GEN. MULTI-ENG.	GEN. TURBO-PROP	GEN. TURBO-JET	HELI-COPTERS
SCABBING/EXPLOSION AREAS									
Take-off	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
In-flight	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Landing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PERFORATION/EXPLOSION AND PERFORATION/FIRE AREAS									
Take-off	0.0113	0.00	0.0154	0.0093	0.00	0.00	0.00	0.00	0.00
In-flight	0.0108	0.00	0.0188	0.0110	0.00	0.00	0.00	0.00	0.00
Landing	0.0113	0.00	0.0129	0.0080	0.00	0.00	0.00	0.00	0.00

Source: Calculated Values

TABLE E.3.1.4–11.—*Zone 4 Aircraft Crash Probability per Year for Perforation Leading to Fire*

AIRCRAFT	RW 22 LANDING	RW 04 TAKE-OFF	NON-AIRPORT	TOTAL ZONE 4
Air Carrier	6.6×10^{-9}	1.5×10^{-10}	1.3×10^{-9}	8.1×10^{-9}
Air Taxi	0.00	0.00	0.00	0.00
Large Military	8.7×10^{-10}	5.8×10^{-9}	1.6×10^{-9}	8.3×10^{-9}
Small Military	4.5×10^{-7}	1.8×10^{-8}	4.4×10^{-8}	5.1×10^{-7}
Single-engine piston	0.00	0.00	0.00	0.00
Multi-engine piston	0.00	0.00	0.00	0.00
Turboprop	0.00	0.00	0.00	0.00
Turbojet	0.00	0.00	0.00	0.00
Helicopters	0.00	0.00	0.00	0.00
Total	4.6×10^{-7}	2.4×10^{-8}	4.7×10^{-8}	5.3×10^{-7}

Source: Calculated Values

TABLE E.3.1.4–12.—*Zone 4 Aircraft Crash Probability per Year for Perforation Leading to Explosion*

AIRCRAFT	RW 22 LANDING	RW 04 TAKE-OFF	NON-AIRPORT	TOTAL ZONE 4
Air Carrier	3.1×10^{-9}	7.0×10^{-11}	6.5×10^{-10}	3.8×10^{-9}
Air Taxi	0.00	0.00	0.00	0.00
Large Military	1.0×10^{-9}	6.9×10^{-9}	1.9×10^{-9}	9.8×10^{-8}
Small Military	5.9×10^{-7}	2.3×10^{-8}	5.5×10^{-8}	6.6×10^{-7}
Single-engine piston	0.00	0.00	0.00	0.00
Multi-engine piston	0.00	0.00	0.00	0.00
Turboprop	0.00	0.00	0.00	0.00
Turbojet	0.00	0.00	0.00	0.00
Helicopters	0.00	0.00	0.00	0.00
Total	5.9×10^{-7}	3.0×10^{-8}	5.8×10^{-8}	6.8×10^{-7}

Source: Calculated Values

TABLE E.3.1.5–1.—*Zone 12 Reduced Skid Distances*[1]

BUILDING	REDUCED SKID DISTANCES (FEET)
12-64	Commercial: 1,338
12-84	Commercial, Military: 210
12-99	Commercial, Large Military (T): 484
12-104	No Reduction
12-44	Commercial, Large Military (T): 758
12-85	Commercial, Large Military (T): 645
12-96	Commercial, Large Military (T), and Small Military: 307
12-98	No Reduction
12-41	No Reduction
12-50	Commercial, Large Military (T): 581
12-60	Commercial, Military (T): 678
12-94	Commercial, Large Military (T): 565
12-104A	No Reduction
12-44 Cell 8	Commercial, Military (T): 758
12-26 Pit Vault	No Reduction
12-42 North Vault	No Reduction
12-42 South Vault	No Reduction
12-116	No Reduction
12-58	Commercial, Large Military (T): 600

[1]The DOE Standard mean skid distances (in feet) are:
Commercial: 1,570
General Aviation: 68
Large Military: 780 (Take-off) 368 (Landing)
Small Military: 246 (Take-off) 447 (Landing)
Source: DOE 1996g:B-29, Figure 4.15.1.1-2

TABLE E.3.1.5–2.—*Zone 12 Building Dimensions*

BUILDING	BUILDING LENGTH (ft)	BUILDING WIDTH (ft)	BUILDING HEIGHT (ft)
12-64	360	73	23
12-84W	242	70	24
12-84E	155	60	24
12-99	204	70	20
12-104N	161	70	20
12-104S	161	70	20
12-44	400	120	38
12-85	114	72	38
12-96	114	72	38
12-98	270	102	39
12-50	35	35	44
12-60	140	100	14.2
12-41	182	67	21
12-94	80	63	15
12-44-8	114	72	38
12-26PV	22	21	14.5
12-42NV	30	22	10
12-42SV	30	22	10
12-104A	311	162	28
12-116	197	136	37
12-58	62	42	11

Sources: Pantex 1996; PC 1995e

TABLE E.3.1.5–3.—*Zone 12 Aircraft Operational Data: Take-off, In-Flight, and Landing*

	AIR CARRIER	AIR TAXI	LG MILITARY	SM. MILITARY	GEN. SINGLE ENG.	GEN. MULTI-ENG.	GEN. TURBO-PROP	GEN. TURBO-JET	HELI-COP-TERS
DOE Standard Wingspan (ft)	98	59	223	78	50	50	73	50	50
Representative Wingspan (ft)	110.7	65.1	150.9	39.8	43.1	40.7	63.3	45.7	50
Take-off Skid Length (ft)	1,570	1,570	780[a]	246	68	68	68	68	0
Landing Skid Length (ft)	1,570	1,570	368	447[a]	68	68	68	68	0
Mean cotϕ	9.6	9.6	7.4 T[a] 9.7 L	8.4 T[a] 10.4 L	8.2	8.2	8.2	8.2	0.58
NPf(x,y)	6×10^{-8}	4×10^{-7}	1×10^{-7}	5×10^{-6}	3.1×10^{-5}	1.4×10^{-5}	1.2×10^{-5}	1.4×10^{-5}	N/A
Take-off Effective Areas (mi^2)	0.2794	0.2351	0.2379	0.0847	0.0577	0.0571	0.0634	0.0585	0.0157
Landing Effective Areas (mi^2)	0.2794	0.2351	0.1504	0.1074	0.0577	0.0571	0.0634	0.0585	0.0157
In-flight Effective Areas (mi^2)	0.2670	0.2292	0.2759	0.1270	0.0597	0.0597	0.0661	0.0597	0.0157

[a]Conservatively used for in-flight.
Source: DOE 1996g

TABLE E.3.1.5–4.—*Zone 12 Aircraft Crash Location Probabilities: Runway 22*

AIRCRAFT CATEGORY	CRASH LOCATION PROBABILITY	
	TAKE-OFF (PER MILE^2)	LANDING (PER MILE^2)
Air Carrier	0.00	1.7×10^{-4}
Air Taxi	0.00	1.7×10^{-4}
Large Military	0.00	8.3×10^{-5}
Small Military	0.00	2.6×10^{-3}
Single-engine piston	0.00	5.6×10^{-4}
Multi-engine piston	0.00	5.6×10^{-4}
Turboprop	0.00	5.6×10^{-4}
Turbojet	0.00	5.6×10^{-4}
Helicopters	N/A	N/A

N/A - Not applicable
Source: DOE 1996g:Tables B-2 to B-13

TABLE E.3.1.5–5.—*Zone 12 Aircraft Crash Location Probabilities: Runway 04*

AIRCRAFT CATEGORY	CRASH LOCATION PROBABILITY	
	TAKE-OFF (PER MILE^2)	LANDING (PER MILE^2)
Air Carrier	1.2×10^{-5}	0.00
Air Taxi	1.2×10^{-5}	0.00
Large Military	9.8×10^{-4}	1.1×10^{-5}
Small Military	1.5×10^{-3}	0.00
Single-engine piston	0.00	0.00
Multi-engine piston	0.00	0.00
Turboprop	0.00	0.00
Turbojet	0.00	0.00
Helicopters	N/A	N/A

Source: DOE 1996g:Tables B-2 to B-13

TABLE E.3.1.5–6.—*Zone 12 Aircraft Crash Location Probabilities: Runway 31*

AIRCRAFT CATEGORY	CRASH LOCATION PROBABILITY	
	TAKE-OFF (PER MILE^2)	LANDING (PER MILE^2)
Air Carrier	N/A	N/A
Air Taxi	0.00	0.00
Large Military	N/A	N/A
Small Military	0.00	0.00
Single-engine piston	0.00	0.00
Multi-engine piston	0.00	0.00
Turboprop	0.00	0.00
Turbojet	0.00	0.00
Helicopters	N/A	N/A

N/A = Not applicable for commercial and large military aircraft because these aircraft do not operate on this runway.
Source: DOE 1996:Tables B-2 to B-13

TABLE E.3.1.5–7.—*Zone 12 Aircraft Crash Probabilities*

AIRCRAFT CATEGORY	CRASH PROBABILITY (PER YEAR)				
	RW 22 LANDING	RW 04 LANDING	RW 04 TAKE-OFF	NON-AIRPORT	TOTAL ZONE 12
Air Carrier	5.2×10^{-8}	0.00	1.6×10^{-9}	1.6×10^{-8}	7.0×10^{-8}
Air Taxi	2.7×10^{-7}	0.00	4.6×10^{-9}	9.2×10^{-8}	3.6×10^{-7}
Large Military	6.7×10^{-8}	4.9×10^{-9}	5.0×10^{-7}	2.9×10^{-8}	6.0×10^{-7}
Small Military	6.6×10^{-6}	0.00	1.3×10^{-6}	6.7×10^{-7}	8.5×10^{-6}
Single-engine piston	2.4×10^{-6}	0.00	0.00	1.8×10^{-6}	4.2×10^{-6}
Multi-engine piston	1.2×10^{-6}	0.00	0.00	8.3×10^{-7}	2.1×10^{-6}
Turboprop	4.2×10^{-7}	0.00	0.00	7.9×10^{-7}	1.2×10^{-6}
Turbojet	2.5×10^{-7}	0.00	0.00	8.1×10^{-7}	1.1×10^{-6}
Helicopters	0.00	0.00	0.00	2.7×10^{-7}	2.7×10^{-7}
Total	1.1×10^{-5}	4.9×10^{-9}	1.8×10^{-6}	5.3×10^{-6}	1.8×10^{-5}

Source: Calculated Values

TABLE E.3.1.5–8.—*Zone 12 Structural Scabbing Calculation*

BUILDING	OVER-BURDEN (FT)	THICK-NESS (IN)	AIR CARR-IER	AIR-TAXI	LARGE MILI-TARY	SMALL MILI-TARY	GEN-ERAL: SINGLE ENG.	GEN-ERAL: MULTI-ENG.	GEN-ERAL: TURBO-PROP	GEN-ERAL: TURBO-JET	HELI-COPTER
12-84W, 12-99, 12-104, W	13	18	ND	ND	ND	ND	ND	ND	ND	ND	ND
12-84W, 12-99, 12-104, R	2	18	D	ND	D	ND	ND	ND	ND	ND	ND
12-64R	2	9	D	D	D	D	ND	ND	ND	ND	ND
12-64 W	13	18	D	ND	ND	ND	ND	ND	ND	ND	ND
12-84E R	2	18	D	ND	D	ND	ND	ND	ND	ND	ND
12-84E W	0	36	ND	ND	ND	ND	ND	ND	ND	ND	ND
12-44, 12-85, 12-96, 12-98 R & W	17	12	ND	ND	ND	ND	ND	ND	ND	ND	ND
12-50 R	2	14	D	ND	D	D	ND	ND	ND	ND	ND
12-50 W	13	12	ND	ND	ND	ND	ND	ND	ND	ND	ND
12-60 R	2	0.3[a]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12-60 W	13	0.3[a]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12-41 R	0	0.1	D	D	D	D	D	D	D	D	D
12-41 W	0	0.1	D	D	D	D	D	D	D	D	D
12-94 R	0	36	D	ND	D	ND	ND	ND	ND	ND	ND
12-94 W	0	30	D	ND	D	ND	ND	ND	ND	ND	ND
CELL 8	17	12	ND	ND	ND	ND	ND	ND	ND	ND	ND
12-26 PIT VAULT R&W	0	12	D	D	D	D	D[b]	D	D[b]	D	D[b]
NORTH & SOUTH VAULT R&W	0	8	D	D	D	D	D	D	D	D	D
12-104A R & W	3	18	D	ND	ND	ND	ND	ND	ND	ND	ND
12-116 R & W	0	24	D	D	D	D	ND	ND	ND	ND	ND
12-58 R	3	12	D	ND	D	D	ND	ND	ND	ND	ND
12-58 W	25	12	ND	ND	ND	ND	ND	ND	ND	ND	ND

[a]Steel
[b]Scabbing occurs for the walls, but not the roof.
D = Damage; scabbing occurs.
R = Roof
N/A = Not applicable because it is a steel structure.
ND = No Damage; scabbing does not occur.
W = Walls
Source: Pantex 1996

TABLE E.3.1.5–9.—*Zone 12 Structural Perforation Calculation*

BUILDING	OVER-BURDEN (FT)	THICK-NESS (IN)	AIR CAR-RIER	AIR-TAXI	LARGE MILI-TARY	SMALL MILI-TARY	GEN-ERAL: SINGLE ENG.	GEN-ERAL: MULTI-ENG.	GEN-ERAL: TURBO-PROP	GEN-ERAL: TURBO-JET	HELI-COPTER
12-84W, 12-99, 12-104, W	13	18	ND	ND	ND	ND	ND	ND	ND	ND	ND
12-84W, 12-99, 12-104, R	2	18	D	ND	ND	ND	ND	ND	ND	ND	ND
12-64R	2	9	D	ND	D	D	ND	ND	ND	ND	ND
12-64 W	13	18	ND	ND	ND	ND	ND	ND	ND	ND	ND
12-84E R	2	18	D	ND	ND	ND	ND	ND	ND	ND	ND
12-84E W	0	36	ND	ND	ND	ND	ND	ND	ND	ND	ND
12-44, 12-85, 12-96, 12-98 R & W	17	12	ND	ND	ND	ND	ND	ND	ND	ND	ND
12-50 R	2	14	D	ND	ND	ND	ND	ND	ND	ND	ND
12-50 W	13	12	ND	ND	ND	ND	ND	ND	ND	ND	ND
12-60 R	2	0.3[a]	D	D	D	D	ND	ND	ND	ND	ND
12-60 W	13	0.3[a]	ND	ND	ND	ND	ND	ND	ND	ND	ND
12-41 R	0	0.1	D	D	D	D	D	D	D	D	D
12-41 W	0	0.1	D	D	D	D	D	D	D	D	D
12-94 R	0	36	ND	ND	ND	ND	ND	ND	ND	ND	ND
12-94 W	0	30	D[b]	ND	ND	ND	ND	ND	ND	ND	ND
CELL 8	17	12	ND	ND	ND	ND	ND	ND	ND	ND	ND
12-26 PIT VAULT R&W	0	12	D	D	D	D	ND	ND	ND	ND	ND
NORTH VAULT R&W SOUTH VAULT R&W	0	8	D	D	D	D	ND	ND	ND	ND	ND
12-104A R & W	3	18	ND	ND	ND	ND	ND	ND	ND	ND	ND
12-116 R & W	0	24	D	ND	D	ND	ND	ND	ND	ND	ND
12-58 R	3	12	D	ND	ND	ND	ND	ND	ND	ND	ND
12-58 W	25	12	ND	ND	ND	ND	ND	ND	ND	ND	ND

[a]Steel
[b]Perforation occurs for the walls but not the roof.
D = Damage; perforation occurs.
ND = No Damage; perforation does not occur.
R = Roof
W = Walls
Sources: Pantex 1996; PC 1995e

TABLE E.3.1.5–10.—*Zone 12 Reduced Effective Areas (in square miles)*

	AIR CARRIER	AIR TAXI	LARGE MILITARY	SMALL MILITARY	GEN. SINGLE ENG.	GEN. MULTI-ENG.	GEN. TURBO-PROP	GEN. TURBO-JET	HELI-COPTERS
SCABBING/EXPLOSION AREAS									
Take-off	0.0329	0.00	0.0257	0.0011	0.00	0.00	0.00	0.00	0.00
In-Flight	0.0319	0.00	0.0326	0.0015	0.00	0.00	0.00	0.00	0.00
Landing	0.0329	0.00	0.0206	0.0009	0.00	0.00	0.00	0.00	0.00
PERFORATION/EXPLOSION AREAS									
Take-off	0.0626	0.0439	0.0335	0.0135	0.0043	0.0043	0.0045	0.0043	0.0007
In-Flight	0.0608	0.0434	0.0374	0.0206	0.0044	0.0044	0.0046	0.0044	0.0007
Landing	0.0626	0.0439	0.0205	0.0184	0.0043	0.0043	0.0045	0.0043	0.0007
PERFORATION/FIRE AREAS									
Take-off	0.0513	0.0179	0.0351	0.0028	0.00	0.00	0.00	0.00	0.00
In-Flight	0.0480	0.0168	0.0454	0.0065	0.00	0.00	0.00	0.00	0.00
Landing	0.0513	0.0179	0.0197	0.0043	0.00	0.00	0.00	0.00	0.00

Source: Calculated Values

TABLE E.3.1.5–11.—*Zone 12 Aircraft Crash Probability per Year for Scabbing Leading to Explosion*

AIRCRAFT	RW 22 LANDING	RW 04 LANDING	RW 04 TAKEOFF	NON-AIRPORT	TOTAL ZONE 12
Air Carrier	6.1×10^{-9}	0.00	1.9×10^{-10}	1.9×10^{-9}	8.3×10^{-9}
Air Taxi	0.00	0.00	0.00	0.00	0.00
Large Military	9.1×10^{-9}	6.8×10^{-10}	5.4×10^{-8}	3.3×10^{-9}	6.7×10^{-8}
Small Military	5.4×10^{-8}	0.00	1.6×10^{-8}	7.7×10^{-9}	7.8×10^{-8}
Single-engine piston	0.00	0.00	0.00	0.00	0.00
Multi-engine piston	0.00	0.00	0.00	0.00	0.00
Turboprop	0.00	0.00	0.00	0.00	0.00
Turbojet	0.00	0.00	0.00	0.00	0.00
Helicopters	0.00	0.00	0.00	0.00	0.00
Total	6.9×10^{-8}	6.8×10^{-10}	7.0×10^{-8}	1.3×10^{-8}	1.5×10^{-7}

Source: Calculated Values

TABLE E.3.1.5–12.—*Zone 12 Aircraft Crash Probability per Year for Perforation Leading to Explosion*

AIRCRAFT	RW 22 LANDING	RW 04 LANDING	RW 04 TAKEOFF	NON-AIRPORT	TOTAL ZONE 12
Air Carrier	1.2×10^{-8}	0.00	3.6×10^{-10}	3.7×10^{-9}	1.6×10^{-8}
Air Taxi	4.9×10^{-8}	0.00	8.5×10^{-10}	1.7×10^{-8}	6.8×10^{-8}
Large Military	9.1×10^{-9}	6.7×10^{-10}	7.0×10^{-8}	3.7×10^{-9}	8.4×10^{-8}
Small Military	1.1×10^{-6}	0.00	2.1×10^{-7}	1.0×10^{-7}	1.4×10^{-6}
Single-engine piston	1.8×10^{-7}	0.00	0.00	1.3×10^{-7}	3.1×10^{-8}
Multi-engine piston	9.2×10^{-8}	0.00	0.00	6.1×10^{-8}	1.5×10^{-8}
Turboprop	3.0×10^{-8}	0.00	0.00	5.5×10^{-8}	8.6×10^{-8}
Turbojet	1.9×10^{-8}	0.00	0.00	5.9×10^{-8}	7.8×10^{-8}
Helicopters	0.00	0.00	0.00	1.1×10^{-8}	1.1×10^{-8}
Total	1.5×10^{-6}	6.7×10^{-10}	2.8×10^{-7}	4.4×10^{-7}	2.2×10^{-6}

Source: Calculated Values

TABLE E.3.1.5–13.—*Zone 12 Aircraft Crash Probability per Year for Perforation Leading to Fire*

AIRCRAFT	RW 22 LANDING	RW 04 LANDING	RW 04 TAKE-OFF	NON-AIRPORT	TOTAL ZONE 12
Air Carrier	9.6×10^{-9}	0.00	2.9×10^{-10}	2.9×10^{-9}	1.3×10^{-8}
Air Taxi	2.0×10^{-8}	0.00	3.5×10^{-10}	6.7×10^{-9}	2.7×10^{-8}
Large Military	8.7×10^{-9}	6.5×10^{-10}	7.3×10^{-8}	4.5×10^{-9}	8.7×10^{-8}
Small Military	2.6×10^{-7}	0.00	4.3×10^{-8}	3.4×10^{-8}	3.4×10^{-7}
Single-engine piston	0.00	0.00	0.00	0.00	0.00
Multi-engine piston	0.00	0.00	0.00	0.00	0.00
Turboprop	0.00	0.00	0.00	0.00	0.00
Turbojet	0.00	0.00	0.00	0.00	0.00
Helicopters	0.00	0.00	0.00	0.00	0.00
Total	3.0×10^{-7}	6.5×10^{-10}	1.2×10^{-7}	4.8×10^{-8}	4.7×10^{-7}

Source: Calculated Values

TABLE E.3.2.1–2.—*Aircraft Crash Rates*

AIRCRAFT CATEGORY	CRASH RATE	
	TAKE-OFF (PER TAKE-OFF)	LANDING (PER LANDING)
Air Carrier	2.0×10^{-7}	2.6×10^{-7}
Air Taxi	1.0×10^{-6}	2.3×10^{-6}
Military: Large	5.7×10^{-7}	1.6×10^{-6}
Military: Small	1.8×10^{-6}	3.3×10^{-6}
General: Single-Engine	1.1×10^{-5}	2.0×10^{-5}
General: Multi-Engine	9.3×10^{-6}	2.3×10^{-5}
General: Turboprop	3.5×10^{-6}	8.3×10^{-6}
General: Turbojet	1.4×10^{-6}	4.7×10^{-6}

Source: DOE 1996g:Table B-1

TABLE E.3.2.1–3.—*Manzano WSA Aircraft Crash Location Probability*

AIRCRAFT CATEGORY	CRASH LOCATION PROBABILITY			
	RUNWAY 1 TAKE-OFF (PER MILE^2)	RUNWAY 1 LANDING (PER MILE^2)	RUNWAY 2 TAKE-OFF (PER MILE^2)	RUNWAY 2 LANDING (PER MILE^2)
Air Carrier	1.1×10^{-2}	3.4×10^{-2}	0.00	0.00
Air Taxi	1.1×10^{-2}	3.4×10^{-2}	0.00	0.00
Military: Large	3.9×10^{-2}	1.6×10^{-2}	0.00	9.5×10^{-4}
Military: Small	2.5×10^{-2}	1.6×10^{-3}	1.1×10^{-4}	3.3×10^{-4}
General: Single-Engine	4.3×10^{-3}	6.8×10^{-3}	0.00	0.00
General: Multi-Engine	4.3×10^{-3}	6.8×10^{-3}	0.00	0.00
General: Turboprop	4.3×10^{-3}	6.8×10^{-3}	0.00	0.00
General: Turbojet	4.3×10^{-3}	6.8×10^{-3}	0.00	0.00

Source: DOE 1996g:Tables B-2 to B-13

TABLE E.3.2.1–4.—*Sandia National Laboratories In-Flight Aircraft Crash Rate Probabilies(NPf(x,y))*

AIRCRAFT	CRASH RATE PROBABILITY[1]
Air Carrier	6.0×10^{-8}
Air Taxi	4.0×10^{-7}
Military: Large	1.0×10^{-7}
Military: Small	5.0×10^{-6}
General: Single-Engine	8.0×10^{-4}
General: Multi-Engine	8.0×10^{-4}
General: Turboprop	8.0×10^{-4}
General: Turbojet	8.0×10^{-4}

[1]In crashes per square mile, per year, centered at the site.
Sources: DOE 1996g:Tables B-14 and B-15

TABLE E.3.2.2–1.—*Manzano WSA Aircraft Operational Data: Take-off, In-Flight, and Landing*

	AIR CARRIER	AIR TAXI	MILITARY: LARGE	MILITARY: SMALL	GENERAL: SINGLE ENGINE	GENERAL: MULTI-ENGINE	GENERAL TURBO-PROP	GENERAL: TURBOJET
Maximum Wingspan (ft)	211	75	223	93	50	50	80	78
Skid Length (ft)	0	0	0	0	0	0	0	0
Mean Take-off Impact Angle cotϕ (degree)	9.6	9.6	7.4	8.4	8.2	8.2	8.2	8.2
Mean In-flight Impact Angle cotϕ (degree)	9.6	9.6	7.4	8.4	8.2	8.2	8.2	8.2
Mean Landing Impact Angle cotϕ (degree)	9.6	9.6	9.7	10.4	8.2	8.2	8.2	8.2
Take-off Effective Areas (mi^2)	0.0291	0.0140	0.0361	0.0176	0.0127	0.0127	0.0163	0.0160
In-flight Effective Areas (mi^2)	0.0291	0.0140	0.0361	0.0176	0.0127	0.0127	0.0163	0.0160
Landing Effective Areas (mi^2)	0.0291	0.0140	0.0301	0.0152	0.0127	0.0127	0.0163	0.0160

Sources: Jane's 1961-1996; DOE 1996g:Tables B-17 and B-18; Calculated Values

TABLE E.3.2.3–1.—*Manzano WSA Aircraft Crash Probabilities*

AIRCRAFT CATEGORY	CRASH PROBABILITY (PER YEAR)					
	RUNWAY 1 TAKE-OFF	RUNWAY 1 LANDING	RUNWAY 2 TAKE-OFF	RUNWAY 2 LANDING	IN-FLIGHT	TOTAL
Air Carrier	2.5×10^{-6}	0.00	7.7×10^{-6}	0.00	1.7×10^{-9}	1.0×10^{-5}
Air Taxi	3.2×10^{-6}	0.00	9.9×10^{-6}	0.00	5.6×10^{-9}	1.3×10^{-5}
Military: Large	4.0×10^{-6}	0.00	1.6×10^{-6}	2.3×10^{-7}	3.6×10^{-9}	5.9×10^{-6}
Military: Small	7.9×10^{-6}	5.5×10^{-8}	5.1×10^{-7}	1.7×10^{-7}	8.8×10^{-8}	8.7×10^{-6}
General: Single-Engine	9.4×10^{-6}	0.00	1.5×10^{-5}	0.00	4.4×10^{-6}	2.9×10^{-5}
General: Multi-Engine	3.6×10^{-6}	0.00	5.7×10^{-6}	0.00	2.0×10^{-6}	1.1×10^{-5}
General: Turboprop	1.5×10^{-6}	0.00	2.4×10^{-6}	0.00	2.2×10^{-6}	6.1×10^{-6}
General: Turbojet	6.7×10^{-7}	0.00	1.1×10^{-6}	0.00	2.5×10^{-6}	4.2×10^{-6}
Total	3.3×10^{-5}	5.5×10^{-8}	4.4×10^{-5}	4.0×10^{-7}	1.1×10^{-5}	8.8×10^{-5}

Source: Calculated Values

TABLE E.3.2.4–1.—*Aircraft Missile Characteristics for Manzano WSA*

AIRCRAFT CATEGORY	IMPACT VELOCITY (FT/SEC)	ENGINE WEIGHT (LBS)	ENGINE DIAMETER (IN)	PERFORATE
Air Carrier	422	3,495	26	N
Air Taxi	422	861	31	N
Military: Large	338	4,234	34	N
Military: Small	422	4,201	51	N
General: Single-Engine	152	483	20	N
General: Multi-Engine	152	488	20	N
General: Turboprop	152	465	19	N
General: Turbojet	152	2,574	37	N

Sources: LLNL 1995; Jane's 1961-1996; Calculated Values

TABLE E.3.3–1—*Distance to Airports in Vicinity from DAF*

AIRPORT	NUMBER OF RUNWAYS	DISTANCE AND DIRECTION FOR DAF	RUN-WAYS	AIRCRAFT CATE-GORIES USING RUNWAYS	COMPARISON TO PROBABILITY DENSITY FUNCTION	INCLUDED IN ANALYSIS
McCarran International Airport	Not determined	~76 miles SE	Not determined	All Categories	Distance is outside all categories	N
North Las Vegas Airport	Not determined	~76 miles SE	Not determined	All Categories	Distance is outside all categories	N
Nellis Air Force Base	Not determined	~76 miles SE	Not determined	Military	Distance is outside all categories	N
Beatty Airfield	1	42 miles W	Runway 1	General Aviation	Distance is outside general aviation category	N
Indian Springs AF Auxiliary Field	2	30 miles SE	Runway 1	Military	Distance is outside military category	N
Desert Rock Airstrip	1	19 miles S	Runway 1	General Aviation	Distance is outside general aviation category	N
Landing Strip (near Yucca Lake)	1	4 miles N	Runway 1	General Aviation	Activity is restricted and is bounded by in-flight operations	N
Landing Strip	1	17 miles S	Runway 1	General Aviation	Distance is outside general aviation category	N
Landing Strip	1	39 miles WNW	Runway 1	General Aviation	Distance is outside general aviation category	N
Landing Strip	1	49 miles NNW	Runway 1	General Aviation	Distance is outside general aviation category	N

Sources: USGS 1985; USGS 1986; USGS 1988; USGS 1979a

TABLE E.3.3.1–1.—*NTS In-Flight Aircraft Crash Rate Probabilities (NPf(x,y))*

AIRCRAFT CATEGORY	CRASH RATE PROBABILITY[1]
Air Carrier	2.0×10^{-7}
Air Taxi	3.0×10^{-6}
Military: Large	2.0×10^{-7}
Military: Small	6.0×10^{-6}
General: Single-Engine	8.0×10^{-5}
General: Multi-Engine	8.0×10^{-5}
General: Turboprop	8.0×10^{-5}
General: Turbojet	8.0×10^{-5}

[1]In crashes per square mile, per year, centered at the site.
Sources: DOE 1996g:Tables B-14 and B-15

TABLE E.3.3.2–1.—*NTS Aircraft Operational Data: In-flight*

	AIR CARRIER	AIR TAXI	MILITARY: LARGE	MILITARY: SMALL	GEN.: SINGLE ENGINE	GEN.: MULTI-ENGINE	GEN.: TURBO-PROP	GEN.: TURBOJET
Maximum Wingspan (ft)	211	75	223	93	50	50	80	78
In-flight Skid Length (ft)	1,570	1,570	780	447	68	68	68	68
Mean In-flight Impact Angle cotϕ (degree)	9.6	9.6	7.4	8.4	8.2	8.2	8.2	8.2
In-flight Effective Areas (mi^2)	0.0669	0.0560	0.0433	0.0261	0.0142	0.0142	0.0150	0.0150

Sources: Jane's 1961-1996; DOE 1996g:Tables B-17 and B-18; Calculated Values

TABLE E.3.3.3–1. —*NTS Aircraft Crash Probabilities*

AIRCRAFT CATEGORY	CRASH PROBABILITY (PER YEAR) IN-FLIGHT
Air Carrier	1.3×10^{-8}
Air Taxi	1.7×10^{-7}
Military: Large	8.7×10^{-9}
Military: Small	1.6×10^{-7}
General: Single Engine	5.0×10^{-7}
General: Multi-Engine	2.3×10^{-7}
General: Turboprop	2.0×10^{-7}
General: Turbojet	2.3×10^{-7}
Total	1.5×10^{-6}

Source: Calculated Values

TABLE E.3.4.1–1. —SRS In-Flight *Aircraft Crash Rate Probabilities (NPf(x,y))*

AIRCRAFT CATEGORY	CRASH RATE PROBABILITY[1]
Air Carrier	2.0×10^{-7}
Air Taxi	3.0×10^{-6}
Military: Large	1.0×10^{-7}
Military: Small	6.0×10^{-7}
General: Single-Engine	2.0×10^{-4}
General: Multi-Engine	2.0×10^{-4}
General: Turboprop	2.0×10^{-4}
General: Turbojet	2.0×10^{-4}

[1]In crashes per square mile, per year, centered at the site.
Source: DOE 1996g:Tables B-14 and B-15

TABLE E.3.4.2–1. —*SRS Aircraft Operational Data: In-flight*

	AIR CARRIER	AIR TAXI	MILI-TARY: LARGE	MILI-TARY: SMALL	GEN.: SINGLE-ENGINE	GEN.: MULTI-ENGINE	GEN.: TURBO-PROP	GEN.: TURBOJET
Maximum Wingspan (ft)	211	75	223	93	50	50	80	78
In-flight Skid Length (ft)	1,570	1,570	780	447	68	68	68	68
Mean In-flight Impact Angle cotϕ (degree)	9.6	9.6	7.4	8.4	8.2	8.2	8.2	8.2
In-flight Effective Areas (mi^2)	0.0353	0.0253	0.0225	0.0115	0.0054	0.0054	0.0060	0.0060

Sources: Jane's 1961-1996; DOE 1996g:Tables B-17 and B-18; Calculated Values

TABLE E.3.4.3–1. —*SRS Aircraft Crash Probabilities*

AIRCRAFT	CRASH LOCATION PROBABILITY (PER YEAR) IN-FLIGHT
Air Carrier	7.1×10^{-9}
Air Taxi	7.6×10^{-8}
Military: Large	2.3×10^{-9}
Military: Small	6.9×10^{-9}
General: Single-Engine	4.8×10^{-7}
General: Multi-Engine	2.2×10^{-7}
General: Turboprop	2.1×10^{-7}
General: Turbojet	2.3×10^{-7}
Total	1.2×10^{-6}

Source: Calculated Values

TABLE E.3.4.4–1.—*Aircraft Missile Characteristics for P-Reactor*

AIRCRAFT	IMPACT VELOCITY (FT/SEC)	ENGINE WEIGHT (LBS)	ENGINE DIAMETER (IN)	PERFORATE
Air Carrier	422	3,495	26	Y
Air Taxi	422	861	31	N
Military: Large	338	4,234	34	Y
Military: Small	422	4,201	51	N
General: Single-Engine	152	483	20	N
General: Multi-Engine	152	488	20	N
General: Turboprop	152	465	19	N
General: Turbojet	152	2,574	37	N

Sources: LLNL 1995; Jane's 1961-1996; Calculated Values

TABLE E.3.5–1.—*Distance to Airports in Vicinity of FMEF*

AIRPORT	NUMBER OF RUNWAYS	DISTANCE AND DIRECTION FROM FMEF	RUNWAYS	AIRCRAFT CATE-GORIES USING RUNWAYS	COMPARISON TO PROBABILITY DENSITY FUNCTION		INCLUDED IN ANALYSIS
					X COOR-DINATE	Y COOR-DINATE	
Tri-Cities Airport	3	17 miles SE	Runway 1	All Categories	16 to 17 miles	0 to 1 mile	Y[a]
			Runway 2	All Categories	0 to 1 mile	16 to 17 miles	N
			Runway 3	All Categories	0 to 1 mile	16 to 17 miles	N
Vista Field	2	16 miles SSE	Runway 1	General Aviation	15 to 16 miles	4 to 5 miles	N
			Runway 2	General Aviation	4 to 5 miles	15 to 16 miles	N
Richland Field	3	8 miles SSE	Runway 1	General Aviation	8 to 9 miles	2 to 3 miles	N
			Runway 2	General Aviation	Runway 1 bounds Runway 2		N
			Runway 3	General Aviation	Runway 1 bounds Runway 3		N
Beardsley Airfield (near Prosser)	1	26 miles SW	Runway 1	General Aviation	Distance is outside general aviation category		N
Sunnyside Airport	1	30 miles WSW	Runway 1	General Aviation	Distance is outside general aviation category		N
Landing Strip (near Horse Heavens Hills)	1	20 miles SSW	Runway 2	General Aviation	Distance is outside general aviation category		N

[a]Only small military aircraft in the landing mode had a nonzero probability density value.
Source: USGS 1978a

TABLE E.3.5.1–1.—*1994 Tri-Cities Airport Traffic Activity*

AIRCRAFT CATEGORY	NUMBER OF FLIGHTS
Air Carrier	2,645
Air Taxi	21,807
Military	2,597
Large (33.2%)	862
Small (66.8%)	1,735
General Aviation	54,818
Single Engine (43.8%)	24,010
Multi-Engine (19.8%)	10,854
Turboprop (17.0%)	9,319
Turbojet (19.4%)	10,635
Total	81,867

Source: PC 1996a

TABLE E.3.5.1–2.—*Aircraft Crash Rates*

AIRCRAFT CATEGORY	CRASH RATE	
	TAKE-OFF (PER TAKE-OFF)	LANDING (PER LANDING)
Air Carrier	2.0×10^{-7}	2.6×10^{-7}
Air Taxi	1.0×10^{-6}	2.3×10^{-6}
Military: Large	5.7×10^{-7}	1.6×10^{-6}
Military: Small	1.8×10^{-6}	3.3×10^{-6}
General: Single-Engine	1.1×10^{-5}	2.0×10^{-5}
General: Multi-Engine	9.3×10^{-6}	2.3×10^{-5}
General: Turboprop	3.5×10^{-6}	8.3×10^{-6}
General: Turbojet	1.4×10^{-6}	4.7×10^{-6}

Source: DOE 1996g:Table B-1

TABLE E.3.5.1–3.—*Hanford Site Aircraft Crash Location Probability*

AIRCRAFT CATEGORY	CRASH LOCATION PROBABILITY
	RUNWAY 1 LANDING (PER MILE^2)
Air Carrier	0
Air Taxi	0
Military: Large	0
Military: Small	1.1×10^{-3}
General: Single-Engine	0
General: Multi-Engine	0
General: Turboprop	0
General: Turbojet	0

Source: DOE 1996g:Table B-12

TABLE E.3.5.1–4.—*Hanford Site In-Flight Aircraft Crash Rate Probabilities (NPf(x,y))*

AIRCRAFT CATEGORY	CRASH RATE PROBABILITY[1]
Air Carrier	5.0×10^{-8}
Air Taxi	2.0×10^{-6}
Military: Large	1.0×10^{-7}
Military: Small	4.0×10^{-8}
General: Single-Engine	1.0×10^{-4}
General: Multi-Engine	1.0×10^{-4}
General: Turboprop	1.0×10^{-4}
General: Turbojet	1.0×10^{-4}

[1]In crashes per square mile, per mile, centered at the site.
Source: DOE 1996g:Tables B-14 and B-15

TABLE E.3.5.4–1.—*Aircraft Missile Characteristics for FMEF*

AIRCRAFT CATEGORY	IMPACT VELOCITY (FT/SEC)	ENGINE WEIGHT (LBS)	ENGINE DIAMETER (IN)	PERFORATE
Air Carrier	422	3,495	26	N
Air Taxi	422	861	31	N
Military: Large	338	4,234	34	N
Military: Small	422	4,201	51	N
General: Single-Engine	152	483	20	N
General: Multi-Engine	152	488	20	N
General: Turboprop	152	465	19	N
General: Turbojet	152	2,574	37	N

Sources: LLNL 1995; Jane's 1961-1996; Calculated Values

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APPENDIX F

Transportation Risk Analysis

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APPENDIX F
TRANSPORTATION RISK ANALYSIS

F.1 INTRODUCTION

This appendix contains additional material for support of the impact analyses in the transportation sections of the EIS. Further information regarding Pantex Plant related transportation activities, including nonradiological hazardous wastes and materials, is provided in the Pantex Plant *Safety Information Document* and the *Ross Aviation Transportation Analysis Report* (Pantex 1996a; Ross 1994).

F.2 PACKAGING

Pantex Plant utilizes many different containers for packaging of nuclear explosives, explosives and explosive components, and radioactive materials. These containers provide protection against accidental release of hazardous material. Each container is designed for a specific application, and some have firm guidelines for their construction. Specifications for containers used during offsite transportation of radioactive materials are contained in 10 CFR 71. The following are examples of packaging guidelines for intersite shipment of radioactive material.

F.2.1 Limited Quantity/ Instruments and Articles

These materials are packaged in strong, tight packages that will not leak the radioactive contents during normal transportation.

F.2.2 Type A Packaging

Type A packages must be designed according to the requirements of 49 CFR Sections 173.24, 173.411, and 173.412. This package type must be adequate to prevent any loss of radioactive material or shielding while subjected to normal (i.e., incident-free) transport conditions. This packaging will be in appropriate inner containers to prevent leakage of the contents with the inner containers overpacked in one of the following containers:

- Strong fiberboard box.
- Tightly sealed can or drum.
- Strong wooden box.
- Approved Department of Transportation (DOT)–7A equivalent packaging.
- Original containers received from manufacturer, if in good condition.

Materials shall be cushioned to prevent movement, and containers shall be securely closed.

F.2.3 Type B Packaging

Type B packages must meet all of the requirements for Type A packaging as well as withstand test conditions that simulate serious accident damage. The test results must show that only a limited loss of shielding and essentially no loss of material occurs. The test conditions are determined by the Nuclear Regulatory Commission (NRC) in regulation 10 CFR 71.73 and include the following:

- A 9-meter (30-foot) free drop onto an unyielding surface.
- A dynamic crush test consisting of dropping a 500-kilogram (1,100-pound) mass from a height of 9 meters (30 feet) onto the container.
- A puncture test consisting of a free drop greater than 1 meter (3.3 feet) onto a 15-centimeter (6-inch) diameter steel pin.

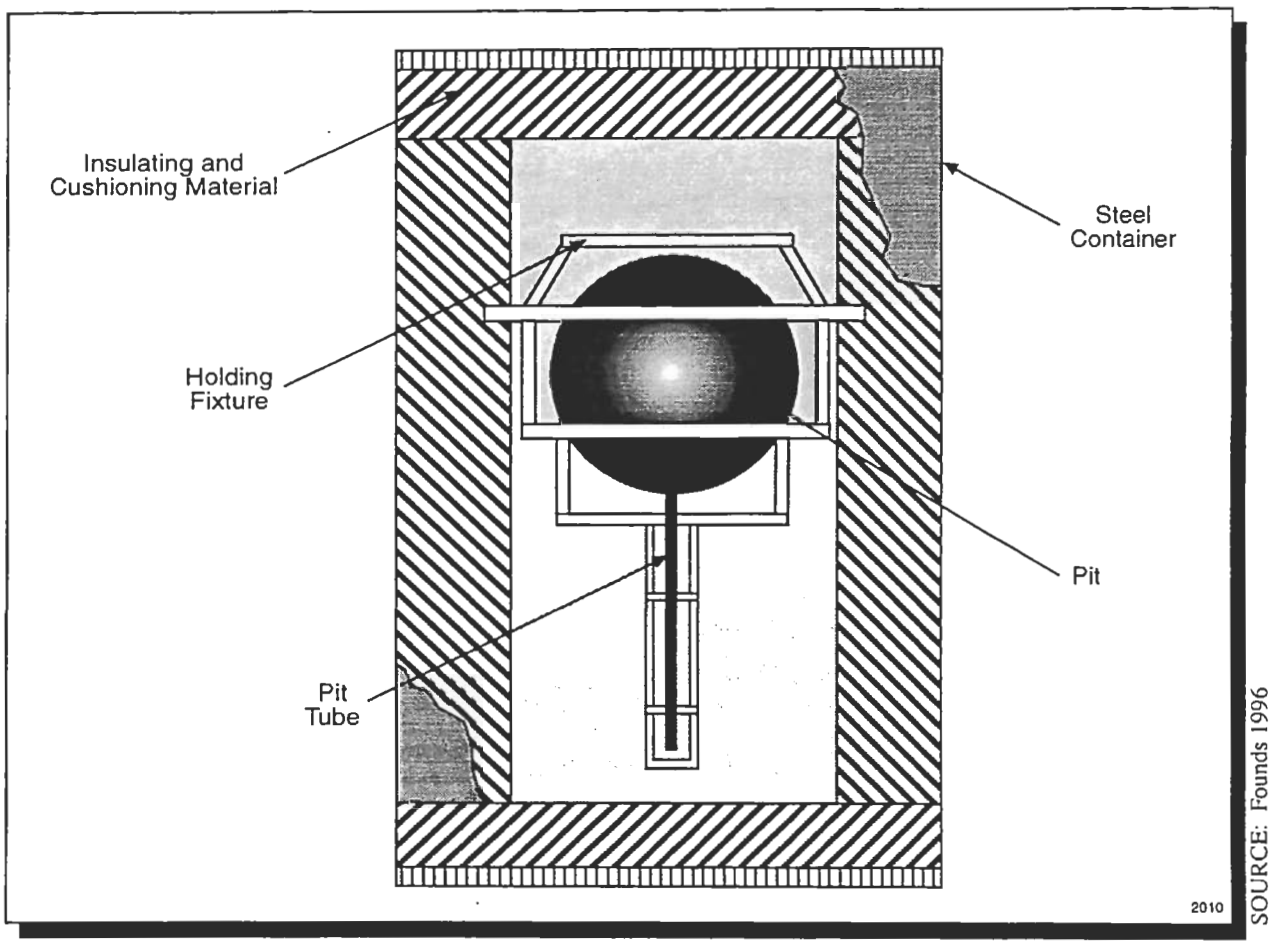
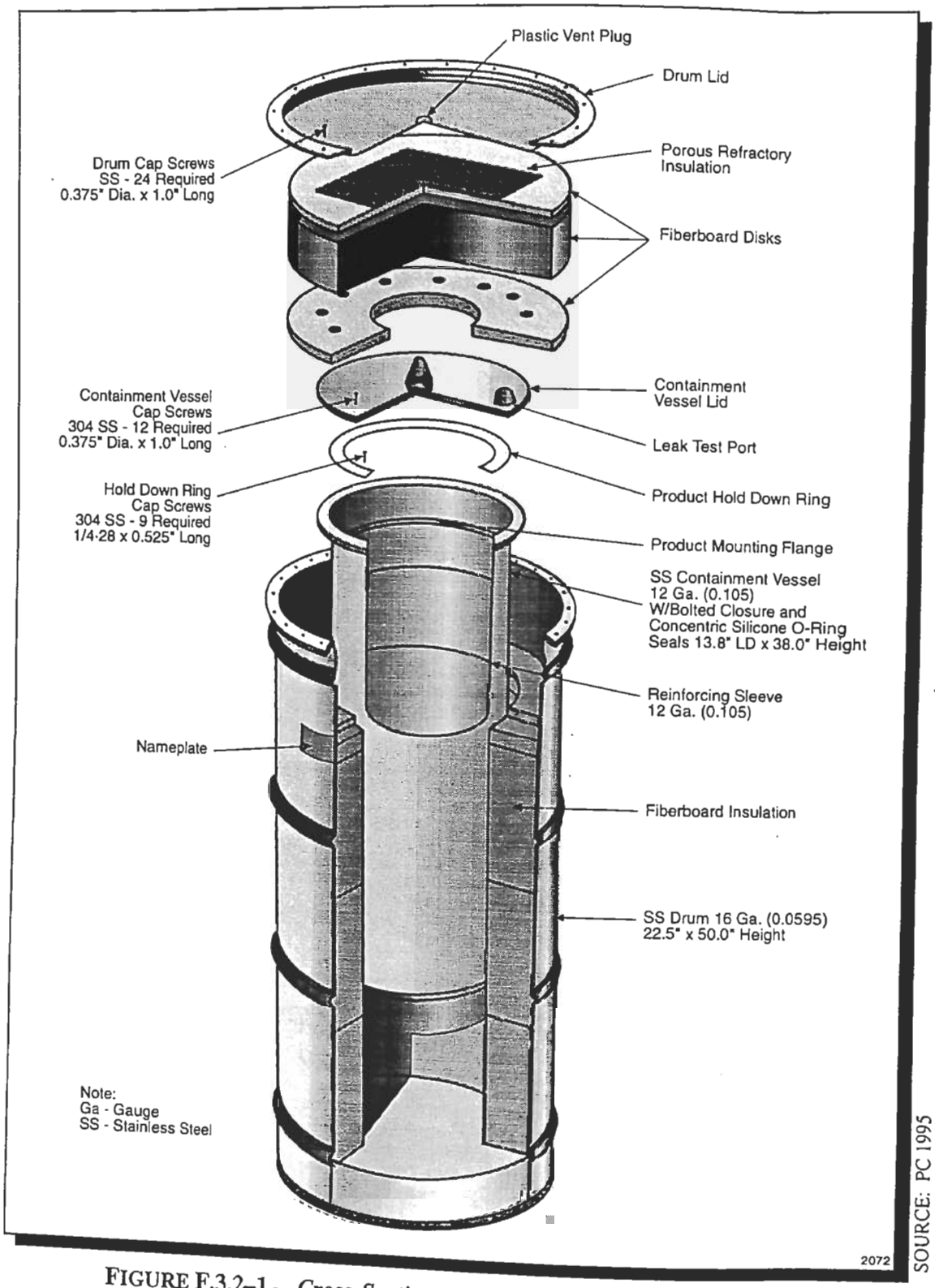


FIGURE F.3.1–1.—*Cross-Sectional View of an AL–R8 Container.*



SOURCE: PC 1995

FIGURE F.3.2–1.—*Cross-Sectional View of an FL-Type Container.*

containment vessel of the AT–400A is completely welded, which provides superior behavior in fire environments. The AT–400A container also performs significantly better than the FL container in impact, puncture, and crush environments.

F.4 Transportation Vehicles and Safety and Support Equipment

Vehicles used for onsite transportation include hardened trailers, flatbed trailers, Safe Secure Tractor Trailers (SSTs), forklifts, tow motors, Stage Right trailers, tractors, electric carts, and transportation carts. This section discusses the Stage Right equipment that is in use at Pantex Plant. Further information on transportation vehicles and equipment is provided in the *Safety Information Document* and the *Transportation Evaluation Report for Ross Aviation, Inc.* (Pantex 1996a; Ross 1994).

F.4.1 Stage Right Forklift

The Stage Right forklift is a technologically advanced electric forklift, specifically designed for the Stage Right project for pit storage. This forklift is larger than the other electric forklifts at Pantex Plant and is fully enclosed. The Stage Right forklift rides on a special rail system that keeps it in a straight line throughout its operation. This rail system contains a sensor system that detects the position of the forklift on the rails throughout its operation. The Stage Right forklift can perform its loading operations only when it is correctly positioned between these light sensors. The operator has a display in front of him to notify him when the forklift is in position.

The Stage Right forklift has one boom arm for lifting the Stage Right pallets. This boom arm has a unique safety feature to prevent an inadvertent puncture of a pit container. On the extreme end of the boom there exists a compression sensor that, when compressed, completely stops the action of the Stage Right forklift. The pressure of a person's outstretched arm is enough to compress the sensor and shut down the forklift. The boom has to be in exactly the correct position to fit into the Stage Right pallet boom slot. Once positioned, the Stage Right forklift can continue with its operation. The Stage Right forklift will be replaced by an automated guided vehicle when development at Pantex Plant is completed.

F.4.2 Stage Right Trailer

Pits are transferred between Zone 12 South and Zone 4 in either a double-axle, non-hardened pallet trailer or a hardened trailer. These pallet trailers are able to withstand a 2,722-kilogram (6,000-pound) load or more, and are towed by stakebed trucks. The trailer box is approximately 127 centimeters (50 inches) wide, 203 centimeters (80 inches) high, and 356 centimeters (140 inches) long. The frame of the trailer is the load-bearing structure so that the outer skin and rivets are not subject to any load other than their own weight. An emergency electric braking system is in place to stop the trailer in the event that the connection with the tow vehicle is broken. These Stage Right trailers are specifically built to hold Stage Right pallets (see Figure F.4.2–1).

F.4.3 Stage Right Pallet

Two types of these pallets exist. The first can accommodate four AL–R8 containers, and the second can hold six AL–R8 containers. In this pallet's design, the containers sit both in it and on it depending on the pallet's positioning (see Figure F.4.3–1).

A new Stage Right pallet that will be able to accommodate both the AL–R8 and AT–400A containers is in the design phase at Pantex Plant. This new pallet will be constructed of stainless steel. The Stage Right pallet that can accommodate four containers is approximately

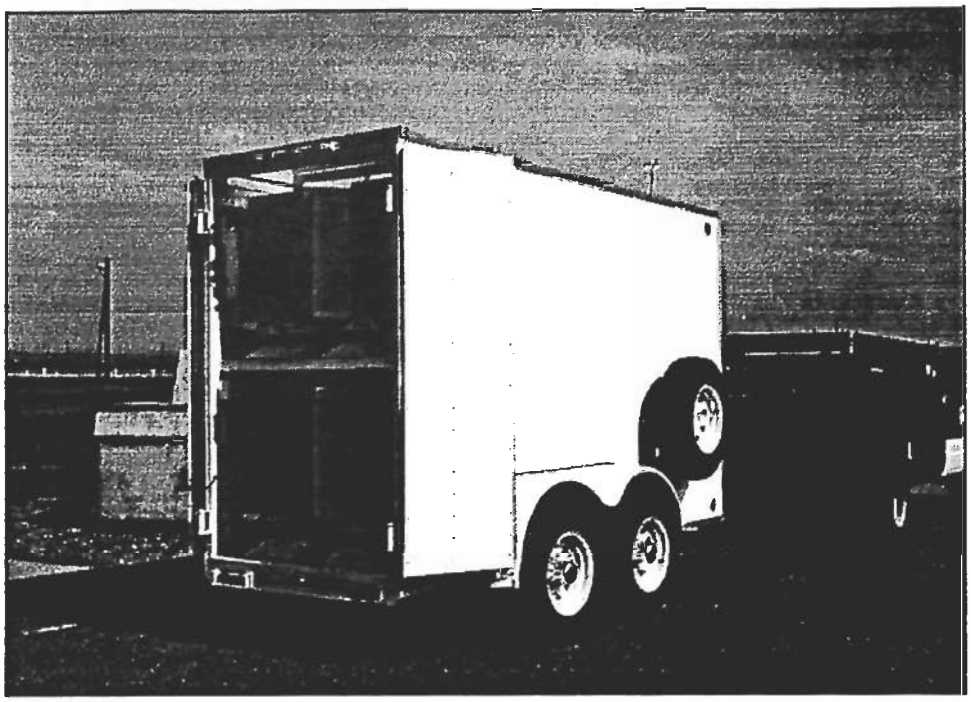


FIGURE F.4.2–1.—*Stage Right Trailer.*

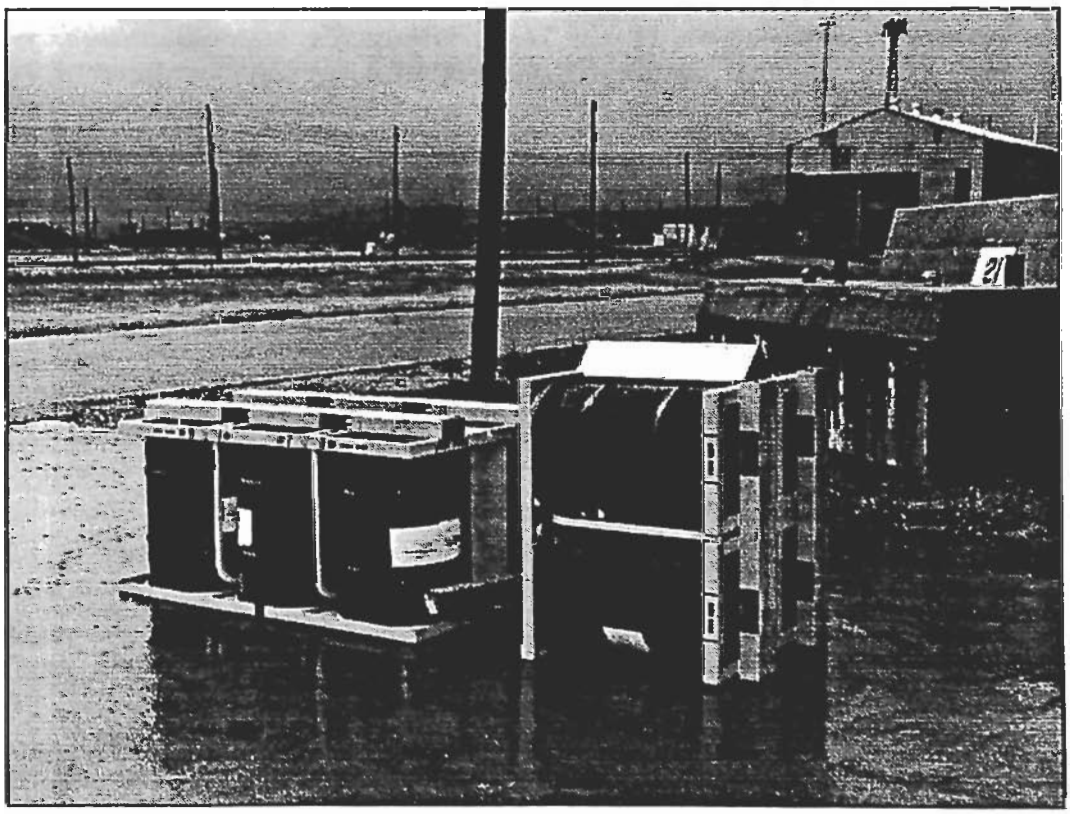


FIGURE F.4.3–1.—*Stage Right Pallet.*

104 centimeters by 99 centimeters by 74 centimeters (41 inches by 39 inches by 29 inches), and the Stage Right pallet that can accommodate six containers is approximately 155 centimeters by 99 centimeters by 74 centimeters (61 inches by 39 inches by 29 inches).

F.5 INTERSITE TRANSPORTATION IMPACT ASSESSMENTS

The Analysis of Dispersal Risk Occurring in Transportation (ADROIT) code was developed specifically for the Defense Programs Transportation Risk Analysis program and is currently being used in the development of safety analysis for DOE transportation activities. The code was designed specifically to evaluate event trees and conduct consequence assessments for SST shipments and air transport of tritium reservoirs. The code can also be used to evaluate the effect on the assessed risk of modifications to equipment or procedures (positive measures), changes in shipment campaigns, improvements in understanding of cargo, etc.

The assessment covers transportation of nuclear explosives and pits by SST and tritium reservoirs by DC–9 aircraft for the period fiscal year (FY) 1997–2006. Annual risks are computed based on projected shipments associated with current 10-year weapon planning documents.

For nuclear explosives, the baseline 10-year shipments were obtained from current weapons activity schedules. For security reasons, detailed information on the specific weapon systems and routes is classified.

For tritium reservoirs, the baseline shipment schedule corresponds to those for nuclear explosives. The number of tritium reservoirs to be transported between Pantex Plant and the Savannah River Site (SRS) is assumed to be equal to the number of nuclear explosives transported to or from Pantex Plant. All tritium reservoirs will be transported in DC–9 aircraft. Up to 75 tritium reservoirs may be transported per flight. The projected baseline shipments of tritium reservoirs was obtained from current 10-year weapons activity schedules.

Assessments were conducted for pit transportation from Pantex Plant to four alternative storage sites: Nevada Test Site (NTS), SRS, Hanford Site, and Kirtland Air Force Base (KAFB). An assessment was also conducted for transportation of pits between Pantex Plant and LANL and return (for the purpose of quality assurance and testing). Pits are expected to be transported in a DOT-certified container, such as, the AT–400A container.

The estimated risks for nuclear explosive shipments, pit shipments, and tritium reservoir shipments are documented in the following sections. All calculations were conducted with the ADROIT code, Version 1.1, which was developed specifically for transportation of Defense Programs materials. A description of the methodology used in the ADROIT code appears in section F.6.

F.5.1 Nuclear Explosive Shipments

F.5.1.1 *Incident-Free Risk*

Tables F.5.1.1–1 and F.5.1.1–2 summarize incident-free risks. The health risk from incident-free exposure is obtained by multiplying the exposure by the dose-health effects factor, which is typically taken to be 0.0005 latent cancer fatalities (LCFs) per person-rem (NAP 1990). It should be noted that for greater accuracy the ADROIT code uses a distribution curve rather than a single point estimate of 0.0005.

TABLE F.5.1.1–1.—*Baseline Incident-Free Risk, Nuclear Explosive Shipments*[1]

PERIOD	COLLECTIVE HEALTH RISK, LCF	MAXIMUM INDIVIDUAL HEALTH RISK, LCF
1997	2×10^{-4}	5×10^{-7}
1998	6×10^{-5}	2×10^{-7}
1999	5×10^{-5}	2×10^{-7}
2000	6×10^{-5}	2×10^{-7}
2001	8×10^{-5}	2×10^{-7}
2002	4×10^{-5}	9×10^{-8}
2003	4×10^{-5}	9×10^{-8}
2004	9×10^{-5}	3×10^{-7}
2005	2×10^{-4}	3×10^{-7}
2006	3×10^{-5}	9×10^{-8}
10-Year Total	9×10^{-4}	2×10^{-6}
Annual Average	9×10^{-5}	2×10^{-7}

[1] With a dose rate of 3.0 mrem/hr at the surface of an SST.

TABLE F.5.1.1–2.—*Baseline Incident-Free Exposure, Nuclear Explosive Shipments*[1]

PERIOD	COLLECTIVE DOSE, PERSON-REM	MAXIMUM INDIVIDUAL DOSE, REM
1997	0.5	2×10^{-3}
1998	0.2	5×10^{-4}
1999	0.1	3×10^{-4}
2000	0.2	4×10^{-4}
2001	0.2	4×10^{-4}
2002	0.1	3×10^{-4}
2003	0.1	3×10^{-4}
2004	0.3	5×10^{-4}
2005	0.3	6×10^{-4}
2006	0.1	2×10^{-4}
10-Year Total	2	5×10^{-3}
Annual Average	0.2	5×10^{-4}

[1] With a dose rate of 3.0 mrem/hr at the surface of an SST.

F.5.1.2 *Accident Fatality Risk—Nuclear Explosive Shipments*

Table F.5.1.2–1 summarizes the accident fatality risk. The estimated risk for the baseline shipment schedule is highest in FYs 1997 and 2005, which are the years in which the shipment volume is greatest. The risk curves for accident fatality risk in FY 1997 are shown in Figure F.5.1.2–1.

TABLE F.5.1.2–1.—*Baseline Accident Fatality Risk, Nuclear Explosive Shipments*

PERIOD	HEALTH RISK, FATALITIES
1997	1×10^{-3}
1998	5×10^{-4}
1999	4×10^{-4}
2000	5×10^{-4}
2001	6×10^{-4}
2002	3×10^{-4}
2003	3×10^{-4}
2004	9×10^{-4}
2005	1×10^{-3}
2006	3×10^{-4}
10-Year Total	6×10^{-3}
Annual Average	6×10^{-4}

F.5.1.3 *Accident Dispersal Risk—Nuclear Explosives*

Table F.5.1.3–1 summarizes the dispersal risk from weapons shipments. The estimated risk for the baseline is FY 1997, which is the year with the greatest shipment volume. The risk curves for accident fatality risk in FY 1997 are shown in Figure F.5.1.3–1. The probability of

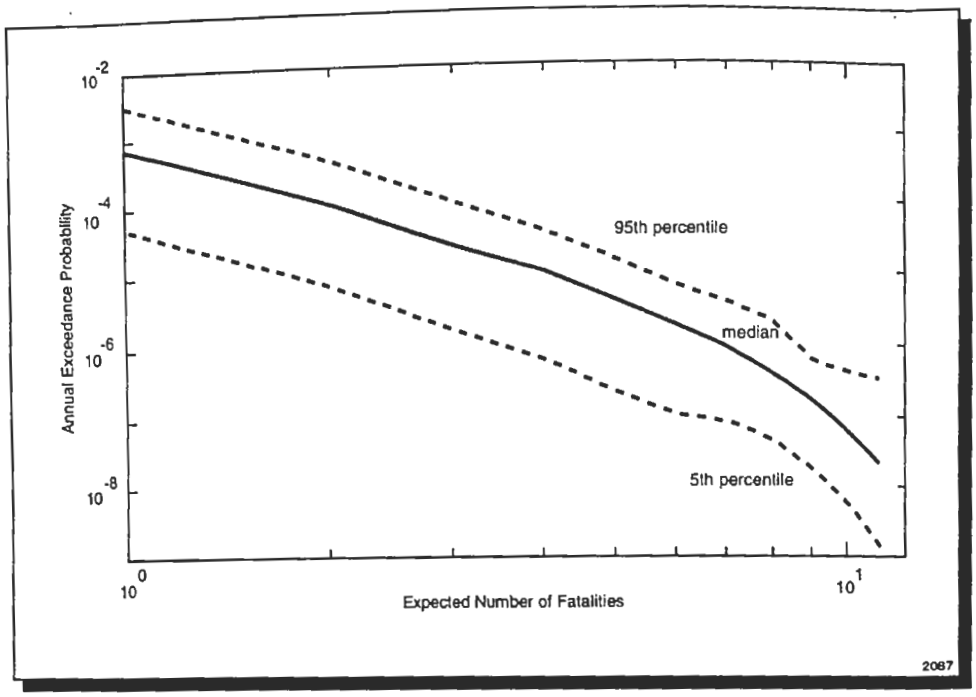


FIGURE F.5.1.2–1.—*Accident Fatality Risk Curves for 1997.*

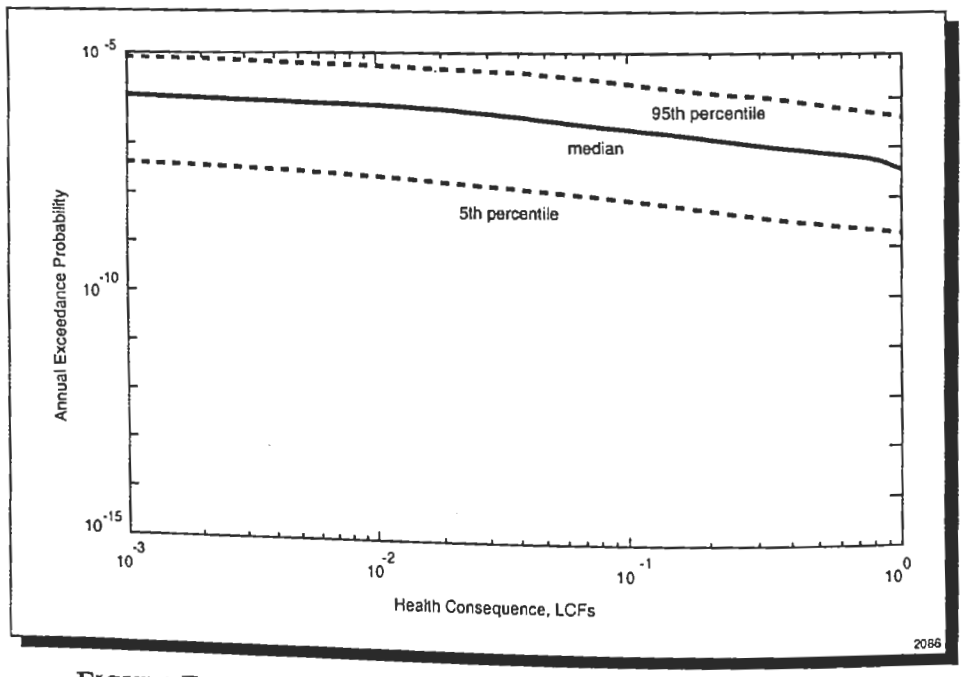


FIGURE F.5.1.3–1.—*Baseline Accident Dispersal Risk Curves for 1997, Weapons Shipments.*

having more than one LCF arising from a dispersal event associated with nuclear explosive shipments to or from Pantex Plant is most likely between 2×10^{-9} and 5×10^{-7} (the 5th and 95th percentiles) with a median estimate of approximately 4×10^{-8}. The shape of each individual risk curve reflects randomness in the outcome. The difference between the 5th percentile, median, and 95th percentile risk curves reflects the calculated uncertainty in the estimates. The baseline risk values given in Table F.5.1.3–1 are the average values of the areas under the complete set of risk curves for each year considered.

TABLE F.5.1.3-1.—*Baseline Accident Dispersal Risk, Nuclear Explosive Shipments*

PERIOD	ACCIDENT DISPERSAL RISK	
	COLLECTIVE HEALTH RISK, LCF	MAXIMUM INDIVIDUAL HEALTH RISK, LCF
1997	5×10^{-7}	1×10^{-9}
1998	2×10^{-8}	1×10^{-10}
1999	2×10^{-8}	1×10^{-10}
2000	2×10^{-8}	1×10^{-10}
2001	5×10^{-8}	3×10^{-10}
2002	2×10^{-8}	1×10^{-10}
2003	2×10^{-8}	1×10^{-10}
2004	5×10^{-8}	4×10^{-10}
2005	9×10^{-8}	5×10^{-10}
2006	2×10^{-8}	1×10^{-10}
10-Year Total	8×10^{-7}	3×10^{-9}
Annual Average	8×10^{-8}	3×10^{-10}

The dominant risk environments are highway accidents involving severe collisions and fires and accidents involving very long duration fires. There is no single, dominant scenario associated with credible ($>10^{-7}$ yr^{-1}), high-consequence events. For the purposes of this discussion high-consequence is defined to be greater than 1 LCF. Instead there are a collection of scenarios that together constitute credible, high-consequence events. These scenarios have the following common characteristics:

- The accident includes either a severe collision and fire (such as a collision with a heavy truck or fixed object that also involves a fuel fire) or a very long duration fuel fire (such as an accident with a fuel tanker or train that involves a fuel fire).
- The accident results in violent reaction of the high explosive.

Similarly, there is no single dominant scenario associated with credible, moderate consequence event. For the purposes of this discussion moderate consequence is defined to be less than 1 LCF. The scenarios that dominate the moderate-consequence events have the following common characteristics:

- The accident includes either a severe collision and fire (such as a collision with a heavy truck or fixed object that also involves a fuel fire) or a very long duration fuel fire (such as an accident with a fuel tanker or train that involves a fuel fire).
- The accident results in a fire-driven dispersal and/or the accident occurs in a rural area.

F.5.2 Pit Shipments

F.5.2.1 *Incident-Free Risk*

Table F.5.2.1–1 provides unit risk factors for intersite pit shipments. The incident-free exposure health risk is obtained by multiplying the exposure by the dose-health effects factor,

TABLE F.5.2.1–1.—*Incident-Free Unit Risk Factors for 2,000 Pit Shipments per Year*

PERIOD	FROM PANTEX TO				
	NTS	SRS	HANFORD	KAFB	LOS ALAMOS[1]
Collective Health Risk, LCF	1×10^{-4}/yr	1.5×10^{-4}/yr	1.5×10^{-4}/yr	2.5×10^{-5}/yr	2.0×10^{-6}/yr
Maximum Individual Health Risk, LCF	1.5×10^{-7}/yr	1.5×10^{-7}/yr	1.5×10^{-7}/yr	1.5×10^{-7}/yr	1.5×10^{-8}/yr
Collective Dose[2], Person-Rem	0.20/yr	0.30/yr	0.30/yr	0.05/yr	0.005/yr
Maximum Individual Dose, rem	4×10^{-4}/yr	4×10^{-4}/yr	4×10^{-4}/yr	4×10^{-4}/yr	3×10^{-5}/yr
Mean Accident Fatality Risk	4×10^{-4}/yr	6×10^{-4}/yr	4×10^{-4}/yr	8×10^{-5}/yr	1×10^{-5}/yr

[1]Only 30 pits to and from Los Alamos.
[2]Using unit dose rate of 1 mrem/hr at 1 meter from the trailer side.

which is typically taken to be 5.0×10^{-4} LCFs per person-rem (NAP 1990).

Approximately 63 percent of the collective exposure (and health risk) is received by people on the roadway. About 33 percent is received by members of the public at rest stops. The balance of the collective exposure is received by people off the roadway. By contrast, the maximum individual dose (and risk) is received by an individual off the roadway. This is because all of the shipments are either to or from Pantex Plant, so an individual living in the vicinity of the plant near the roadway is assumed to be exposed to the intrinsic radiation from all the shipments, whereas the people sharing the roadway or at rest stops are not likely to include the same individuals for all (or even most) shipments.

F.5.2.2 *Accident Fatality Risk*

Table F.5.2.1–1 summarizes the accident fatality risk. The estimated risk is highest for the alternative involving interim storage at SRS. The risk curves for annual accident fatality risk for 2,000 pit shipments to SRS are shown in Figure F.5.2.2–1.

F.5.2.3 *Accident Dispersal Risk*

The accident dispersal risk for pit shipments is based on the performance characteristics of the FL-Type container because performance data on the AT–400A could not be incorporated into the risk assessment in time for this EIS. However, performance testing of the AT–400A indicates that it can withstand considerably more severe accident environments than the FL-type container. The containment vessel in the AT–400A container is completely welded, which provides superior behavior in fire environments (in terms of preventing a dispersal). The AT–400A container also performs significantly better than the FL-type container in impact, puncture, and crush environments. Consequently, the estimates provided here for accident dispersal risk (based on the FL-type container) are believed to significantly overstate the actual risk of shipping pits in the AT–400A container. In fact, the probability of releasing plutonium from a pit

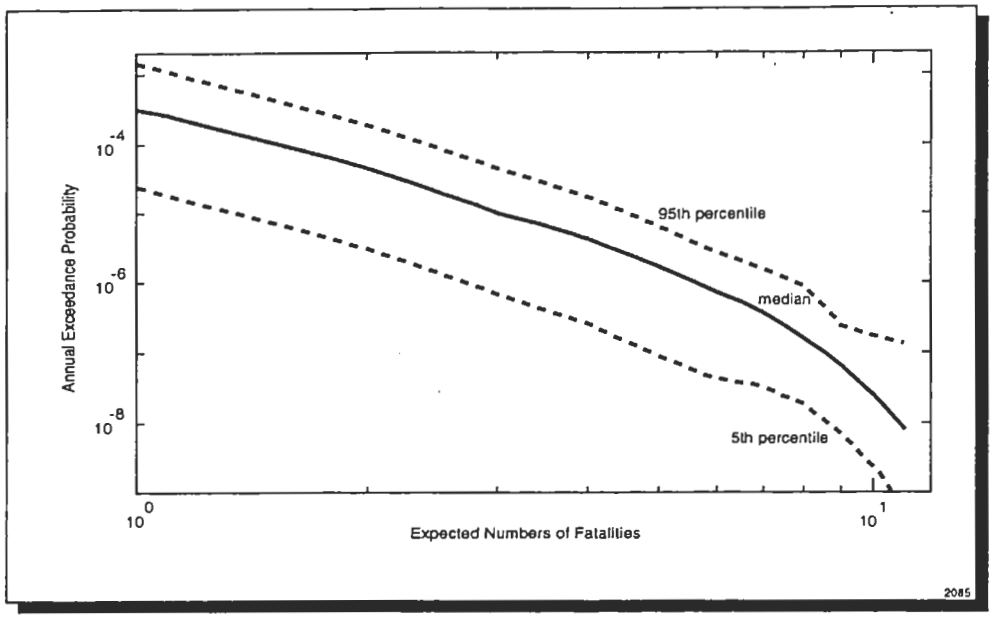


FIGURE F.5.2.2–1.—*Fatality Risk Curves for 2,000 Pit Shipments to the Savannah River Site.*

in an AT–400A container during SST transportation may be negligible.

Table F.5.2.3–1 summarizes the accident dispersal risk for pit shipments in the FL-type container. The estimated risk is highest for the alternative involving interim storage at the Hanford Site. The risk curves for annual accident dispersal risk associated with 2,000 pit shipments between Pantex Plant and Hanford Site are shown in Figure F.5.2.3–1. The probability of having more than 1 LCF arising from a dispersal event associated with pit shipments from Pantex Plant is most likely less than 7×10^{-8} (the 95th percentiles). The shape of each individual risk curve reflects randomness in the outcome whereas the difference between the median and 95th percentile risk curves reflects the calculated uncertainty in the estimates. The mean risk values given in Table F.5.2.3–1 are the average

TABLE F.5.2.3–1.—*Unit Risk Factors for Dispersal Health Risk from 2,000 Pit Shipments per Year*

	FROM PANTEX TO				
	NTS	SRS	HANFORD	KAFB	LOS ALAMOS[1]
Collective Health Risk, LCF	4×10^{-8}/yr	5×10^{-8}/yr	8×10^{-8}/yr	4×10^{-9}/yr	2×10^{-10}/yr
Maximum Individual Health Risk, LCF	4×10^{-11}/yr	1×10^{-10}/yr	1×10^{-10}/yr	1×10^{-11}/yr	5×10^{-13}/yr

[1]Only 30 pits a year to and from LANL.

TABLE F.5.3.1–1.—*Baseline Accident Dispersal Risk, Tritium Reservoir Shipments*

PERIOD	COLLECTIVE HEALTH RISK, LCF	MAXIMUM INDIVIDUAL HEALTH RISK, LCF
1997	1×10^{-8}	9×10^{-11}
1998	4×10^{-9}	4×10^{-11}
1999	3×10^{-9}	3×10^{-11}
2000	4×10^{-9}	4×10^{-11}
2001	4×10^{-9}	4×10^{-11}
2002	2×10^{-9}	2×10^{-11}
2003	2×10^{-9}	2×10^{-11}
2004	5×10^{-9}	5×10^{-11}
2005	6×10^{-9}	6×10^{-11}
2006	1×10^{-9}	1×10^{-11}
10-Year Total	4×10^{-8}	4×10^{-10}
Annual Average	4×10^{-9}	4×10^{-11}

The difference between the 5th percentile, median and 95th percentile risk curves reflects the calculated uncertainty in the estimates. The mean risk values given in Table F.5.3.1.–1 are the average values of the areas under the complete set of risk curves for each year considered. The dominant risk environment is accidents at or near an airport that involve severe crashes and/or fires. There are no credible ($>10^{-7}$ yr^{-1}), high-consequence events. For the purposes of this discussion high-consequence is defined to be greater than 1 LCF.

There is not a single dominant scenario associated with credible, moderate consequence event. For the purposes of this discussion moderate consequence is defined to be less than 1 LCF. The scenarios that dominate the moderate consequence events have the following common characteristics:

- The accident includes either a severe crash and/or a fire.

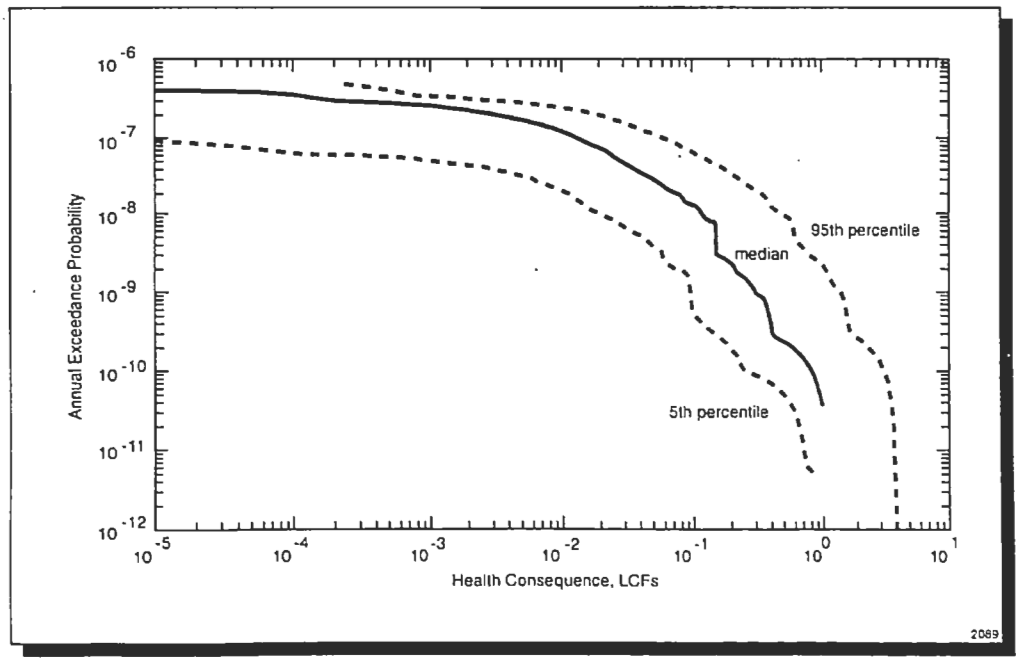


FIGURE F.5.3.1–1.—*Accident Dispersal Risk Curves for Fiscal Year 1997, Tritium Shipments.*

- The accident occurs either at or near the airport.

F.6 ADROIT METHODOLOGY

The ADROIT code was used to calculate the incident-free risk, the dispersal risk, and the accident risk from intersite shipments expected in the timeframe of this EIS.

F.6.1 Incident-Free Risk

The ADROIT code utilizes the RADTRAN–IV methodology to calculate incident-free exposures. The transportation of radioactive material results in some radiological exposure to the general public along the route. Included in the ADROIT computer code incident-free risk calculations for transport are models describing exposures to persons (e.g., residents) adjacent to the transport route (off-link exposures), exposures to persons (e.g., passengers on passing vehicles) sharing the transport route (on-link doses), and exposures to persons at stops (e.g., residents and truck crews not directly involved in the shipment).

For calculational purposes, each SST is modeled as a point radiation source located at the geometric center of the trailer. The source strength of the radiation is usually given in terms of the Transportation Index, which is a measure of the source strength 1 meter (3.3 feet) from the "package" surface (For weapon shipments, a dose rate of 3 millirem per hour at the surface of the trailer was used (PC 1995a). For pit shipments, a dose rate of 1 millirem per hour at 1 meter from the trailer surface was used).

As an SST carrying radioactive material traverses its route, people in the area adjacent to the route will receive low levels of radiation. The dose each person receives depends on his distance from the route and the speed of the source as it passes them. A combination of geometric dispersion and absorption of the radiation in the environment outside of the SST produces a rapid drop-off of radiation dose with distance from the source. Also, the faster the shipment passes the less exposure time there is for people along the route. Data from the 1990 Census was used to compute population density as a function of location along the roadway.

Vehicles sharing the roadway with the shipment have the potential for exposure to the radiation source. The basic approach for treating people on the roadway is very similar to that used for people off the roadway. An effective population density for the roadway is obtained and in all the calculations the population distribution is treated as a continuum. To keep the model both simple and conservative, the shielding provided by the vehicles transporting people on the roadway is neglected.

Typical SST shipment schedules include stops for fuel, meals, and rest/driver change. During those stops the public in the vicinity of the SST is exposed to a stationary source of radiation. The total rest stop time is taken to be 25 percent of the total driving time.

F.6.2 Accident Fatality Risk

The probability of fatalities due to direct effects of the accident environment (i.e., blunt trauma and/or burns to vehicle occupants, pedestrians and/or bystanders) is calculated using the ADROIT code based on the event tree shown in Figure F.6.2–1.

The probability of a fatal accident involving an SST is calculated, first, by estimating the annual probability, based on a given shipment campaign, of an SST accident severe enough to require that the vehicle cannot be driven. This value is obtained from the overall SST tow-away rate per mile for a given type of roadway and the distance traveled on specific types of roadways. The probability of a fatal accident and the number of fatalities given a tow-away accident is obtained from historical databases

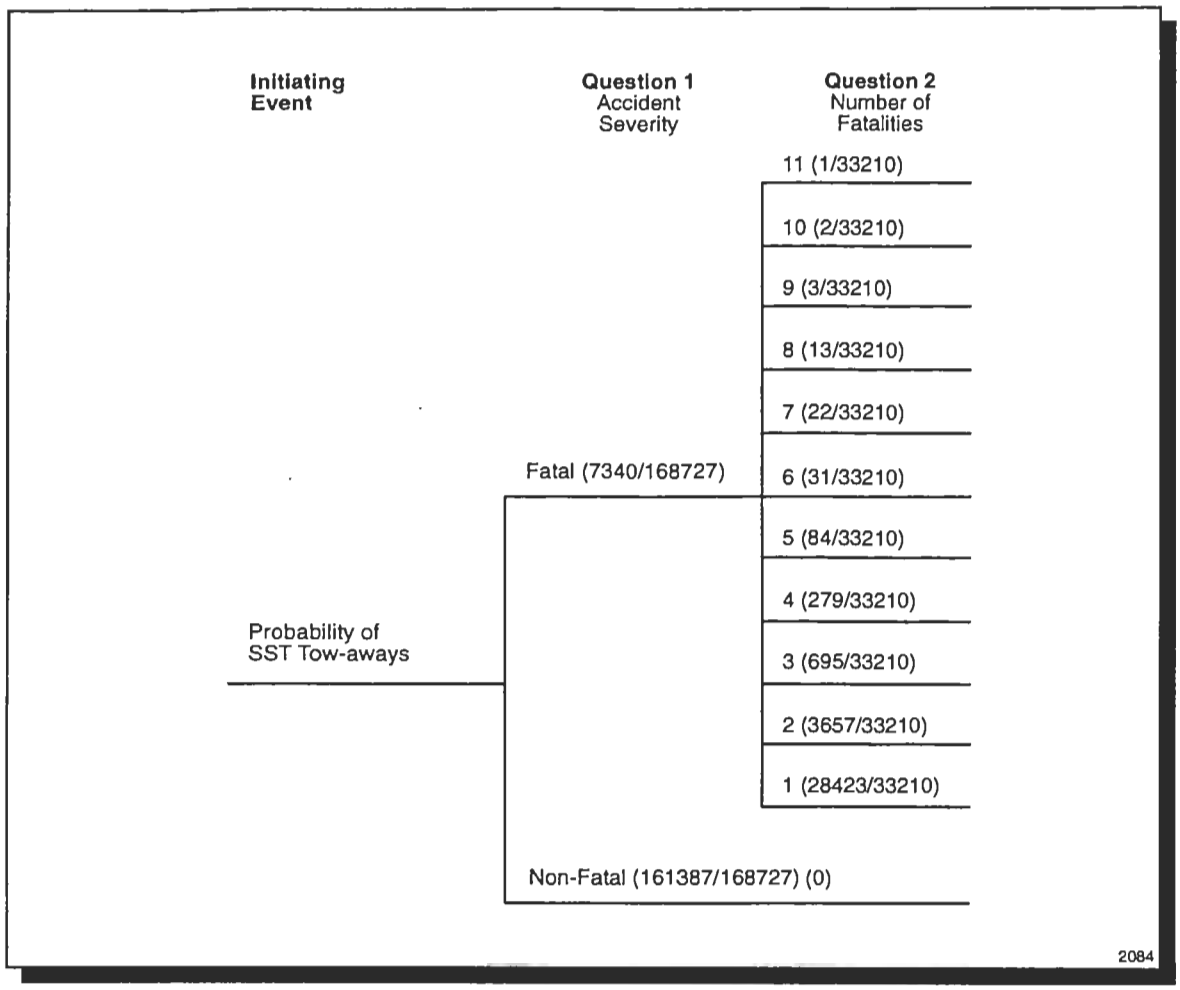


FIGURE F.6.2–1.—*Event Tree for Calculation of Fatality Risk.*

describing tractor-trailer accident severities (NAP 1990; SNL 1993).

F.6.3 Accident Dispersal Risk

Radioactive materials transported between sites include plutonium, uranium, and tritium. Other than relatively low levels of intrinsic radiation (which is considered in the incident-free analysis), plutonium and uranium do not pose a significant health hazard unless they are converted to an aerosol with respirable size particles. Three mechanisms by which aerosol may be generated and released are considered in the ADROIT code: violent reaction of high explosive(s) (HE), oxidation in a fire, and spalling and breakup of the surface oxide layer by mechanical forces.

There are three basic elements of the accidental dispersal risk assessment: *Probabilities, Consequences, and Uncertainties*. *Probabilities* of release by the three mechanisms that can produce respirable-sized aerosols and specific consequence scenarios are developed based on an event tree analysis. *Consequences* are evaluated for each end event in the tree through an assessment which integrates dispersal calculations, route characterization, population data, and dose-health effects models to provide an estimate of excess LCFs. *Uncertainties* are evaluated by incorporating Latin hybercube sampling into the calculations for probabilities and consequences.

F.6.3.1 *Event Tree*

The basis for the probability analysis in the ADROIT code is an event tree analysis. An event tree is a logic diagram that describes accident sequences that can lead to specific consequence scenarios. The event tree is composed of questions that define the types and severities of transportation accidents that occur, the resulting damage to the transporter and cargo, release mechanisms, accident locations, and the meteorological conditions. The event tree developed for the ADROIT code to analyze transportation of radioactive material in SSTs consists of 17 questions. These questions are depicted in Figures F.6.3.1–1 through F.6.3.1–4. A similar event tree is used for air transportation but is not discussed further.

The initiating events for the tree are traffic accidents in one of four operating environments. The operating environments are based on road type and population area. Although the structure of the tree is the same for all four initiating events, the quantification of some of the branches depends on the operating environment. The initiating events are quantified in terms of an annual probability of occurrence. All other branches of the tree are quantified in terms of conditional probabilities.

The remainder of this discussion is regarding the initiating events and the branches of the event tree. Details of the response of the packaging system (the packaging system includes the SST, container, and cargo) are limited because of the sensitive nature of the information involved in the evaluation of package response.

F.6.3.2 *Initiating Event Probabilities*

Highway transportation accidents are evaluated in four operating environments based on road type and population (SNL 1994a). Road types are divided into limited access roads and non-limited access roads. The distinction in road type is made because accident rates and the frequency of different accident types vary significantly with road type. Population areas are divided into urban and rural areas. The distinction in population area is retained primarily to capture the difference in the size of the population exposed given a dispersal event.

The initiating event probabilities are calculated as the product of the following: the overall tow-away accident rate per mile for SST transport; the fraction of tow-away accidents that have severities comparable to fatal accidents; influence factors that relate the overall accident rate to the operating environment of interest; and the mileage in the operating environment of interest.

The operating history with SST transport is sufficiently long to define an overall tow-away accident rate. The mean estimate for the rate of tow-away accidents involving an SST is 0.066 per million miles (SNL 1994a). However, the number of accidents experienced with SST transports is not sufficient to quantify the accident rate in the operating environments of interest or the types and severities of accidents. Thus, general commerce data for heavy truck transportation is used as a surrogate for SST data to quantify the relative accident rates in different operating environments and the types and severities of accidents.

The most comprehensive database available on heavy truck accidents is the Trucks Involved in Fatal Accidents (TIFA) database (UM 1991; UM 1993), which is maintained by the University of Michigan Transportation Research Institute. This database contains information on fatal accidents. Fatal accidents provide a good match with accidents of sufficient severity to threaten cargoes carried within SSTs.

Because of the lack of details for SST accident rates in operating environments of interest and the types and severities of accidents it was

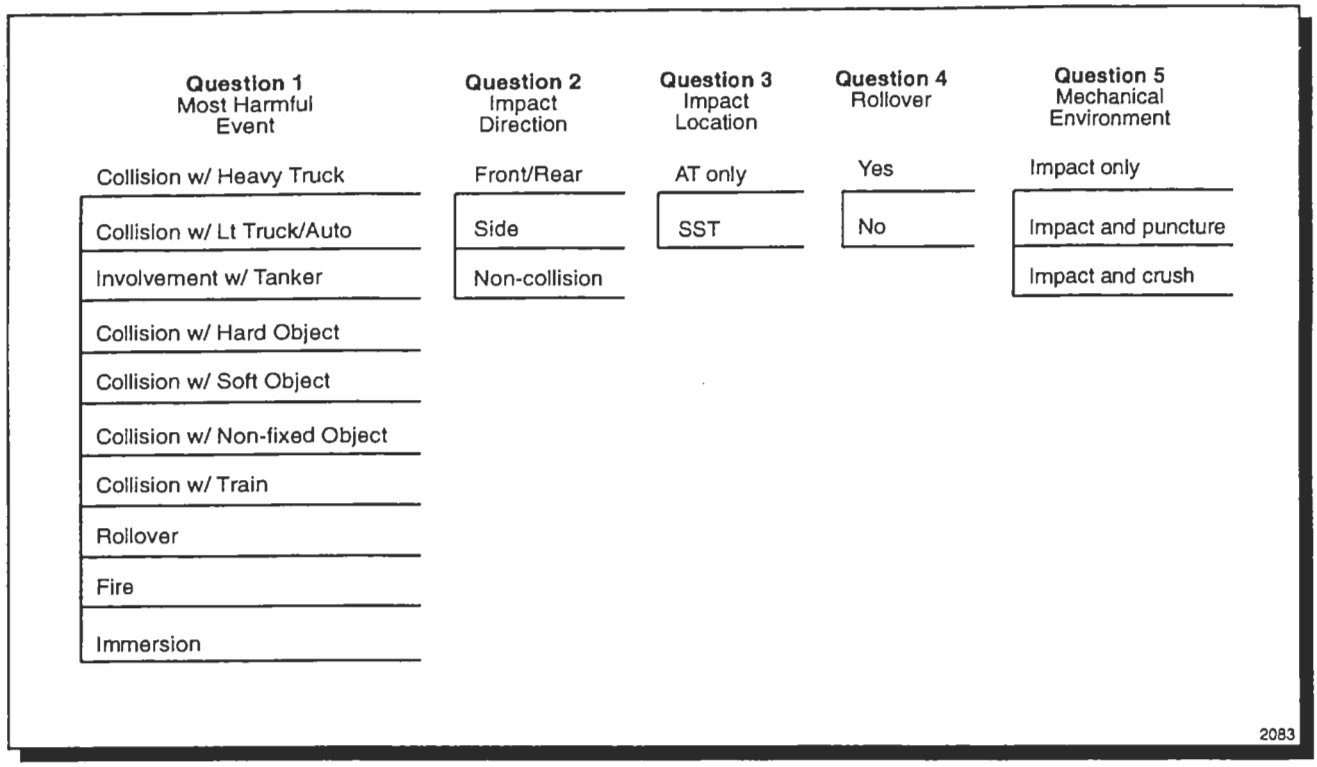


FIGURE F.6.3.1–1.—*ADROIT Dispersal Event Tree Questions 1–5.*

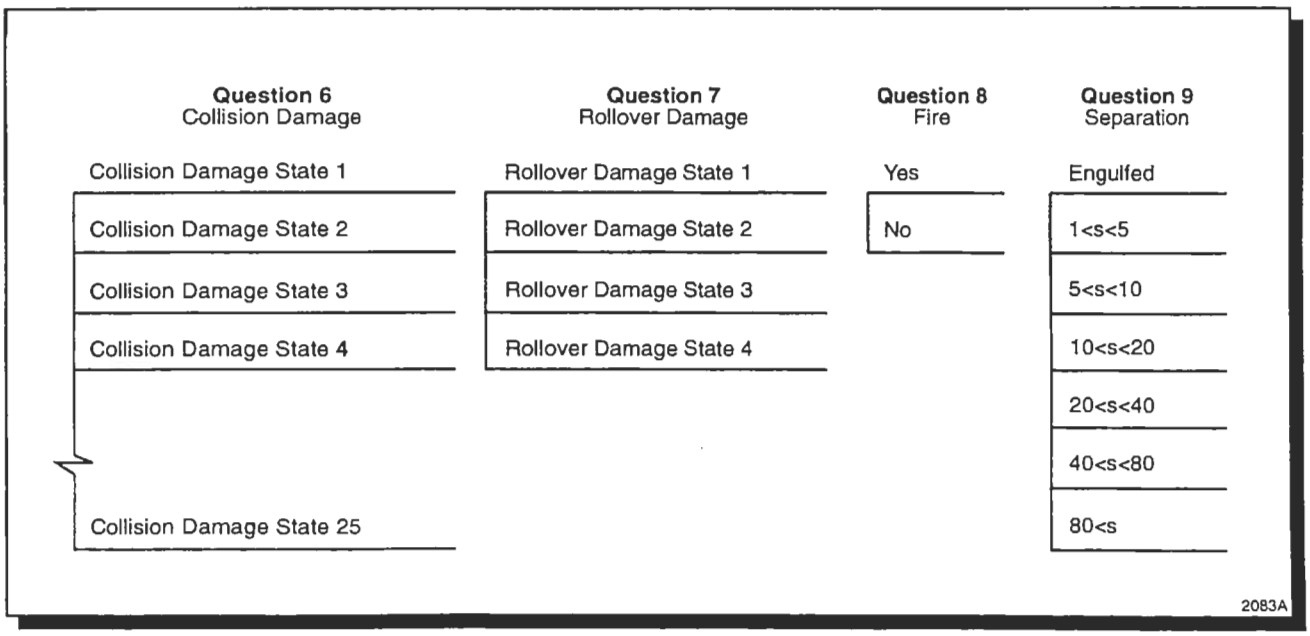


FIGURE F.6.3.1–2.—*ADROIT Dispersal Event Tree Questions 6–9.*

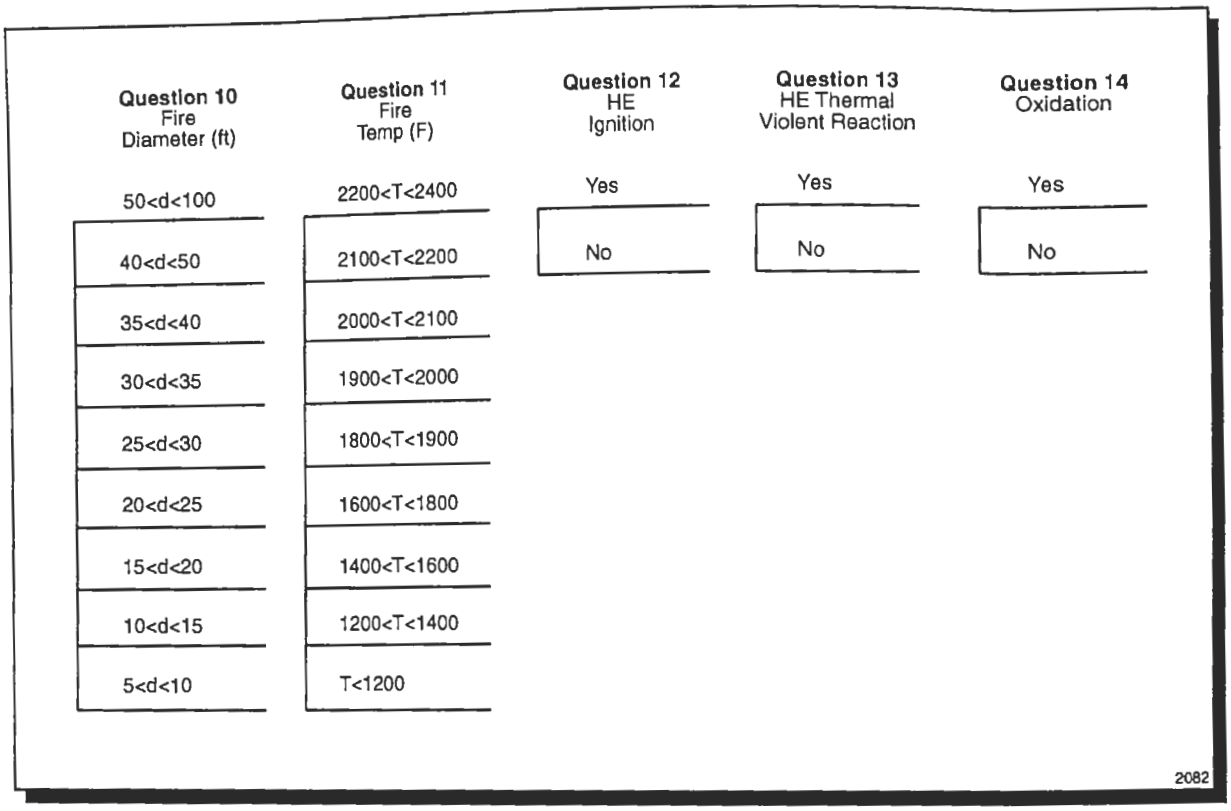


FIGURE F.6.3.1–3.—*ADROIT Dispersal Event Tree Questions 10–14.*

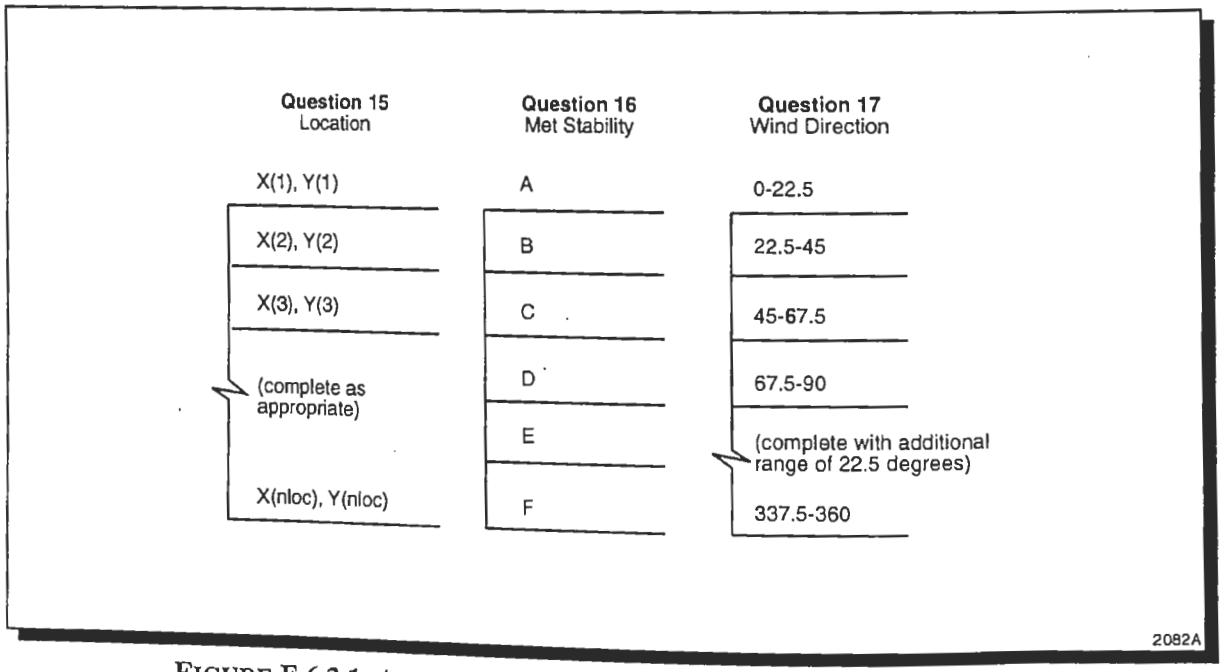


FIGURE F.6.3.1–4.—*ADROIT Dispersal Event Tree Questions 15–17.*

necessary to introduce a factor which could provide a bridge between the tow-away accident rate and the severities and operating environments of interest. The bridge is provided by modifying the tow-away accident rate with an estimate of the fraction of tow-away accidents that are considered to have severities comparable to fatal accidents. The fraction is estimated to be between 0.042 and 0.51 (SNL 1994b). In general, the tow-away rate includes accidents of lesser severity than those associated with fatal accidents.

Because the probability of occurrence of accidents of varying severities is different for different road types and the consequences of accidents differ because of differing population densities, highway transportation accidents were evaluated in four operating environments based on road type and population area. Table F.6.3.2–1 presents the four influence factors (SNL 1994a).

The mileage in each operating environment is derived from shipment projections and route characterization. The TIGER/Line files (Census 1991; Census 1991a) were used to develop route segmentation data files, which include information on geographic location, operating environment, and applicable meteorological stations as a function of route mile marker (cumulative distance from the route origin) at closely-spaced points.

F.6.3.3 *Accident Environments*

Radioactive materials are shipped in packaging systems that mitigate accident environments and help prevent releases to the environment. Normal transportation environments do not produce environments that threaten the integrity of the packaging system. However, the environments produced from very severe traffic accidents could exceed the capabilities of the packaging system and cause a release of radioactive material.

The risk assessment implemented in the ADROIT code considers impact, puncture, crush, and thermal environments. In traffic accidents, impact, puncture, and crush environments are associated with collision and rollover events; thermal environments are associated with fires involving the fuel system, cargo, or other elements of the vehicles and/or objects involved in the accident. The response of the packaging system to these environments is interdependent. For example, the response of the packaging system to a fire reflects damage to the packaging system caused by collision and rollover.

The accident data needed to define the probability of packaging system failure include probabilities of various accident types and distributions of collision, rollover, and fire severity. The response of the packaging system and the collision, rollover, and fire severity depend on the type of accident. There are a large number of accident variables that can be used to characterize the accident. In the ADROIT code, the emphasis is placed on defining the minimum number of accident characterizations that would provide sufficient definition of the accident environment to analyze the response of the packaging system and also provide reasonable differentiation of the collision, rollover, and fire severities. As a result, the variables used to characterize

TABLE F.6.3.2–1.—*Influence Factors*

ROAD AND POPULATION TYPE	LIMITED URBAN	LIMITED RURAL	OTHER URBAN	OTHER RURAL
Influence Factor	0.63	0.93	3.91	3.83

accidents were selected based in part on specific features of the packaging system used by DOE to transport radioactive material.

The packaging system used by DOE to transport radioactive material includes the cargo, containers, and the SST. The most important features of the SST that protect the cargo in accident environments include the walls of the trailer, which provides significant thermal protection in fire environments, and the cargo tie-down system, which provides a means of holding the cargo in place. In general, damage to the packaging system in an accident depends on a number of factors:

- If the accident involves a collision, accident characteristics that may affect the response of the packaging system include the location of the principal impact, the impact direction, the collision energy absorbed, the peak contact velocity, and the collision duration. Specifically, damage to the trailer walls depends on the location of the principal impact, the impact direction, and the collision energy absorbed. The damage to the container and cargo depends on the peak contact velocity and the collision duration.
- If the accident involves a rollover, the primary characteristic of the rollover used to evaluate the response of the packaging system (primarily damage to trailer walls) is the skid distance.
- If the accident involves a fire, additional accident characteristics that affect the response of the packaging system include the effective fire temperature, the size of the fire, the separation between the fire and the trailer, and the duration of the fire.

The types of vehicles and/or other objects involved, collision occurrence, angle of impact, location of principal impact, rollover occurrence, and fire occurrence are factors that define the types of accidents. The peak contact velocity, skid distance, effective fire temperature, fire size, fire separation, and fire duration are factors that define the severity of the accident.

The branches of Questions 1–4 and 8 in the ADROIT event tree define the factors used to characterize the type of accident. Questions 9–11 are used to describe the fire separation, fire size, and fire temperature. The peak contact velocity, skid distance, and fire duration are used in the evaluation of the branch probabilities for Questions 6, 7, 12, and 14. Details of the statistical distributions used to describe these input variables can be found in *A Statistical Description of the Types and Severities of Accidents Involving Tractor Semi-Trailers* (SNL 1994b).

F.6.3.4 *Response of Packaging System to Accident Environments*

The response of the packaging system to the accident environments is addressed in Question 5–7 and 12–14. The possible responses to collisions, rollovers, and fires are considered. The response states address mechanisms that lead to release of radioactive material (e.g., violent reaction of HE by either mechanical or thermal initiation) as well as damage to the SST walls and cargo that may affect subsequent thermal response to a fire.

Question 5 is used to define the type of mechanical environments to which the cargo may be subject. Question 6 addresses the damage to the packaging system associated with collision events. Twenty-five collision damage states, which are determined from combinations of SST wall damage and cargo damage, are represented in the event tree. The damage states are hierarchical and are listed from the most severe to no significant damage. For scenarios in which a collision occurs, the branch probabilities are obtained by the split fraction

introduction of a large number of uncertainties in the estimates. Historical information from similar activities provides a more accurate estimate of future exposures.

Historical dosimetry information indicates a conservative dose estimate of 6.5×10^{-4} person-rem per handling operation for the transportation and staging department. Handling operations include interzone transfers of weapons and weapons components with associated vehicle loading/unloading as well as SST loading/unloading. For the 10-year period under evaluation in this EIS, a conservative estimate of 94,000 handling operations was made resulting in a cumulative dose of 61 person-rem to the transportation and staging workers.

The bounding estimate of handling operations for the Proposed Action includes the transfer of 20,000 pits from Zone 4 to Zone 12 with a subsequent return to Zone 4 for the pit repackaging project. The estimate also includes the transfers of weapons and weapons components at an operational level of 2,000 weapons per year. The conservative estimates for both dose per handling and quantity of handling events were made to bound the impacts expected from Zone 4 operations with associated material handling and interzone transfers.

Because there were no identifiable historical doses exclusively relating to large numbers of SST pit container loading or unloading operations, these radiological exposures were obtained using time and position estimates for placing and securing pit containers within an SST. Figure F.7–1 shows the required restraint for pit containers within an SST. The following assumptions were used to estimate worker exposures for pit container loading/unloading operations:

- To position and restrain a pit container within an SST requires 15 minutes.
- An AT–400A pit container dose rate of 1.5 millirem per hour at 1 meter (3 feet) was used.
- Two personnel are required for the pit container restraint operation.
- During the loading operation, the workers spend 5 minutes at a distance of approximately 1 meter (3 feet), and 10 minutes at approximately 0.3 meter (1 foot) from the pit containers.
- During the loading operations, the workers are exposed to the pit container being loaded and the nearest seven pit containers.
- Impacts from unloading operations are the same as for loading operations
- No credit is taken for protective gear (e.g., lead aprons).

F.8 REGULATIONS

This section briefly describes the regulatory environment for transporting radioactive materials and wastes out of Pantex Plant. These materials must comply with both DOE requirements and DOT regulations governing offsite shipments.

DOT has the responsibility for establishing transportation regulations, but the enforcement of these regulations is shared with the Federal Highway Administration, the Federal Aviation Administration, the National Highway Traffic Safety Administration, the Native American tribes, and the states. Other aspects of radioactive and mixed materials or wastes transportation are regulated by NRC, the Environmental Protection Agency, and the Occupational Safety and Health Administration. The Environmental Protection Agency is responsible for hazardous wastes, and Occupational Safety and Health Administration is concerned with the safety of workers. The Federal Emergency Management Agency has the responsibility of coordinating the Federal assistance, planning, and training for any and all

types of emergency response situations (including transportation accidents) with local, tribal, and state governments.

The DOT and NRC share the regulatory responsibility for radioactive materials and wastes containers. The NRC regulates, reviews, and certifies Type B containers. The DOT, with the NRC's consultation, regulates all other radioactive materials packaging. DOE has the authority of DOT (under 49 CFR section 173.7) to give approval for certain packaging and certain operational aspects of its research, defense, and contractor-related shipments of materials requiring Type B containers. However, in this process the DOE must use NRC-equivalent standards and procedures.

Because of the stringent regulations on transport packaging manufacture, shipment identification, package and vehicle inspections, and routing and driver training, there has never been a documented death or significant injury associated with radioactive materials transport in the DOE complex for more than 40 years.

Table F.8–1 is a list of regulations and standards that govern the transportation processes at Pantex Plant.

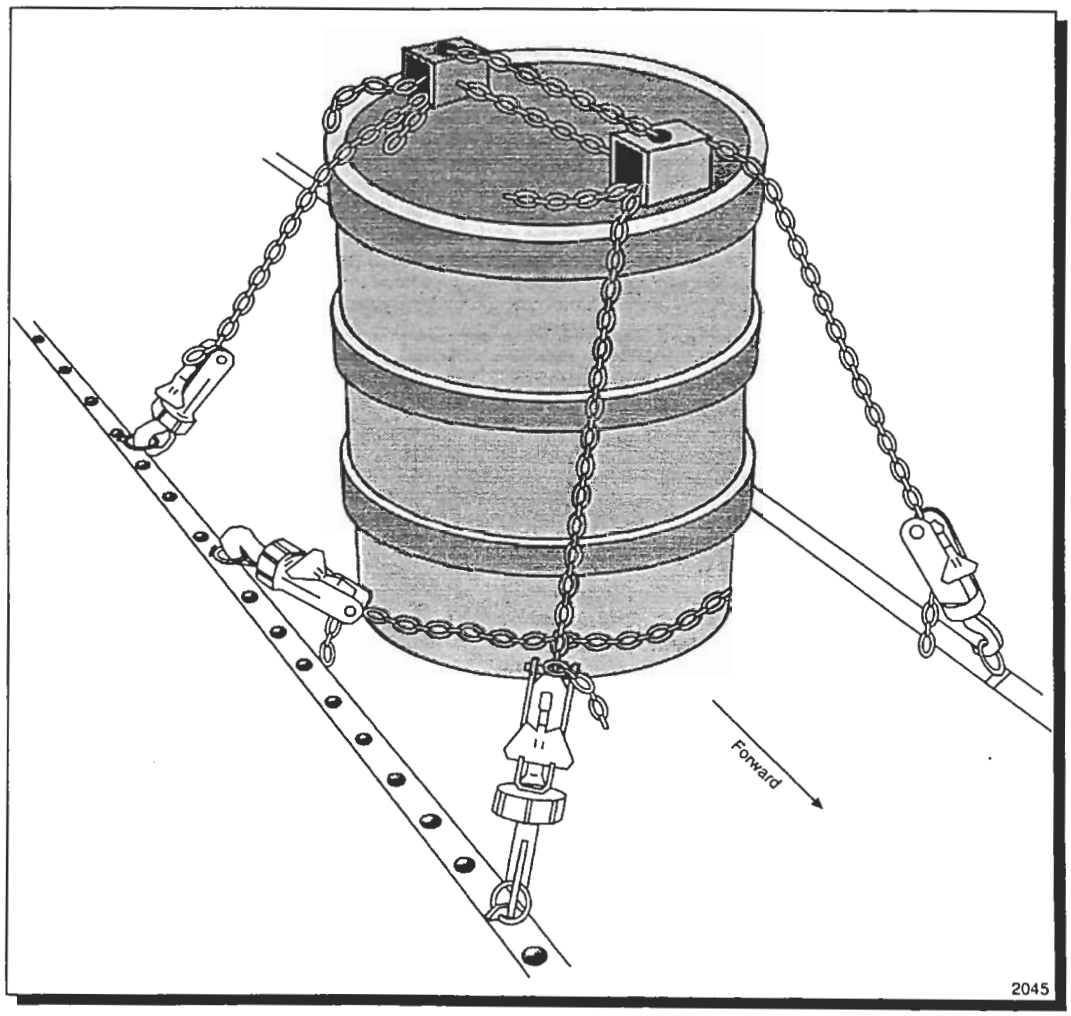


FIGURE F.7–1.—*Restraint of Pit Containers within a Safe Secure Tractor Trailer.*

TABLE F.8–1.—*Regulations or Guidance for the Transportation of Hazardous, Radioactive, and Mixed Materials or Wastes*

REGULATIONS OR GUIDANCE	RESPONSIBLE AGENCY
10 CFR Part 71, Subpart H, "Packaging and Transportation of Radioactive Material"	Nuclear Regulatory Commission
29 CFR Part 1910, "Occupational Safety and Health Standards"	
49 CFR Part 172, "Hazardous Materials Tables, Hazardous Materials Communication Requirements, and Emergency Response Information Requirements"	DOT
49 CFR Part 173, "Shippers—General Requirements for Shipment and Packages"	DOT
49 CFR Part 177, "Carriage by Public Highway"	DOT
49 CFR Part 178, "Specifications for Packaging"	DOT
49 CFR Part 390, "Federal Motor Carrier Safety Regulations"	DOT
49 CFR Part 391, "Qualifications of Drivers"	DOT
49 CFR Part 392, "Driving of Motor Vehicles"	DOT
49 CFR Part 393, "Parts and Accessories Necessary for Safe Operation"	DOT
49 CFR Part 395, "Hours of Service of Drivers"	DOT
49 CFR Part 396, "Inspection, Repair, and Maintenance"	DOT
49 CFR Part 397, "Transportation of Hazardous Materials; Driving and Parking Rules"	DOT
ANSI-MH2.13, *Specification for 30-Gallon Full-Removable-Head Universal Drum (DOT-17H)*	American National Standards Institute
DOE/EV/06194, *Explosives Safety Manual*	DOE
DOE/EH-02561, *U.S. DOE Radiological Control Manual*	DOE
DOE/DNA STP 4551D, *Transportation of Nuclear Weapons Material, Shipment by Safe Secure Trailer*	DOE
DOE Order 5480.11, "Radiation Protection for Occupational Workers"	DOE
DOE Order 5610.12, "Packaging and Offsite Transportation of Nuclear Components, and Special Assemblies Associated with the Nuclear Explosive and Weapon Safety Program"	DOE
DOE-STD-3009-YR, "Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Analysis Reports"	DOE
Pantex Plant Standard STD-1463, "Explosive Limits"	Mason & Hanger-Silas Mason Co., Inc.
Pantex Plant Standard STD-1700, "Outbound Shipments (Non Weapons)"	Mason & Hanger-Silas Mason Co., Inc.
Pantex Plant Standard STD-3120, "Scrap Explosives and Contaminated Waste Materials"	Mason & Hanger-Silas Mason Co., Inc.

TABLE F.8–1.—*Regulations or Guidance for the Transportation of Hazardous, Radioactive, and Mixed Materials or Wastes*-Continued

REGULATIONS OR GUIDANCE	RESPONSIBLE AGENCY
Pantex Plant Standard STD-3140, "Notification, Investigation, and Reporting of Occurrences"	Mason & Hanger-Silas Mason Co., Inc.
Pantex Plant Standard STD-3161, "Electrical Storm and Severe Weather Precautionary Procedures"	Mason & Hanger-Silas Mason Co., Inc.
Pantex Plant Standard STD-3180, "Traffic Safety Program"	Mason & Hanger-Silas Mason Co., Inc.
Pantex Plant Standard STD-3470, "Onsite Packaging and Transportation of Hazardous Materials, Substances, and Wastes"	Mason & Hanger-Silas Mason Co., Inc.
Pantex Plant Standard STD-3484, "Certification of Mixed Waste Shipments"	Mason & Hanger-Silas Mason Co., Inc.
Pantex Plant Standard STD-3485, "Waste Certification Program"	Mason & Hanger-Silas Mason Co., Inc.
Pantex Plant Standard STD-3486, "Waste Acceptance Criteria"	Mason & Hanger-Silas Mason Co., Inc.
Pantex Plant Standard STD-3487, "Guidance for Marking and Labeling of Radioactive Waste Packages"	Mason & Hanger-Silas Mason Co., Inc.
Pantex Plant Standard STD-3488, "Training Requirements for Radioactive and Mixed Waste Management"	Mason & Hanger-Silas Mason Co., Inc.
Pantex Plant Standard STD-3489, "WCO Surveillance Program"	Mason & Hanger-Silas Mason Co., Inc.
Pantex Plant Standard STD-3490, "Material Characterization"	Mason & Hanger-Silas Mason Co., Inc.
MNL RS-001, "Pantex Plant Radiological Control Manual"	Mason & Hanger-Silas Mason Co., Inc.
EPP-1000, Pantex Plant Emergency Management Plan	Mason & Hanger-Silas Mason Co., Inc.
O&I Standard 3-1070.5, "Waste Characterization Plan of NTS Wastes"	Mason & Hanger-Silas Mason Co., Inc.
O&I Standard 6-5000, "General Safety Requirements for Zone 11"	Mason & Hanger-Silas Mason Co., Inc.
O&I Standard 7-0028, "Receiving, Inspection & Packaging of MAA Wastes"	Mason & Hanger-Silas Mason Co., Inc.
O&I Standard 7-0029, "Compacting Procedures for Waste Generated in the MAA"	Mason & Hanger-Silas Mason Co., Inc.
O&I Standard 7-0034, "Waste Management, Monitoring and Decontamination of Weapon Components"	Mason & Hanger-Silas Mason Co., Inc.
O&I Standard 7-0034.1, "Receiving and Inspection of NTS Waste"	Mason & Hanger-Silas Mason Co., Inc.
O&I Standard 7-5000, "General Safety Requirements—Production and Support Activities"	Mason & Hanger-Silas Mason Co., Inc.
O&I Standard 7-5080, "Safety Requirements—Onsite Transportation of Chemical Explosives, Nuclear Explosives, and Weapon Components"	Mason & Hanger-Silas Mason Co., Inc.
O&I Standard 7-5600, "Area E (Firing Site)—General Safety Requirements"	Mason & Hanger-Silas Mason Co., Inc.

TABLE F.8–1.—*Regulations or Guidance for the Transportation of Hazardous, Radioactive, and Mixed Materials or Wastes*-Continued

REGULATIONS OR GUIDANCE	RESPONSIBLE AGENCY
O&I Standard 7-5638.1, "General Safety Requirements for Handling Nuclear Explosives and NELAs"	Mason & Hanger-Silas Mason Co., Inc.
O&I Standard 7-5640, "General Safety Requirements for Transportation of Nuclear Explosives by Motor Vehicle"	Mason & Hanger-Silas Mason Co., Inc.
O&I Standard 7-5650, "General Safety Requirements for Zone 4"	Mason & Hanger-Silas Mason Co., Inc.
O&I Standard 7-5655, "Zone 4 Storage and Disposal of HE Material"	Mason & Hanger-Silas Mason Co., Inc.
O&I Standard 7-5656, "Low-Level Radioactive Component Waste Packaging"	Mason & Hanger-Silas Mason Co., Inc.
O&I Standard 7-5660, "Burning Ground Operating Procedure"	Mason & Hanger-Silas Mason Co., Inc.
O&I Standard 7-5660.2, "Handling, Transportation, and Staging of Hazardous Waste Awaiting Offsite Shipment"	Mason & Hanger-Silas Mason Co., Inc.
O&I Standard 7-5660.3, "Preshipment Transportation, Handling and Staging of NTS Material"	Mason & Hanger-Silas Mason Co., Inc.
O&I Standard 7-5660.4, "Radioactive Waste Shipment"	Mason & Hanger-Silas Mason Co., Inc.
O&I Standard 7-5660.5, "Loading of NTS Material for Offsite Shipment"	Mason & Hanger-Silas Mason Co., Inc.

Source: Pantex 1994

REFERENCES

10 CFR 71.73 — Nuclear Regulatory Commission, "Packaging and Transportation of Radioactive Material", *Code of Federal Regulations,* Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC.

10 CRF 71, Subpart H — Nuclear Regulatory Commission, "Packaging and Transportation of Radioactive Material", *Code of Federal Regulations,* Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC.

49 CFR 173.24 — U.S. Department of Transportation, "Shippers-General Requirements for Shipment and Packages", *Code of Federal Regulations,* Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC.

49 CFR 173.411 — U.S. Department of Transportation, "Shippers-General Requirements for Shipment and Packages", *Code of Federal Regulations,* Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC.

49 CFR 173.412 — U.S. Department of Transportation, "Shippers-General Requirements for Shipment and Packages", *Code of Federal Regulations,* Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC.

49 CFR 173.7 — U.S. Department of Transportation, "Shippers-General Requirements for Shipment and Packages", *Code of Federal Regulations,* Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC.

Census 1991 — Bureau of the Census, 1990 TIGER/Line Census Files, Technical Documentation, U.S. Department of Commerce Washington, DC, 1991.

Census 1991a — Bureau of the Census, 1990 TIGER/Line Census Files, [machine-readable data files], U.S. Department of Commerce, Washington, DC, 1991.

Founds 1996 — Vu-Graph Transparency of Al–R8 container provided by N. Founds of DOE Albuquerque Operations Office.

NAP 1990 — *Health Effects of Exposures to Low Levels of Ionizing Radiation: BIER V,* Committee on the Biological Effects of Ionizing Radiations, Board on Radiation Effects Research, Commission on Life Sciences, National Research Council, National Academy Press, Washington, DC, 1990.

Pantex 1994 — *On-Site Transportation Safety Risk Assessment,* Pantex Plant, Amarillo, TX, 1994.

Pantex 1996a — Pantex Plant, *Safety Information Document*, prepared for the U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM, September 1996.

Pantex nd — Pantex Plant, EIS Facts, Stage Right, Newsletter, Amarillo, TX, nd.

PC 1995 — McBride, D., "Transportation Certificate for FL-Pit Container," SWEIS request for information supplied by D. McBride, Pantex Plant, Amarillo, TX, May 1, 1995.

PC 1995a — Petraglia, J., Dose Rates, SWEIS Request for Information Supplied by J. Petraglia, Battelle Pantex, TX, TR-006, January 3, 1995.

Ross 1994 — DOE, *Transportation Evaluation Report for Ross Aviation, Inc.*, prepared under Contract DE-AC04-89AL52318 by Ross Aviation, Inc., for the U.S. Department of Energy, Albuquerque Operations Office, February 1, 1994.

SNL 1993 — Neuhauser, K.S. and F.L. Kanipe, *RADTRAN 4 Volume II: Technical Manual,* SAND89-2370, Sandia National Laboratories, August 1993.

SNL 1994 — Larsen, M.E., *MELTER: A Model of the Thermal Response of Cargoes Transported in the Safe-Secure Trailer Subject to Fire Environments for Risk Assessment Applications,* SAND93-0737, Sandia National Laboratories, August 1994.

SNL 1994a — Phillips, J.S., D.B. Clauss and D.F. Blower, *Determination of Influence Factors and Accident Rates for the Armored Tractor/Safe Secure Trailer,* SAND93-0111, Sandia National Laboratories, April 1994.

SNL 1994b — Clauss, D.B., R.K. Wilson D.F. Blower and K.L. Campbell, *A Statistical Description of the Types and Severities of Accidents Involving Tractor Semi-Trailers,* SAND93-2580, Sandia National Laboratories, June 1994.

UM 1991 — Blower, D., *Trucks Involved in Fatal Accidents, Codebook 1980-88, By Power Unit Type,* UMTRI-91-36, University of Michigan, Transportation Research Institute, 1991.

UM 1993 — Sullivan, K.P. and D.L. Massie, *Trucks Involved in Fatal Accidents, 1990 Factbook,* UMTRI-93-1, University of Michigan, Transportation Research Institute, 1993.

APPENDIX G

Pollution Prevention and Waste Minimization

APPENDIX G
POLLUTION PREVENTION AND WASTE MINIMIZATION

G.1 INTRODUCTION

This appendix addresses the current status of Pantex Plant's Pollution Prevention and Waste Minimization (PP/WM) program. This section discusses the program's background; current elements, including source reduction, process change, material substitution, administrative policies, pollution prevention opportunity assessments (PPOAs), technology transfer, recycling/reuse, treatment, energy and water conservation, and future programs.

G.2 BACKGROUND

NEPA emphasizes minimizing the impacts that result from Federal activities. The *Pollution Prevention Act of 1990* and the *Hazardous and Solid Waste Amendments of 1984* enabled Federal agencies to develop and implement PP/WM programs. NEPA's original purpose, which was to "promote efforts which will prevent or eliminate damage to the environment..." was complemented by both acts (42 U.S.C. 4321; PC 1995a:1). This relationship was further strengthened in a 1993 memorandum from the Council on Environmental Quality, which recommended that Federal agencies incorporate pollution prevention principles, techniques, and mechanisms throughout their NEPA planning and decision making processes (PC 1993a:2).

To help facilities meet regulatory requirements, the Environmental Protection Agency (EPA) has published strategies and guidelines on PP/WM. The *Pollution Prevention Act* establishes an environmental protection hierarchy, with pollution prevention/source reduction as the most desirable environmental management option. If pollution cannot be prevented, then, in descending order of preference, environmentally sound recycling, treatment, and disposal are listed as alternative waste management options (PC 1993:Attach. 2).

Waste minimization centers on source reduction or recycling of solid wastes regulated by the *Resource Conservation and Recovery Act* (RCRA). Pollution prevention complements the concept of waste minimization by focusing on the following: source reduction and other practices that reduce or eliminate pollutants through increased efficiency in the use of raw materials, energy, water, or other resources or protection of natural resources by conservation (PC 1993:2). Waste minimization is an implied element of the pollution prevention process.

The State of Texas established the *Waste Reduction Policy Act of 1991*, Senate Bill 1099, which amended the *Texas Solid Waste Disposal Act* (Texas Statutes, Article 4477-7) to include requirements for the elimination of hazardous waste generation through source reduction and waste minimization. TNRCC serves to enforce this act by requiring:

- Operators of hazardous waste disposal facilities to maintain records necessary to determine the amount of hazardous waste disposed.
- Large quantity generators of industrial solid or hazardous waste to provide recordkeeping and use a manifest or other appropriate system to ensure that waste is transported to an authorized facility.
- Large quantity generators to provide plans for the reduction of the release of pollutants or contaminants into the air and water and to establish reasonable goals for the reduction in volume of generated hazardous waste and the amount of pollutants and contaminants using

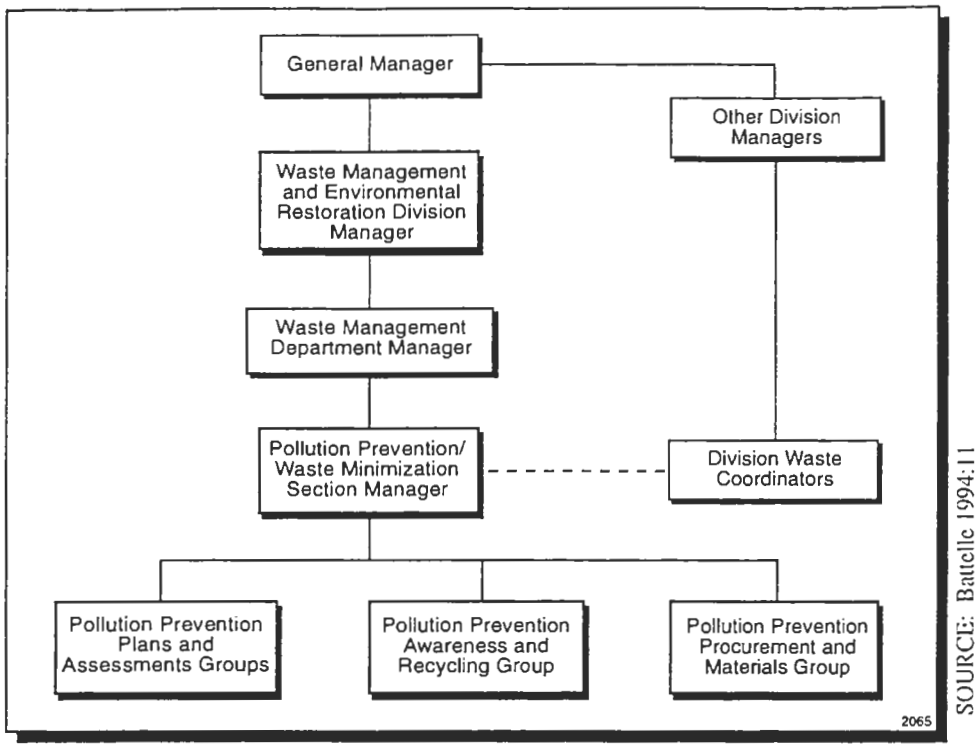


FIGURE G.3–1.—*Simplified Schematic of the Pantex Plant Pollution Prevention and Waste Minimization Program.*

TABLE G.3–1.—*Sixteen Elements of the Pantex Plant Pollution Prevention and Waste Minimization Program*

1.	Foster a philosophy to conserve resources and create a minimum of waste/pollution in achieving site strategic objectives.
2.	Reduce the volume of hazardous, radioactive, and mixed wastes.
3.	Promote the use of nonhazardous materials in plant operations to minimize the potential risks to human health and the environment.
4.	Reduce or eliminate the generation of waste materials through input substitution, product reformulation, process modification, improved housekeeping, and onsite closed-loop recycling to achieve minimal adverse effects on the air, water, and land.
5.	Enhance communication of waste minimization objectives, goals, and ideas laterally and vertically among site organizations.
6.	Promote integration and coordination of waste generators and waste managers on waste minimization matters.
7.	Characterize wastestreams and establish a baseline of waste generation data.
8.	Identify and implement methods and technologies for waste minimization.
9.	Target policies, procedures, or practices that may be barriers to waste minimization.
10.	Create incentives for pollution prevention.
11.	Develop and implement employee pollution prevention awareness and occupational training programs.
12.	Collect and exchange waste minimization information through technology transfer, outreach, and educational networks.
13.	Develop mechanisms for fully disseminating current technical information to site users.
14.	Enhance employee awareness of pollution prevention goals, objectives, and methods.
15.	Develop specific goals and schedules for waste minimization activities.
16.	Comply with Federal and State regulations and DOE requirements for waste minimization.

Source: Battelle 1994:6

TABLE G.3.1–1.—*Source Reduction at Pantex Plant*

SOURCE REDUCTION TECHNIQUES	SPECIFIC SOURCE REDUCTION MEASURES
PROCESS CHANGES	
Affirmative Procurement	Inventory reduction. Recycled material purchased. Recyclability of material considered before purchased. Content of hazards considered before products are purchased. Product durability considered.
Technical Redesign	Fireloop construction project. Firing range lead removal.
Procedural Controls	Reduced repackaging hazardous reagents into smaller containers. Documented waste codes in standard operating procedures for all excess materials generated. Accurately defining the Radioactive Materials Management Area. Redefining high explosive-contaminated waste.
Maintenance Procedures	Oil and grease analyzer.
MATERIAL SUBSTITUTION	
Chemical Control Program	Replaced hazardous solvents with Safety Kleen Premium Solvent. Replaced hazardous solvents with a citrus-based nonhazardous solvent. Substituted water-based nonhazardous paints to replace solvent-based enamels.
ADMINISTRATIVE POLICIES	
PP/WM Team	Set goals for reducing volume of wastes and other pollutants. Perform PPOAs. Perform life cycle assessments. Coordinate technology transfer efforts.
Employee Incentives	Cash rewards for new waste minimization solutions.
Program Feedback	Quarterly newsletter, *Waste Minimizer*, published that lists achievements and needs. Annual reports on waste generation and waste minimization progress.
Employee Training	One hundred percent of Pantex Plant employees received PP/WM training. Computer-based training course.
Database Tracking System	Ability to track air releases, material usage, volume, cost, and operation records of treatment and recycling systems.
Cost Allocation	Under development.
Technology Transfer	Workshops (i.e., Waste Reduction Information Exchange). Field trips. Dissemination of the *Waste Minimizer*. Use of the Pollution Prevention Information Clearinghouse distribution center for EPA documents and other information. Use of the Pollution Prevention Information System.
Waste Characterization	Monitoring mixed waste for radiation, allows for declassification of waste. Segregation of waste. Reviewing/revising Pantex Plant specific waste codes to reflect RCRA definition.
Implementation and Evaluation	Program review and update.

Sources: PC 1995:1 thru 10; Pantex1996:14.4

TABLE G.3.1–2.—*Waste Volumes from Routine Operations (in cubic meters [cubic yards])*

WASTE TYPE[1]	1992	1993	1994	1995	PERCENTAGE CHANGE 1993–1995
Low-Level Waste[2]	265 (348)	287 (375)	232 (303)	185 (242)	-20
Low-Level Mixed Waste[3]	51 (67)	38 (50)	25 (33)	29 (38)	+16
Solid Waste (Nonhazardous)	6,489 (8,488)	10,885 (14,238)	4,664 (6,101)	4,039 (5,283)	-13
Hazardous Waste	589 (770)	370 (484)	193 (252)	460 (602)	+138
TSCA Waste	95 (124)	113 (148)	8[4] (10)[4]	357 (467)	+4,363
Sanitary Waste	494 (646)	612 (800)	835 (1,092)	740 (968)	-11
TOTAL	7,984 (10,443)	12,305 (16,095)	5,957 (7,792)	5,810 (7,599)	-3

[1]Conversions of different waste types from weight to volume were made using a conversion factor of 0.72 kg of waste per liter (6 lbs waste per gallon).
[2]Volumes from past years have been revised to include nonproduction waste.
[3]Mixed waste contains both radioactive and hazardous waste components.
[4]Generation of asbestos waste decreased in 1994.
Source: DOE 1996:18

TABLE G.3.1–3.—*Waste Reduction Goals for 1994–1999 (in percent)*

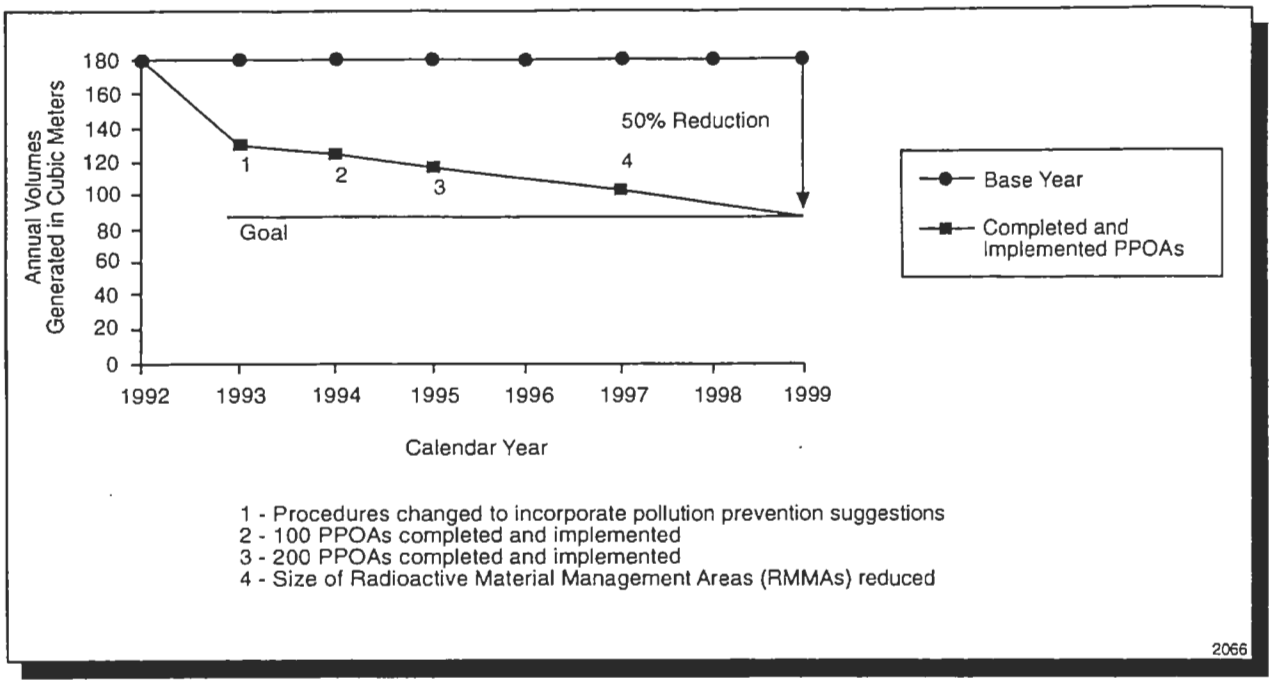
WASTE TYPE	1994	1995	1996	1997	1998	1999
Low-Level Radioactive Waste	6	5	4	4	4	4
Low-Level Mixed Waste	4	4	4	4	4	4
Hazardous Waste	3	2	2	2	2	2
TSCA Waste	29*	8	8	8	8	8

*Destruction of old steam plant building resulted in a dramatic increase from 1992 waste generation levels. Completion of this activity, in addition to regularly planned PP/WM activities, results in an unusually high reduction goal for the following year.
Source: Battelle 1994:A-1

chemicals requiring disposal by 50 percent. Table G.3.1–3 details the required reduction through 1999. In any given year, wastes are expected to be reduced by 2 to 40 percent.

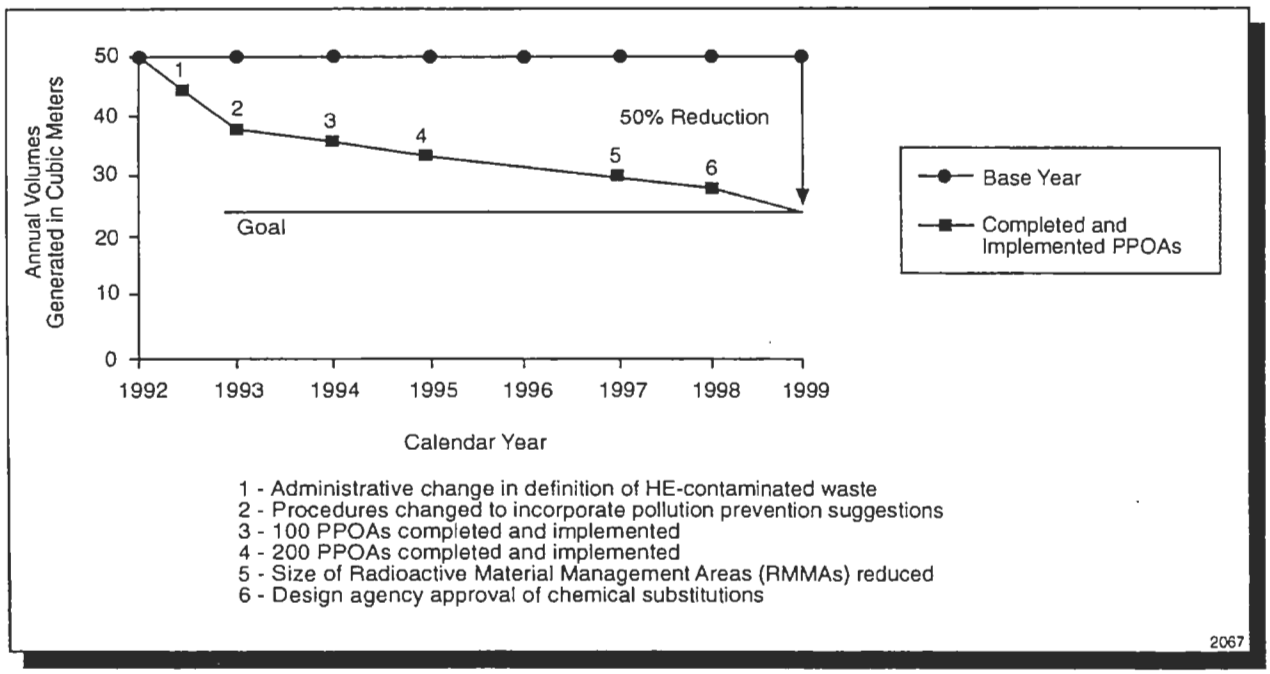
G.3.2 Process Changes

Process changes (i.e., affirmative procurement, technical redesign, procedural controls, and maintenance procedures) were examined to ensure that wastes are minimized to an extent that is technically and economically feasible (Battelle 1994:21). With the 1994 implementation of new procedural controls (i.e., a required visual inspection) for high explosive(s) (HE)-contaminated waste, a 99 percent reduction in the generation of HE-contaminated hazardous waste was achieved. This decrease has resulted in the use of fewer active thermal treatment units and reduced air emissions at the Burning Ground (DOE 1995a:3-7). The savings are estimated at $80,000 per year (PC 1995:8). The fireloop construction project utilized process changes (reevaluation of solid waste management unit data, rerouting piping, and recharacterization of wastes) that resulted in reducing the amount of hazardous and Class 1 wastes by 215 cubic meters (281 cubic yards) at a savings of $516,750 in January of 1995 (PC 1995:4).



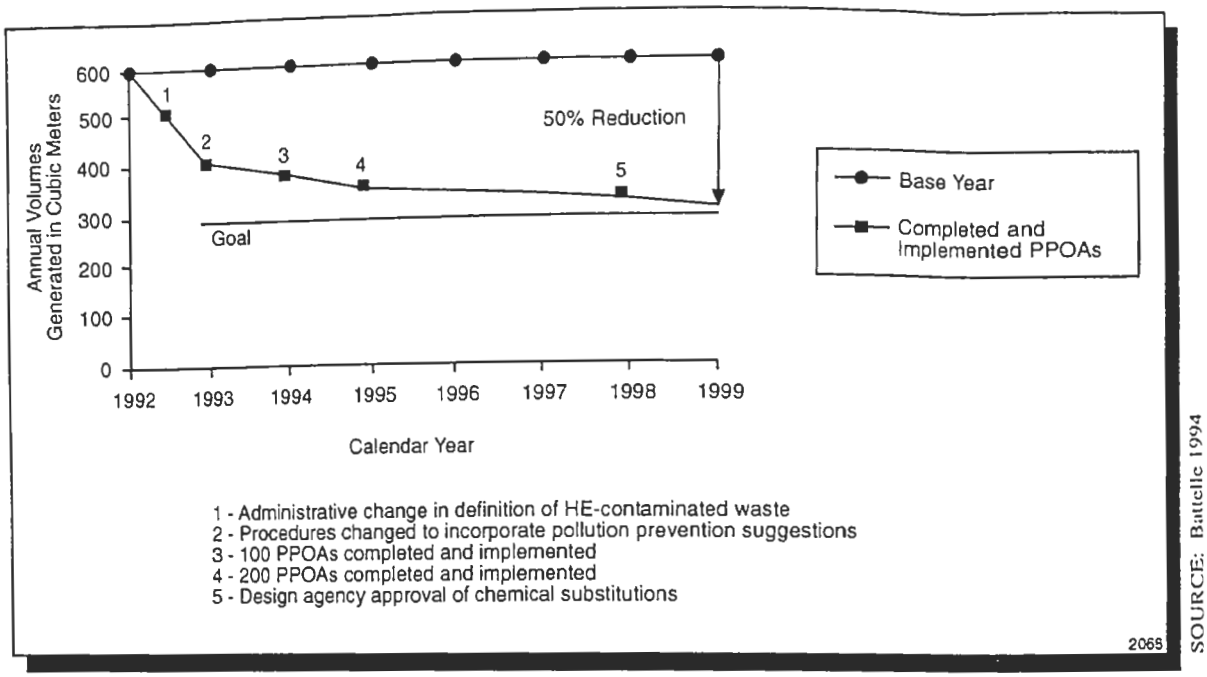
SOURCE: Battelle 1994

FIGURE G.3.5–1.—*Tasks Required to Reach Waste Reduction Goal for Low-Level Radioactive Waste.*



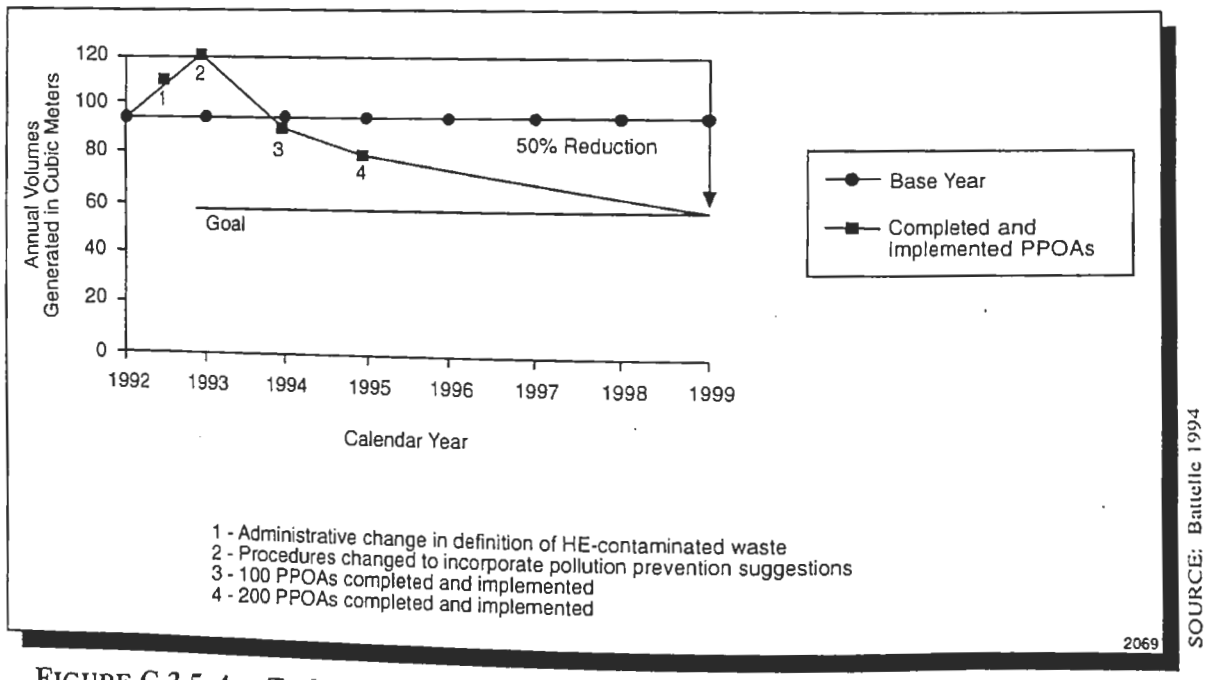
SOURCE: Battelle 1994

FIGURE G.3.5–2.—*Tasks Required to Reach Waste Reduction Goal for Low-Level Mixed Waste.*



SOURCE: Battelle 1994

FIGURE G.3.5–3.—*Tasks Required to Reach Waste Reduction Goal for Hazardous Waste.*



SOURCE: Battelle 1994

FIGURE G.3.5–4.—*Tasks Required to Reach Waste Reduction Goal for Toxic Substance Control Act Waste.*

G.3.6 Technology Transfer

A key Pantex Plant mission, initiated through administrative policies consistent with the *Stevenson-Wydler Technology Innovation Act of 1980* (15 U.S.C. 3701), is technology transfer. Activities involving technology transfer are coordinated through the PP/WM team and the Federal Laboratory Consortium (Battelle 1994:27). The consortium promotes technology transfer through links to the public and private sectors and support services such as training and assistance in implementing partnership opportunities. The purpose of technology transfer programs is to enhance the competitiveness of U.S. industries in the global economy.

Technology transfer opportunities will also aid in reducing DOE's cost for maintaining nuclear competence by making onsite facilities available to U.S. industries through User Facility Agreements. Some facilities that could have dual use are Metrology, Nondestructive Evaluation Testing, Analytical Laboratories, Synthesis and Formulation, Machining, and Explosives Testing. Cooperative Research and Development Agreements with local colleges and universities for teaching and research will provide DOE with a trained and highly qualified labor pool that could help maintain and enhance the capabilities at Pantex Plant (DOE 1995:14).

To reduce future emissions and stabilize wastes to meet land disposal restrictions standards (LDRs), DOE technology transfer efforts include the development of DOE and/or commercially developed technologies. Macroencapsulation and stabilization are technologies which are being considered for development at Pantex Plant.

For operations, technology transfer efforts are currently being explored in conjunction with future programs (see Table G.3.11–1) at Pantex Plant. An example of this is with the Nondestructive Evaluation Facility, proposed for construction in 1997. Approximately 30 percent of the workload at this facility would result from technology transfer operations such as high energy radiography, computer tomography, and digital imaging (DOE 1994a:1, I.b-4).

G.3.7 Recycling and Reuse

Waste reduction and elimination is promoted through the implementation of onsite and offsite recycling, reuse, and reclamation activities. The scope of the recycling program focuses on hazardous and office-generated waste (e.g., aluminum cans and office paper). Many of the recycling programs currently in place, such as the recovery and sale of precious metal, show a profit (Battelle 1994:22). Table G.3.7–1 provides examples of Pantex Plant's recycling and reuse activities, accomplishments, and savings. As an example of PP/WM, Building 11–29 recovers silver from photo solutions and wastewater previously discharged to the wastewater treatment facility and Playa 1. The closed-loop system is an ion exchange process. Another example of PP/WM is the recovery of dimethyl sulfoxide and HMX high explosives from Class 1 nonhazardous industrial solid waste solutions resulting from weapon dismantlement operations (PC 1996:1, 2).

G.3.8 Treatment

Low-level mixed waste (LLMW) and hazardous waste (HW) are generated as a result of plant operations associated with the dismantlement of weapons, associated support, and environmental restoration activities. LLMW contains both radionuclides and hazardous constituents (Pantex 1996:14.5). HW is any material that is a solid waste and a listed HW or exhibits any of the characteristics of ignitibility, corrosivity, reactivity, or toxicity (Pantex 1996:14.5).

Limited physical treatment and processing of waste (e.g., compaction, sorting, repackaging, and wastewater filtration) is currently

TABLE G.3.7–1.—*Pantex Plant Recycling/Reuse Activities, Accomplishments, Amount Reduced, and Savings*

RECYCLING/REUSE CATEGORIES	ACCOMPLISHMENTS	AMOUNT REDUCED	SAVINGS
	RECYCLING		
Metals	Weapons metal (gold, aluminum, copper, nickel, lead titanium, tantalum, and beryllium). Aluminum (cans). Silver (photo, x-rays). Steel and plastic. HE-contaminated scrap metal. Lead.	41 metric tons (40 tons)	$2,100,000
Vehicle Maintenance	Used oil. Used and scrap tires. Antifreeze. Batteries. Freon.	2,877 liters (760 gallons) 875 tires 8,158 liters (2,155 gallons) 19,010 kilograms (41,887 pounds) 112 kilograms (300 pounds)	$3,040 $33,325 $3,000
Office	Digital photographic equipment. Office paper. Replace offset printer. Toner cartridges.	12,513 kilograms of HW (27,571 pounds) 1,321 metric tons (1,300 tons) 682 kilograms of HW (1,503 pounds) 41 metric tons (40 tons)	$472,223 $23,400 $40,000 $70,000
Chemicals	Unused chemicals. Pesticide containers. Dimethyl sulfoxide.	20 drums 20 drums of HW 1,493 kilograms (4,000 pounds)	$69,380 $3,240 $14,000
Weapons Materials	HE excess.	14,928 kilograms (40,000 pounds)	NR
Infrastructure	Fluorescent lights.	6,000	NR
	REUSE		
Water Conservation Program	Wastewater.	Under study.	NR

NR - Not Reported
Sources: PC 1995:1 thru 10; Pantex 1996:14.4

performed. HW produced must be shipped offsite for treatment, processing, and disposal. Some LLMW has been sent by DOE to a permitted offsite commercial facility; the remaining LLMW, regulated under the *Federal Facility Compliance Act* (42 U.S.C. 6901), is currently being stored at Pantex Plant (Battelle 1995:13, 15).

With the completion of the proposed Hazardous Waste Treatment and Processing Facility in 1999, Pantex Plant would conduct LLMW processing and treatment operations using DOE developed technologies that would enable stored and future generated LLMW to meet LDRs and be disposed of offsite (Battelle 1995:15). When applicable, Pantex Plant would

pursue commercial LLMW treatment. HW would continue to be shipped offsite for treatment and disposal at commercial facilities when the Hazardous Waste Treatment and Processing Facility is operational. The new facility would allow for enhanced waste sorting/repackaging, sampling, compacting, drum rinsing and crushing, and waste minimization opportunities (e.g., solvent recovery) (Battelle 1995:13). Benefits include reduced air emissions and stabilized wastes.

HE-contaminated waste material may be characterized as a RCRA HW that exhibits the characteristic of reactivity pursuant to RCRA under 40 CFR 261.23 (Pantex 1996:14.5). This waste is thermally treated by open burning/open detonation (OB/OD). Discussions of the affected environment and impacts are presented in chapter 4.

A Best Available Control Technology (BACT) analysis for air emissions from explosives treatment at Pantex Plant Burning Ground was conducted and documented in a DOE letter to TNRCC dated October 15, 1993. The BACT review concluded that controlled open thermal treatment with existing administrative controls constituted BACT. In March 1994, a formal literature search was conducted to investigate treatment/processing methods for HE other than OB/OD. The review identified processes currently in use (e.g., OB/OD and chemical treatment) as well as those in various stages of development. The results of the literature search were forwarded to TNRCC.

At that time, the alternatives were determined to be either technically infeasible for Pantex Plant explosives or economically infeasible on a cost-per-unit mass of air pollutants that could be controlled (Radian 1994:1). The alternative emerging explosive treatment technologies were identified as: advanced thermal treatment methods (i.e, molten salt destruction, supercritical water oxidation, and advanced plasma incineration), chemical/biological treatment methods (e.g., base hydrolysis, chemical/electrochemical oxidation, and biological oxidation), and explosives recovery/reuse technologies (e.g., critical fluid extraction, explosives as supplemental fuels, and solvent recovery).

Since 1994, the development of refined procedures for HE chemical treatment has warranted the further investigation of a base hydrolysis treatability study program to be housed in building 11–36. Though the most commonly generated HEs resulting from dismantlement processes are HMX based, this treatability study can accommodate other types of HE (e.g., RDX, TNT, HNS, TATB, and some of their respective formulations). The total amount of waste that will be used in this study program is 1,000 kilograms (2,200 pounds) where 52 kilograms (115 pounds) will be the maximum per process. As a result of this study, the plant will expect to:

- Obtain the information required to determine the feasibility of treating explosives by base hydrolysis.
- Confirm the composition of the residues from the process.
- Confirm the constituents of the gases emitted to the atmosphere.
- Define the optimum operating parameters for the explosives to be treated (MH 1995:2, 3, 4, 6).

G.3.9 Energy Conservation

In 1995, Pantex Plant consumed 80,046 megawatthours of electricity, compared to 82,224 megawatthours in 1993. Electrical usage decreased as the plant population increased. Pantex Plant employed a total of 3,470 people in 1993, and it employed approximately 3,800 in 1995. It is expected that by the year 2004, electricity consumption will decrease to 62,000 megawatthours. This decrease in consumption is consistent with Executive Order 12902, *Energy Efficiency and*

Water Conservation at Federal Facilities (DOE 1994:1, 7; Pantex 1996:2.0, 9.0).

Pantex Plant used 515,277 thousand cubic feet of gas in 1994, as compared to 468,969 thousand cubic feet in 1995, representing a net decrease of 9 percent. The future forecast predicts a net decrease of gas usage by 11 percent from 468,969 thousand cubic feet in 1995 to 416,000 thousand cubic feet in FY 2005 (DOE 1995:10, Pantex 1996:9-0).

G.3.10 Water Conservation

In 1993, 920 million liters (243 million gallons) of water was pumped from the Ogallala aquifer. In 1994, this decreased by 9 percent to 836 million liters (221 million gallons) of water. Table G.3.10–1 provides information on the amounts of water used at Pantex Plant from 1989 to 1994. Texas Tech University consumed about 25 percent of the water used annually. It is predicted that, by the year 2004, 738 million liters (195 million gallons) of water will be pumped, and by 2005 it will decrease to 568 million liters (190 million gallons) (DOE 1994:7; DOE 1995:10). This reduction in water usage parallels the criteria for Executive Order 12902 which mandates both energy efficiency and water conservation at Federal facilities.

Wastewater decreased by 19 percent from 587 million liters (155 million gallons) generated in 1993 to 477 million liters (126 million gallons) in 1994. In the year 2004, Pantex Plant plans to generate 473 million liters (125 million gallons) of wastewater instead of the 477 million liters (126 million gallons) generated in 1994 (DOE 1994:7; DOE 1995:10).

G.3.11 Future Programs

Future programs consist of evaluating PPOAs, identifying and implementing new technology transfer efforts, employee training, program feedback, and program evaluation. Table G.3.11–1 provides information on 7 future projects at Pantex Plant and their relationship to PP/WM efforts. These planned and tentative projects utilize various facets (e.g., source reduction, treatment, recycle/reuse, energy conservation, and technology transfer) of the PP/WM program to provide for future reductions in waste. Please see appendix H (Environmental Considerations subsections) for additional information regarding each project's compliance with Executive Order 12902.

TABLE G.3.10–1.— ***Amount of Water Used at Pantex Plant from 1989–1994 (in million liters [million gallons])***

YEAR	WATER PUMPED	WATER SOLD TO TEXAS TECH UNIVERSITY	NET PLANT USE
1989	1,052 (278)	261 (69)	791 (209)
1990	1,147 (303)	303 (80)	844 (223)
1991	1,192 (315)	344 (91)	848 (224)
1992	1,033 (273)	276 (73)	757 (200)
1993	920 (243)	235 (62)	685 (181)
1994	836 (221)	132 (35)	704 (186)
1995	87 (230)[1]	250 (66)[1]	617 (163)[1]

[1]Denotes inconsistent data.
Source: Pantex 1996:9.3

TABLE G.3.11–1.— *Future Projects at Pantex Plant*

PROJECT	FISCAL YEAR	DESCRIPTION	PP/WM ELEMENTS
Plutonium Resource Center	1995	Transfer of appropriate technology developed from material disposition research and development to private industry.	TT, EC
Gas Analysis Laboratory	1999	Vacuum Technology Group.	TT, EC
Hazardous Waste Treatment and Processing Facility	1999	Process waste to minimize waste volume sent offsite.	SR, T, TT, EC
Materials Compatibility Assurance Facility	2000	Testing is performed on HE and weapon components from other DOE facilities.	TT, EC
Nondestructive Evaluation Facility	2000	Thirty percent of workload from technology transfer operations.	TT, EC
Pit Reuse Facility	2000	Recycle/Reuse.	RR, EC
Metrology and Health Physics Calibration and Acceptance Facility	2001	Energy Conservation Analysis.	EC

Denotations: SR - Source Reduction, T - Treatment, RR - Recycle/Reuse, EC - Energy Conservation, TT - Technology Transfer
Sources: DOE 1994b:7-6, 7-29 to 7-34, 7-37 to 7-42, 9-4, 9-5, 9-31 to 9-34, 9-37 to 9-40, 13-5, and 13-25; DOE 1995b:1.A.1; DOE 1994c:1, App. A.2; E.O. 12902

G.4 SUMMARY

DOE has developed an overall pollution prevention strategy and framework consistent with EPA's recommendations and other requirements (e.g., Executive Order 12856) around which its facilities must structure their own programs. This framework is the basis of Pantex Plant's strategy to implement PP/WM elements and techniques which will use a preventive approach to reduce waste by 50 percent. The program has successfully reduced waste and saved taxpayer dollars. In 1994 alone, Pantex Plant saved $2,000,000 in disposal costs. Source reduction (i.e., process change, material substitution, and administrative policies), recycling/reuse, and treatment are not designed as end products but are means for continued success.

REFERENCES

15 U.S.C. 3701 — *Stevenson-Wydler Technology Innovation Act of 1980*, 15 U.S.C 3701.

42 U.S.C. 4321 — *National Environmental Policy Act of 1969*, 42 United States Code Section 4321.

42 U.S.C. 6901 — *Federal Facility Compliance Act*, RCRA amended, 42 United States Code Section 6901

Battelle 1994 — Battelle Pantex, *Waste Minimization and Pollution Prevention Awareness Plan*, prepared by Pollution Prevention/Waste Minimization Section, Waste Management Department, Waste Management and Environmental Restoration Division, May 25, 1994.

Battelle 1995 — Battelle, *Draft Reference Document for the Hazardous Waste Treatment and Processing Facility*, Version 1.0, prepared for Pantex Plant, Amarillo, TX, April 1995.

DOE 1994 — DOE, *Pantex Plant FY 1994 Site Development Plan*, prepared under Contract DE-AC04-91AL-65030 by Mason & Hanger-Silas Mason Company, Inc., Amarillo, TX, for the U.S. Department of Energy, Amarillo, TX, March 1994.

DOE 1994a — DOE, *Conceptual Design Report, Facilities Capability Assurance Program (FCAP), Non-Destructive Evaluation Facility, Pantex Plant, Part I-Design Concept, Part II-Project Management Plan,* Project No. 88-D-122 (97-AA-02), prepared by Mason & Hanger-Silas Mason Company, Inc., Amarillo, TX, December 1994.

DOE 1994b — DOE, *Pantex Plant FY 1996 CAMP Report Capital Asset Management Process.* prepared under Contract DE-AC04-91AL-65030 by Mason & Hanger-Silas Mason Company, Inc., Amarillo, TX, for the U.S. Department of Energy, April 1994.

DOE 1994c — DOE, "Awards Anticipated and DOE Budget", *Noncompetitive Solicitation National Resource Center for Plutonium*, Draft, prepared for the U.S. Department of Energy, January 1, 1994.

DOE 1995 — DOE, *FY 1995 Pantex Plant Site Development Plan*, prepared under Contract DE-AC04-91AL-65030, by Mason & Hanger-Silas Mason, Company, Inc., Amarillo, TX, for the U.S. Department of Energy, Amarillo, TX, 1995.

DOE 1995a — DOE, *1994 Environmental Report for Pantex Plant*, prepared under Contract DE-AC04-91AL65030 by Mason & Hanger-Silas Mason Company, Inc., Amarillo, TX, for the U.S. Department of Energy, Amarillo, TX, June 1995.

DOE 1995b — DOE, *Conceptual Design Report, Pit Reuse Facility, Pantex Plant,* Authorization No. A56, Volumes I and II, prepared by Mason & Hanger-Silas Mason Company, Inc., Amarillo, TX, for the U.S. Department of Energy, Amarillo Area Office, Amarillo, TX, January 1995.

DOE 1996 — Battelle Pantex and Mason & Hanger-Silas Mason Co., Inc., *1995 Environmental Report for the Pantex Plant*, DOE-AL-65030-9602, prepared under Contract DE-AC04-91AL65030, by the Environmental Protection Department, Environment, Safety and Health Division, for the U.S. Department of Energy, Albuquerque Operations Office, Amarillo Area Office, Amarillo, TX, May 1996.

DOE Order 5400.1 — DOE, "General Environmental Protection Program", Washington, DC, November 9, 1988, Revised June 29, 1990.

DOE Order 5400.3 — DOE, "Hazardous and Radioactive Mixed Waste Program", Washington, DC, February 22, 1989.

DOE Order 5820.2A — DOE, "Radioactive Waste Management," Washington, DC, September 26, 1988.

EO 12856 — Office of the Federal Register, National Archives and Records Administration, Executive Order 12856, Government Printing Office, Washington, DC.

EO 12902 — Office of the Federal Register, National Archives and Records Administration, "Energy Efficiency and Water Conservation at Federal Facilities", Codification of Presidential Proclamations and Executive Orders, Executive Order 12902, Government Printing Office, Washington, DC, March 8, 1994.

MH 1994 — Mason & Hanger-Silas Mason Company, Inc., *Pantex Plant Final Draft Pollution Prevention/Waste Minimization Program Management Plan*, prepared under Contract Number H86496, Task 39, Subtask 02, by Jacobs Engineering Group, Inc., Albuquerque, NM, April 1994.

MH 1995 — Mason & Hanger-Silas Mason Company, Inc., *Notification of Treatability Study Base Hydrolysis of Explosives,* Prepared for the U.S. Department of Energy, Pantex Plant, Amarillo, TX, June 1995.

MH 1996 — Mason & Hanger-Silas Mason Company, Inc. *Pantexan*, Volume 43, Issue 5, May 1996.

Pantex 1996 — Pantex Plant, *Environmental Information Document*, prepared for the U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM, September 1996.

PC 1993 — Sanderson, R., "EPA Office of Federal Activities' Guidance on Incorporating EPA's Pollution Prevention Strategy into the Environmental Review Process", Memo from Richard Sanderson, Director of Federal Activities, USEPA, Washington, DC, to Federal Agency NEPA Liaisons, February 24, 1993.

PC 1993a — Deland, M., "Pollution Prevention and the National Environmental Policy Act", Memo from Michael Deland, Executive Office of the President, Council on Environmental Quality, Washington, DC, to Heads of Federal Departments and Agencies, January 12, 1993.

PC 1995 — Stickrod, A, "Pollution Prevention/Waste Minimization Accomplishments", SWEIS request for information from Anna Stickrod for George Greenly, June 6, 1995.

PC 1995a — Garson, H., "Integrating Pollution Prevention into the National Environmental Policy Act Process and Documentation", Memo from Henry Garson to Leader, EIS Office, Albuquerque Operations Office, File: 5441.11, February 23, 1995.

PC 1996 — Johnson, Jerry, Notification of Intended Waste Storage and Recycling Activities in Building 12-19E, Letter from Jerry Johnson, DOE Amarillo Area Office, Amarillo, TX to Texas Natural Resource Conservation Commission, Austin, TX, April 11, 1996.

Radian 1994 — Battelle Pantex, *Status Review of Potential Alternatives to Open Burning of Energetic Materials at the Pantex Burning Ground*, prepared by Radian Corporation, for Battelle Pantex, Amarillo, TX, March 23, 1994.

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APPENDIX H

Proposed Facility Construction and Upgrades at the Pantex Plant

APPENDIX H
PROPOSED FACILITY CONSTRUCTION AND UPGRADES AT PANTEX PLANT

H.1 INTRODUCTION

This appendix presents detailed descriptions of the proposed facility construction and upgrades at Pantex Plant as discussed in the Proposed Action and No Action Alternatives for this EIS. Along with each project description is an assessment of the environmental impacts associated with that project. Section H.2 identifies the relationship of projects associated with the Proposed Action and the Alternatives, and sections H.3 through H.8 discuss the individual projects.

H.1.1 Purpose

The proposed facility construction and upgrades are evaluated in this EIS because of the integral nature of these projects' specific missions to the overall Pantex Plant mission. This EIS serves as the NEPA documentation for these projects. In addition, the EIS evaluates the cumulative impacts of these projects and the main mission of Pantex Plant. The purpose of this appendix is to provide the decision maker and the public with project-specific information in one report even though the impact analysis also appears under individual environmental resources and issue areas in the main body of this EIS.

H.1.2 Detailed Project Descriptions

The proposed facility construction and upgrade projects would be located in or near Zones 11 and 12 in the southeast quadrant of Pantex Plant (see Figure 3.1.1–1). Facilities designed to meet current explosives safety, seismic, and tornado criteria are needed to replace deteriorating facilities. The proposed facility upgrades are intended to modernize Pantex Plant, streamline efficiency of continued operations, maximize worker safety, reduce the footprint, and meet all regulatory requirements.

The proposed facilities discussed in this appendix include:

- A new Hazardous Waste Treatment and Processing Facility (HWTPF) between Zones 11 and 12 that would accommodate treatment and processing of hazardous waste, low-level waste, and low-level mixed waste. It would routinely treat and process only those wastes currently identified in the plant's *Resource Conservation and Recovery Act* (RCRA) permit application, as amended.
- Modifications of existing facilities to provide a Pit Reuse Facility in Zone 12. This facility would allow modification of certain pits obtained from nuclear weapons dismantlement in order to enhance their safety and allow their future reuse. Pantex Building 12–104 would be modified to accommodate this project.
- Construction of a new Gas Analysis Laboratory near Zone 11. The facility would provide new analytical laboratory space with the requisite environmental controls for sophisticated apparatus.
- Construction of a new Materials Compatibility Assurance Facility near Zone 11. The facility would be used for the environmental aging and compatibility testing of non-nuclear weapon components.
- Construction of a new Nondestructive Evaluation Facility in Zone 12. The facility would house operations such as radiography, ultrasound, digital imaging,

Department proposes to meet its need by constructing the HWTPF. The proposed facility would consolidate current waste operations, provide a state-of-the-art facility to conduct hazardous operations, provide for the treatment and processing of stored wastes, improve waste minimization, and expand plant capabilities for waste treatment and processing to meet future demand goals (Battelle 1995:9). This centralized facility would concentrate like activities in one area, thus providing safer and more efficient working conditions (Battelle 1995:13). An alternative which assesses the facility design with largest potential for impact was used to bound the impacts discussed in volume I of the EIS. The proposed HWTPF is smaller in scope. Both are detailed below.

H.3.2 Bounding Alternative

The bounding HWTPF would, along with the Burning Ground, provide the necessary treatment capacity to meet future demands. The HWTPF would utilize a range of DOE developed treatment and processing technologies.

The HWTPF is presently under preliminary design at Pantex Plant. The purpose of the facility is to treat and process the numerous wastestreams onsite. These wastestreams would include LLMW, LLW, and HW. The HWTPF would enhance the waste sorting and repackaging, sampling, compacting, drum rinsing and crushing, wastewater solidification, and waste minimization capabilities at Pantex Plant. DOE developed technologies for treatment and processing of wastes would consist of basic technologies involving chemical stabilization and macroencapsulation. Wastes would be minimized or stabilized for offsite disposal with the maximum amount of materials undergoing recycling or reuse offsite. It is estimated that the construction of the 2,648-square meter (28,500-square foot) facility would take 24 months, involve approximately 129 workers, and encompass approximately 0.53 hectares (1.31 acres) of land disturbance (PC 1995:Table 1).

H.3.2.1 *DOE Developed Technologies*

DOE developed technologies may include chemical stabilization, macroencapsulation, waste management processes (e.g., compactor, solvent recovery), and offsite DOE and commercial treatment and processing technologies. Expanded discussions are available in the Draft Reference Document for the HWTPF and the FFCA Agreed Order and approved Plans.

Chemical Stabilization

The Agreed Order identifies stabilization as involving immobilization of the debris with reagents that reduce the leachability of the hazardous contaminants to levels deemed appropriate by Federal, State, and local regulations (DOE 1995e:35). To minimize the risk of contaminants leaching into the environment, wastes can be treated to limit the leachability of toxic heavy metal constituents, as well as to produce a hard, water resistant solid that can be deposited in a landfill. This process is called chemical stabilization. Waste generated at Pantex Plant could utilize this process. The process could be batched or continuous and would require a mixer, a waste feed system, and feeders for the reagents and water mixing (Battelle 1995:47-48).

Macroencapsulation

The FFCA Agreed Order identifies macro-encapsulation as enclosing solid waste in an inert envelope to reduce exposure to potential leaching media in a landfill (DOE 1995e:37). This process is achieved by coating waste surfaces with materials (resins, plastics) that enclose it in a jacket of organic material. Jack-eting of the entire waste container to seal wastes is also under consideration. This reduces the

exposure of solid waste to elements that would cause the waste to leach into a landfill. This is the land disposal restriction treatment standard for debris and radioactive solids (Battelle 1995:49).

Other Waste Management Processes

Table H.3.2.1–1 lists additional waste management processes that are under consideration and could be used to treat and process waste generated at Pantex Plant. Treatment and disposal options include

TABLE H.3.2.1–1.—*Waste Management Processes Under Consideration*

TECHNOLOGY	WASTESTREAMS/ACTIONS
Thermal Desorption	Solids, soils, and sludges contaminated with organics.
LLW and LLMW Sorting/Repackaging	Containers would be opened, the LLW and LLMW waste removed and repackaged into appropriate containers.
LLW and LLMW Sampling	After the containers are opened samples would be collected to facilitate the characterization process.
LLMW Drum Crusher	The LLMW drum crusher would be able to crush approximately 50 85-gallon drums per day. These drums would contain LLW containment residuals.
LLMW Aerosol Can-Puncturing Station	Around 100 cans per month containing flammable solvents would be punctured at this station. The cans would be considered to be radioactively contaminated.
LLW and LLMW Compactor	These compactors would compact waste within a 55-gallon drum in order to reduce volume and conserve storage and shipping space. These compactors would be used to compact solid wastes without free liquids.
LLW Wastewater Solidification	A mixer and drum rotator would be used for low level radioactive wastewater in-drum solidification.
HW Sorting/Repackaging/Sampling	Part of the Hazardous Waste Operations Bay would be used to open HW containers, removing the waste material and repackaging it into other containers. Another area within this bay would be used to sample the materials to facilitate characterization.
HW Aerosol Can Puncturing Station	This station would puncture around 100 cans per month which contain a flammable solvent. Currently this procedure is being conducted at the 11–7N Pad, but it would be relocated to the HWTPF.
HW Compactor	This machine would reduce the volume of waste in a container by compacting the material within a 55-gallon drum. This operation is currently being conducted at the 11–7N Pad, and would be relocated to the HWTPF.
HW Drum Rinsing System	The empty hazardous waste-containers would be cleaned prior to reuse, and the secondary rinse water from this procedure would be collected.
HW Solvent Recovery	This is a procedure that purifies used solvents and prepares them for reuse. Pantex currently has this operation in use but would relocate it to the HWTPF. This area would require steam heat at 150 psi delivered at a rate of up to 100 pounds/hour.

Source: Battelle 1995:47-54

commercial facilities and facilities at other DOE sites in accordance with the FFCA Agreed Order and approved Plans.

H.3.3 Facility Description

The bounding HWTPF would be a one-story building located north of the Steam Plant and west of South 13th Street. The facility would be designed for a life of not less than 25 years. The gross area of the facility is 2,650 square meters (28,500 square feet). The HWTPF would be divided into administrative and operations sections. These areas would be separated by a 3-hour fire wall on the exterior of the process areas, an access ramp, and a 1-hour fire wall on the administrative side of the ramp (Battelle 1995:16; DOE 1995:I.E 5).

The building design would be specific to facilitate decontamination and decommissioning. The walls and ceilings would be painted with a pinhole free epoxy paint, and cracks and joints would be sealed with a like material. The floors would be covered in a seamless material, and the walls would be designed for ease in dismantlement and packaging. All of the electrical devices in the operations area would be designed for a wet environment to facilitate washdown activities (Battelle 1995:29, 30). Prefabricated portable buildings for flammable liquid and hazardous liquid storage could be located in close proximity to the HWTPF. Approximately 24 to 30 55-gallon drums would be stored in each building (DOE 1995:I.E. 30-31).

H.3.3.1 *Administration Section*

This section would house offices, record storage, vestibule, locker rooms, a break room, a conference room, and a janitor's closet. This area would be accessible to handicapped individuals. The office area would house 12 employees, use modular furniture, and would comprise approximately 116 square meters (1,250 square feet). Record storage would be approximately 19 square meters (200 square feet) in area. The vestibule would be a 9-square meter (100-square foot) entryway that would provide the facility with a sheltered access. It would comply with handicap access requirements providing the appropriate door opening devices and access ramps.

Men's and women's locker rooms would occupy approximately 56 square meters (600 square feet) of space each, and would provide approximately 10 workers with a shower and locker area, and 8 workers with toilet facilities. The break room would be about 37 square meters (400 square feet) and would provide an eating area for an occupancy of 20 individuals. The conference room is a 42-square meter (450-square foot) open area that would provide a meeting and training space for up to 30 people. The janitor's closet would utilize approximately 9 square meters (100 square feet) of space for the storage of cleaning supplies (Battelle 1995:22-23).

H.3.3.2 *Operations Section*

The Operations Section would contain a shipping and receiving dock, a LLMW and LLW treatment and processing bay, two bays for treatment and processing operations, an HW treatment and processing bay, and a building services area (Battelle 1995:16). Because of the need for rapid evacuation, this building would not be designed to facilitate disabled persons (Battelle 1995:18).

Shipping and Receiving Area

This area would have three truck stalls for shipping, receiving, and crushed dumpster loading. The dock would handle staging of one truckload of material at a time, and the load could be staged for up to a week at the dock. Trucks ranging in size from tractor trailers to pickups would be accommodated. The area would have a forklift ramp for forklift access. The material would be weighed and certified prior to being loaded into the trucks. Other

items for shipment might include bar-coded containers of newly generated waste materials. The containers would be coded for tracking and accountability, and the exterior would be checked for radioactive contamination (Battelle 1995:18).

Radioactive Waste Processing Bay

This area would treat and handle both LLW and LLMW, and may include variations of the following activities: LLW and LLMW sorting and repackaging, LLW and LLMW sampling, LLMW aerosol can puncturing, LLW and LLMW compacting, and low-level wastewater solidification (Battelle 1995:19). The area would have a high-efficiency particulate air (HEPA) filtered intake into the heating, ventilation, and air-conditioning (HVAC) system, as well as exhausts or hood vents to contain the contamination as necessary. Controls, such as cleaning the sorting and repackaging area between wastestreams, would be implemented, and the bay would contain monitors and alarms to alert personnel to the presence of airborne radioactive or chemical hazards (Battelle 1995:19).

Radioactive Waste Treatment Bays

Two bays would be designed to handle the treatment and processing of wastes. One of the bays would process Class 1 flammable liquids utilizing an open system while the other bay would process nonflammable wastes. The bays would contain individual airlocks with sloped accesses. The airlocks would contain a 4.5-metric ton (5-ton) overhead hoist, two overhead automatic doors (measuring, at a minimum, 4.3 meters [14 feet] in width by 4.3 meters [14 feet] in height), and would be HEPA filtered and have an interlocked alarm that would sound if more than one door was opened at a time (Battelle 1995:20-21).

Hazardous Waste Operations Bay

This area would be used for the treatment and handling of HW, such as aerosol can puncturing, HW sorting/repackaging, HW sampling and compacting, HW drum rinsing, and HW solvent recovery. This bay would also have monitors and alarm systems to alert personnel to airborne contamination (Battelle 1995:20).

Building Support Services Area

This area includes the mechanical room, electrical room, storage rooms, personnel airlocks, forklift airlocks, and a supply corridor, with the mechanical and electrical rooms housing the majority of the facilities utility services. The storage rooms would store and stage inert materials, tools, supplies and would be monitored for chemical and radiation contamination. Personnel airlocks, with decontamination showers and eyewash stations and interlocked alarm systems, would be located in each operations bay. Interlocked forklift airlocks would allow forklift and saddletruck access to the bays. If necessary, decontamination of this equipment could be performed inside the airlocks. The supply corridor (ramp) would be the main path for materials handling and personnel access, and would also be the utility corridor for the majority of water, steam, electricity, and HVAC systems (Battelle 1995:21-22).

Flammable Liquid Storage Building

The Flammable Liquid Storage Building could be a 2.4-meter (8-foot) by 6.1-meter (20-foot), prefabricated, portable storage unit located about 24.4 meters (80 feet) southwest of the HWTPF. It would have a storage capacity of 24 55-gallon drums that would be separated by material storage. The stored materials may include polybutadiene, bitumen, polystyrene, epoxy and methylene di-isocyanate, and would be transported to the HWTPF by forklift or dolly. The building would contain an

automatic, dry chemical fire suppression system, would be heated to a minimum temperature of 10 °C (50 °F), and would have a secondary containment unit that would drain into a sump. This would be a Factory Mutual approved, UL classified structure built to satisfy the following codes: Uniform Building Code, National Electric Code, National Fire Protection Association, Occupational Safety and Health Administration (OSHA), and the Environmental Protection Agency (Battelle 1995:24).

Hazardous Liquid Storage Building

The Hazardous Liquid Storage Building could be a 3.0-meter (10-foot) by 4.9-meter (16-foot) prefabricated building situated about 23 meters (75 feet) west of the HWTPF. Twenty 30-gallon containers, safety segregated by hazard, could be stored in this structure. The liquids stored would be used for the neutralization of certain wastestreams, including hydrochloric acid, sulfuric acid, phosphoric acid, glacial acid, and nitric acid. The structure would be heated to a minimum of 10 °C (50 °F), would have a secondary containment which would drain into a sump, and would utilize a mechanical ventilation system to ensure that hazardous fumes are not present (Battelle 1995:24-25).

H.3.3.3 *Environmental Considerations*

This facility would meet all present environmental codes and regulations, and its normal operation would not have cumulative or long-term adverse effects on the environment. Operation of this facility would be in compliance with Federal and State pollution control standards. Permitting requirements for the protection of the air, water, and environment would be readdressed prior to operation of this facility (DOE 1995:I.E 37-40).

The HWTPF conceptual design report for the bounding alternative has established the following schedule: air permit, 6 months; water permit, 6 months; and waste permit, 6 months. If the permits are handled as expected, the consolidated effort would occur within one year. If funding is delayed by one year, the permit modifications would likely begin a year or so later (DOE 1995:I.E 40).

The design of this facility includes an energy conservation analysis. A reduction goal of 10 percent in the average annual energy requirement per gross square foot has been established. Executive Orders 12003 and 12902 and the Pantex Fuel Policy will be followed. The design of the facility includes requirements of 10 CFR 435, Energy Conservation Voluntary Performance Standard for New Buildings; Mandatory for Federal Buildings, as amended. Appendix G, Pollution Prevention and Waste Minimization, presents an additional discussion of water and energy conservation (DOE 1995:I.E 35-36).

H.3.3.4 *Health and Safety*

This facility would operate under an approved Final Safety Analysis Report. The building would be protected by an automatic fire suppression system, alarms, emergency lighting, and fire extinguishers. The process areas would be kept under negative pressure and surfaces would be specially protected for minimizing releases. Airlocks, HEPA filters, emergency showers, eyewash stations, and requirements for personnel protective equipment would be utilized (DOE 1995:I.E 43-44).

H.3.3.5 *Safeguards and Security*

No special requirements are needed since the facility would not handle classified material or documents (DOE 1995:I.E 46).

H.3.4 Relationship to Other Projects

The bounding HWTPF would be constructed with a common dock area with the RCRA Hazardous Waste Staging Facility (currently under construction). The HWTPF would not be dependent upon the adjacent facility. Coordination of fire protection and other utilities and services would be accomplished (DOE 1995:I.C 1).

The High Pressure Fire Protection Water Supply System expansion project would coordinate with the HWTPF project (DOE 1995:I.C 1).

H.3.5 Environmental Impacts

H.3.5.1 *Infrastructure*

Electrical usage would increase from 411 to 598 megawatthours per year. No natural gas would be used at the facility. Steam usage would increase from 3.4 million kilograms per year (7.4 million pounds per year) to 4.5 million kilograms per year (9.9 million pounds per year). The steam generation would increase the use of water from 451,000 liters per year (119,000 gallons per year) to 564,000 liters per year (149,000 gallons per year). It would also increase the use of natural gas from 0.2 million cubic meters per year (7.1 million cubic feet per year) to 0.3 million cubic meters per year (9.5 million cubic feet per year) (PC 1995:Table 3).

H.3.5.2 *Land Resources*

The proposed building site is located between Zones 11 and 12 North adjacent to the recently constructed Hazardous Waste Staging Facility, which is surrounded by a buffer zone. The facility is designed to be 2,648 square meters (28,500 square feet). The facility would consolidate and improve operations and increase the safety to the worker, the public and the environment. No environmental impacts are expected from the proposed construction on the surrounding land resources (PC 1995:Table 1; DOE 1993:11).

H.3.5.3 *Geology and Soils*

There could be very minor impacts to the soils due to erosion during construction. The area of temporarily disturbed soil would be 5,295 square meters (57,000 square feet) (PC 1995:Table 1). Mitigation measures such as sediment traps, diversion of surface water runoff from the construction area, dikes, silt fences, and covering the disturbed area with rip rap would be used to minimize soil erosion.

H.3.5.4 *Water Resources*

Water use is expected to increase from 685,000 liters per year (181,000 gallons per year) to 4,312,000 liters per year (1,141,000 gallons per year). The generation of wastewater is expected to increase from 685,000 liters per year (181,000 gallons per year) to 3,802,000 liters per year (1,006,000 gallons per year). The proposed facility construction site is not located within a known, playa-associated 100-year floodplain (PC 1995:Table 3; Battelle 1995:16, 88).

H.3.5.5 *Air Quality*

Airborne particulate matter (i.e., dirt and equipment emissions) levels would be elevated during the construction period. During operation, the facility design would minimize the possibility of any unplanned or nonsudden release of HW or HW constituents to the air (40 CFR 264.31). The RCRA facility design requirements include emission standards for process vents, equipment leaks, and containers (40 CFR 264 Subparts AA, BB, and CC). The design criteria include HEPA filters in the radioactive and hazardous waste processing areas ventilation systems, use of negative

pressure, interlocked/alarmed air locks, radioactive and hazardous constituents ventilation system monitoring with alarms, and HEPA filter efficiency monitoring and testing (Battelle 1995:57-58). Additionally, the fume level within the building would be limited by the Hazardous Waste Permit (HW-50284). The permit would stipulate the number of waste containers that can be opened at any one time (DOE 1993:11).

Air emissions from current waste management activities are addressed in section 4.7, Air Quality. Waste management air emissions result from drum handling and processing, bulk transport, and fugitive emissions. Hazardous air pollutants include chlorinated solvents like trichloroethane, aromatic solvents like toluene, xylene, ketones, alcohols, ethers, and other organic solvents. Impacts of these activities and air pollutants were modeled and the results were presented in section 4.7.2.1 of volume I, Impacts of Continued Operations. The HWTPF through consolidation and use of state-of-the-art emission control equipment would impact the environment to a lesser degree.

H.3.5.6 *Acoustics*

Noise levels would temporarily increase during construction from operation of heavy construction equipment such as graders, cement mixers, and construction vehicle traffic. During waste handling operations, noise would be emanating from forklift operations and loading dock operations. Local worker and transportation traffic would contribute to the ambient noise in the area. The majority of the noise sources are expected during the operation of the HVAC system and other processing equipment which includes a waste compactor, a drum crusher, and an aerosol can puncturing station (Battelle 1995:75-76). The operational areas design will include noise controls pursuant to OSHA standards (29 CFR 1910.95).

H.3.5.7 *Biotic Resources*

Flora and fauna that currently use the facility construction site would be permanently removed or displaced by construction. The general site area has been disturbed by construction of the existing roads utilities and plant activities including the RCRA Hazardous Waste Staging Facility Treatment (Battelle 1995:73). The building site does not contain any unique, unusual, or critical habitats for known threatened or endangered species, nor does it adversely restrict known or established migratory corridors used by wildlife (DOE 1993:10; Battelle 1995:73).

H.3.5.8 *Cultural Resources*

No archaeological sites or historical resources have been identified in or near the proposed construction site (Battelle 1995:80, 81).

No decisions have been made regarding use of existing facilities that may qualify as a historic resources. The decision to reuse, modify, or demolish will be addressed in future NEPA documentation.

H.3.5.9 *Socioeconomic Resources*

The construction cost of this facility would be approximately $13.5 million. Construction of the facility is expected to employ 129 short-term employees and would probably result in a small temporary increase in local employment (Battelle 1995:85; PC 1995:Table 1). A substantial portion of the material costs would enter the wholesale and retail trade sector of the regional economy. Approximately 25 to 30 percent of this cost would be labor in all aspects of the construction process. This facility is designed for 20 employees. Five of the employees are considered new employees and would represent 0.16 percent of 3,800 employees currently working at Pantex Plant (Battelle 1995:85-86).

H.3.5.10 *Transportation*

The construction of this facility would result in a temporary increase in onsite and area traffic during a 12- to 18-month period. Normal day shift work hours, Monday through Friday, are expected. Since construction of the facility is in a Limited-Access Area, plant security personnel would accompany construction workers to and from the construction site. Wastes would be transported from several storage and accumulation areas in Zones 4, 11, and 12 and back to storage after treatment. Material supplies would be transported through Building 16–15 Central Shipping and Receiving. During operation, five new employees would travel to the plant from the local area. Impact analysis of onsite waste transportation is addressed in section 4.12 of volume I.

H.3.5.11 *Waste Management*

This facility is designed to handle approximately 500-700 cubic meters (650-910 cubic yards) of waste per year. The total volume handled annually is not expected to vary; however, the volume of each type (i.e., low-level mixed, low-level, and hazardous) of waste handled is expected to vary (PC 1996).

Annually, the amount of low-level mixed waste generated at the 2,000 weapons activity level (presented in table 4.13.1.2–3 from section 4.13, Waste Management, in volume I) is 183.2 cubic meters (239.6 cubic yards). A majority of these wastes could be expected to undergo some form of processing or treatment in the HWTPF before disposal as described in section H.3.2.1. The LLMW could undergo sorting and repackaging, waste sampling and certification, marking and labeling to meet Department of Transportation (DOT) requirements, waste compacting, etc. In addition, some waste streams may be solidified. Detailed descriptions of waste volumes by treatability groups and potential DOE treatment technologies, including offsite options, are presented, in whole or in part, in the following documents: 1996 *Pantex Plant Environmental Information Document*, Pantex Plant's *Agreed Order Site Treatment Plan-Compliance Plan*, and the April 1995 *Draft Reference Document for the Hazardous Waste Treatment and Processing Facility* (Pantex 1996a, DOE 1995e, Battelle 1995).

Annually, the amount of low-level waste and hazardous waste generated at the 2,000 weapons level (presented in table 4.13.1.2–3 from section 4.13, Waste Management, in volume I) is 249 cubic meters (326 cubic yards) and 191.6 cubic meters (250.5 cubic yards), respectively. A majority of these wastes could be expected to undergo some form of processing or treatment in the HWTPF before disposal as described in section H.3.2.1. The LLW and HW could undergo sorting and repackaging, waste sampling and certification, marking and labeling to meet DOT requirements, waste compacting, etc. In addition, some waste streams may be solidified (Battelle 1995:41, 42).

H.3.5.12 *Human Health Risks*

There would be no radiation risks during construction, since construction activities would not involve the use of any radioactive materials or waste. Chemical human health risks during construction would be mitigated through compliance with OSHA Chapter 1926 regulations and an approved project-specific health and safety plan. The Contractor Safety and Health Program requires a written plan for approval by the Fire, Waste Management, Industrial Hygiene, and Safety Departments. The plan establishes permits for safety, excavation, fire department, radiation work, confined space entry and hot work (e.g. welding) as necessary (Pantex 1992).

Potential sources of radiological exposures during operation would be limited to alpha-, beta-, and gamma-emitting materials like depleted uranium, thorium, and tritium.

External and internal occupational exposure to radiation would be limited to the standards promulgated in DOE Order 5480.11. Through the use of engineering controls and administrative controls, personnel exposure would be as low as reasonably achievable (ALARA). Potential sources of chemical exposures during operations would be from HW, HW constituents, and chemicals and materials used in treating the waste. Personal protective clothing and equipment would be used to mitigate the potential health risks in compliance with 40 CFR 264 Subparts A, C, and D (Battelle 1995:94-96).

Section 4.14 of volume I bounds human health risks for the entire plant, including waste management operations. A detailed description of the human health risks of waste treatment-related activities is contained in the June 1995 *Environmental Assessment for the Operation of the Glass Melter Thermal Unit at the U.S. Department of Energy's Mound Plant* (DOE 1995d).

H.3.6 No Action Alternative

In the Draft Pantex Plant EIS, the proposed construction of the HWTPF was considered necessary for enhancing waste operational efficiency and safety and meeting regulatory requirements established in the Agreed Order. With offsite disposal shipments of mixed waste in 1994 and two shipments in 1996, as noted in volume I, section 4.13.2.3, and changes contained in the August 1996 Federal Facility Compliance Act (FFCA) Compliance Plan Annual Update document (DOE 1995e), construction of the HWTPF is no longer considered a regulatory requirement.

However, without the HWTPF, waste treatment and processing capabilities remain greatly limited and do not meet the Department's purpose and need. As a result, Pantex Plant would continue to conduct limited treatment and processing of wastes onsite at Building 11–9 and 11–7 Pad. Pantex Plant would continue to rely on offsite contractors and facilities to treat and process waste for offsite disposal. The current waste management practices would continue as would the currently identified problems. Section 4.13 of volume I contains detailed descriptions of the current waste management practices and associated impacts.

H.3.7 Proposed Action—A Scaled Down Version of the Hazardous Waste Treatment and Processing Facility Alternative

The Proposed Action is the construction of a scaled down HWTPF. The proposed HWPTF would conduct the same treatment and processing of waste as the bounding alternative. The construction period would be expected to last 12 months. At an estimated cost of $5 million, the scaled down HWTPF would operate mainly the macroencapsulation and stabilization technologies, as well as the following waste management operations: LLW and LLMW sorting/repackaging, LLW and LLMW sampling, LLMW drum crusher, LLMW aerosol can-puncturing station, LLW and LLMW compactor, LLW wastewater solidification, HW sorting/repackaging/ sampling, HW aerosol can puncturing station, HW compactor, HW drum rinsing system, and HW solvent recovery. The lifecycle is assumed to be 10–15 years less than the bounding alternative facility (PC 1996). Section 4.13 of volume I contains detailed descriptions of the current waste management practices and associated impacts.

This facility would utilize design features and administrative controls to protect employees and the environment and would meet all present environmental codes and regulations, as well as pollution control standards. Its normal operation would not have cumulative adverse

effects on the environment. However, modifications to air, water, and waste permits are expected. Air and water permits are usually reviewed and approved within 6 months. Since this would involve new treatment processes being implemented and current processes occurring in a new facility, the site's Hazardous Waste Permit would have to be modified. Under the current permit, these types of changes are categorized as major changes to the permit. Review and approval of waste permits can last more than two years for major changes. Additionally, preparation of the permit modification requires several months. Detailed design reports and facility plans are required and public meetings would be held to address concerns and justify the adequacy of the permit modification.

H.3.8 Alternatives Eliminated from Detailed Study

Three alternatives were eliminated from detailed study. The use of temporary facilities to conduct waste treatment was not considered practical since RCRA requires extensive design features including secondary containment, emission controls, safety requirements, and fire protection. The modification of the existing treatment facility, Building 11–9, was not analyzed extensively since impacts are considered equal to or greater than moving to a newer facility. Additionally, Building 11–9, a wood structure, was built in 1944 and would require historical preservation coordination. The third alternative requires total offsite management of the waste. However, offsite treatment capacities are subject to change.

H.4 Pit Reuse Facility

H.4.1 Purpose and Need for Action

The Department needs to develop and demonstrate the capability to modify and upgrade pits generated from certain nuclear weapons dismantlement processes into a viable configuration for enhanced safety and reuse (Pantex 1996:App C). Existing weapons have a finite stockpile life, and at the conclusion of this life, these weapons must be disassembled. DOE has not produced new pits since the closure of the Rocky Flats Plant. As a result, the method for maintaining a minimum stockpile weapon count is to reuse these pits obtained from disassembled weapons (DOE 1995b:I.B 2; Pantex 1996:App C).

H.4.2 Proposed Action

The Proposed Action is to modify an existing facility to provide a state-of-the-art facility to modify and upgrade pits to meet future weapon stockpile requirements. The proposed Pit Reuse Facility would provide the necessary capabilities.

This project would consist of the design and construction of the additions and modifications necessary to convert a portion of Building 12–104, Zone 12, into the Pit Reuse Facility (DOE 1995b:I.A 1). A total area of 494 square meters (5,314 square feet) would be affected by the facility upgrades. This area would be modified to meet the requirements of a "moderate hazard, non-reactor nuclear facility," as specified in DOE Order 6430.1A, General Design Criteria.

The conceptual design calls for pit modifications to be conducted in a specially designed workstation with a glovebox-type enclosure in the Glovebox Bays. Two additional bays, a Pit Qualification Bay and a Purge and Backfill Bay would also be provided to clean, weigh, radiograph, leak check, inspect and backfill the pits. A fourth bay, known as the Auxillary Bay, would be provided to support training and production as needed (DOE 1995b:I.A 1).

New structures are proposed as a component of this project to provide support to the operations

area. The four existing bays after modification would collectively be considered one vault area. As a result, when a pit is moved from one bay to another it would never leave the vault area. These barricades would limit access to qualified plant personnel (DOE 1995b:I.B 2).

H.4.3 Relationship to Other Projects

The proposed project has no direct relationship with other planned or current construction projects at Pantex Plant. The vacuum system technology utilized in the Pit Reuse Facility is similar to that of another project, Building 12–116. Other examples of similar operations and technologies include automated pit handling (robotics), automation and shielding (reducing operator exposure time and levels), and gas mixing. These technologies would be incorporated into the Pit Reuse Facility design where possible (DOE 1995b:I.C.1). The SSM EIS (DOE 1996) considers pit reuse capabilities at Savannah River Site (SRS) and Los Alamos National Laboratory (LANL).

H.4.4 Environmental Impacts

H.4.4.1 *Infrastructure*

Electrical usage would increase from 0 to 192 megawatthours per year. No natural gas or steam would be used at the facility (PC 1995:Table 3). The Pit Reuse operations would occupy an existing facility.

H.4.4.2 *Land Resources*

The Pit Reuse operations would occupy an existing facility.

H.4.4.3 *Geology and Soils*

Since this project involves interior modification of an existing building, no impacts to geology and soils are anticipated.

H.4.4.4 *Water Resources*

Water use is expected to increase from 0 liters per year (0 gallons per year) to 320,000 liters per year (84,000 gallons per year). The generation of wastewater is also expected to increase from 0 liters per year (0 gallons per year) to 320,000 liters per year (84,000 gallons per year) (PC 1995:Table 3).

H.4.4.5 *Air Quality*

Airborne particulate matter (i.e., dirt and equipment emissions) levels would be elevated during the construction period. However the majority of the construction work would be completed inside an existing building. Only very small amounts of chemicals (e.g. isopropyl alcohol) would be used during operations. Inert gases (i.e. helium, argon and nitrogen) would be used during routine glovebox operations. Two HEPA filters used in series would remove particulates prior to exhausting through the stack. The total effective dose equivalent to a maximally exposed offsite individual would be less than 0.1 millirem per year. The effective dose equivalent permissible limit is 10 millirem per year (DOE 1994c:31-32, 34-36).

H.4.4.6 *Acoustics*

Noise levels would temporarily increase during construction from operation of heavy construction equipment such as air compressors, cement mixers, and construction vehicle traffic. During pit reuse operations, noise would be emanating from air handling equipment and welding equipment. Local worker and transportation traffic would contribution to the ambient noise in the area. The operational areas design would include noise controls pursuant to OSHA standards (29 CFR 1910.95) (DOE 1994c:30, 32).

would be ALARA. Potential sources of chemical exposures during operations would be from chemicals and materials used in managing special nuclear material. Personal protective clothing and equipment would be used to mitigate the potential health risks (DOE 1995b:I.A.2, I.B.1). Section 4.14 presents Human Health risks associated with all plant activities.

H.4.5 No Action Alternative

One of the alternatives to the construction of the Pit Reuse Facility is to take no action, i.e., not build any facility and allow the limited component life of pits to expire. No source of replacement pits would exist because the production of new pits has been discontinued.

H.4.6 Alternatives Eliminated from Detailed Study

Two alternatives were eliminated from detailed study. The use of temporary facilities to conduct pit reuse operations was not considered practical since DOE requires extensive design features for radiation control, emission controls, safety requirements, security, and fire protection. The second alternative requires offsite facilities located at LANL, or other DOE sites. However, the option was eliminated because of the need to provide close support for assembly and disassembly operations, location near storage facilities, and concern with safety and security associated with the potential for moving pits on National highways (DOE 1995b:I.D 1).

temperature controls, has insufficient storage, and the roof leaks. Furthermore, the existing gas laboratory does not have an adequate ventilation system from health, safety, and environmental standpoints. The current use of mercury in the laboratory is a potential health and safety hazard since there is common ventilation between the laboratory area and the analytical bay. If there were a spill, the mercury vapor could affect the entire laboratory. Building 12–21 does not preclude contamination between bays or work areas. The gas laboratory in Building 12–21 produces mercury contaminated waste from the glass racks and the waste is stored in equipment rooms that have no temperature control, no access control, and inadequate ventilation.

H.5.2 Proposed Action

The new Gas Analysis Laboratory would provide new analytical laboratory space with requisite environmental controls for the sophisticated apparatus (highly calibrated electronic apparatus that facilitates the quantitative and qualitative studies) that would be housed in the proposed facility; provide sufficient work area for all gas phase analytical testing, leak detection of sample cylinders, leak detection of weapon components, cryogenic fractionation, gas mixing, gas transfer, and vacuum technology development work at Pantex Plant; and meet all present environmental codes and regulations in compliance with Federal, State, and local waste management and air and water pollution control standards. The work at the new Gas Analysis

Building 12–21. When the project is complete, several Chemistry Department testing efforts would be consolidated and all of the analytical chemistry functions would be sited together. Gas analysis would be performed on the following gas sample types: weapon repairs, modifications, and disassembles; 35 account gases; materials compatibility testing; weapons aging testing; laser sampling project samples; and special design agency samples. Other activities would include determination of volume, leak detection, bottle evacuations, backfilling premix and standard bottles for instrumentation, hydrogen getter uptake testing, and residual gas analyzes (DOE 1995a:I.B 12). The building would provide staging areas for the compressed gases, chemicals, HW, spare parts for instrumentation and vacuum systems, manifolds, moisture and pressure readouts, and other items used in the Gas Analysis Laboratory and its operation areas.

Part of the new Gas Analysis Laboratory would house the Vacuum Technology Group. Group operations include designing and testing vacuum systems, computer systems and software, and providing support for line operations, such as the vacuum chambers, manifold bays, pit reuse, and Cell 8.

The proposed Gas Analysis Laboratory would be a 2,537-square meter (27,304-square foot) single-story building, located on the west side of Zone 11 that would house highly calibrated electronic apparatus to analyze and test the contents of gas sampling containers. It would also house computer and vacuum laboratories. The proposed building would be a steel frame structure with a solid filled masonry wall and concrete roof cap. A staff of 20 people are anticipated to be working at the Gas Analysis Laboratory on a permanent basis. The Gas Analysis Laboratory would be designed to meet all applicable standards for personnel and public safety as well as environmental control (DOE 1995a:I.A 7-9, I.E 20).

The proposed facility would be divided into the following five areas: Gas Sample Testing Area, supporting laboratories, laboratory support areas, container receiving and issue, and administrative area (DOE 1995a:I.B 11, 20).

H.5.2.1 *Gas Sample Testing Area*

The Gas Sample Testing Area would consist of four rooms that would be used to house gas analysis equipment. Most of this equipment would be relocated from the existing gas laboratory. The Gas Sample Testing Area would contain an analytical glass rack, glass rack bay, mass spectrometer, and a gas chromatography/mass spectrometer, over a net usable area of 390.6 square meters (4,202 square feet). The analytical glass rack room and glass rack bay would house glass racks with associated ventilation systems to perform cryogenic fractionation analysis. The main purpose of an analytical glass rack is to cryogenically separate the components of a gas sample. Cryogenic fractionations are performed on compatibility containers, new disassembly samples desiccants, and any other samples requested by the design agencies. The separation allows for more exact laboratory analysis (e.g., mass spectrometer, gas chromatograph, or gas chromatograph/mass spectrometer) and very accurate determination of the volumes of gas removed from a container. Other functions of the glass rack are to get accurate volumes of samples that are not fractionated and for sample container transfer. An area within the glass rack room would be dedicated for handling hazardous waste generated from the cleaning process. Contained waste would then be moved to the hazardous waste staging sites in the building. The Gas Sample Testing Area would contain up to a maximum of 10 pounds of HE in the glass rack bay (DOE 1995a:I.A 8, I.E 12, 22, 23).

H.5.2.2 *Supporting Laboratories*

Supporting Laboratories would include a glass fabrication laboratory, general laboratory, computer room, and vacuum laboratory, for a net usable area of 153 square meters (1,646 square feet). The general laboratory would be designed to support any type of testing or analysis that would be required, such as for hydrogen getters, pressure variation checks on manometers, backfilling standards and premixes for instrumentation, and for performing volume determinations on non-high explosive(s) (HE) containers and sample bottles. The vacuum laboratory would be used to test vacuum systems, develop evacuation and leak detection techniques, and support disassembly, reuse, and retrofit operations. HW generated in the supporting laboratories would be moved to the HW staging sites within the building (DOE 1995a:I.A 8, I.E 23).

H.5.2.3 *Laboratory Support Area*

The Laboratory Support Area would contain a monitor room, inert staging area, 10 corridors, 2 vacuums, a waiting room, compressed gas staging area, sample bottle preparation and storage area, vestibule, training/conference room, chemical staging area, waste staging area, copier/fax machine, restrooms, janitor's closet, electrical room, mechanical room, break room, control data area, shipping/receiving area, and a ramp that would extend from the main entrance of the Gas Analysis Laboratory to the main entrance of the Materials Compatibility Assurance Facility (MCAF). Specific dimensions and detailed descriptions for each of these supporting areas are provided in the *Conceptual Design Report for the Gas Analysis Laboratory* (DOE 1995a:I.A 8-9; I.E 23-27). The proposed net usable area for laboratory support in the Gas Analysis Laboratory would be 1,431.8 square meters (15,403 square feet).

H.5.2.4 *Container Receiving/Issue Area*

The Container Receiving/Issue Area has been designed to have a 40.2-square meter (432-square foot) net usable area.

H.5.2.5 *Administrative Area*

The Administrative Area would consist of two offices and their corresponding office areas for a net usable area of 233.5 square meters (2,512 square feet).

H.5.2.6 *Environmental Considerations*

The proposed Gas Analysis Laboratory would be a new stand-alone facility designed specifically to meet all present environmental codes and regulations, and its normal operation would not have cumulative or long-term adverse effects on the environment. Normal operation of this facility would be in compliance with Federal, State, and local air and water pollution control standards. Mercury contaminated waste generated in this proposed facility would be collected in appropriate containers. When full, these containers would be moved to a RCRA-permitted hazardous waste treatment, storage, or disposal facility. Operators of the Gas Analysis Laboratory are evaluating possible nonhazardous alternatives to mercury in their processes, but have not yet discovered a viable alternative (DOE 1995a:I.E 30).

The project site would be graded to drain surface water into the existing plant stormwater drainage system. Sanitary waste would be directed and processed through the plant sanitary sewer system. The closed cooling water system blowdown/overflow/drain would also discharge to the sanitary sewer.

Construction debris and nonhazardous waste would be taken to the onsite landfill. All other wastes would be managed through appropriate facilities, including offsite disposal.

The glass rack bay would be the only room to contain HE and would be designed to minimize the spread of HE contamination through proper ventilation. The facility ventilation would be designed so that areas of higher potential HE have higher negative pressure and the flow of air would be from uncontaminated to contaminated areas. Facility design would incorporate ALARA concepts. Airborne effluents from process areas would not be treated prior to exhaust to atmosphere (DOE 1995a:I.E 30).

Pollution and soil erosion controls would be implemented during construction activities to mitigate impacts on air, water, and other environmental resources to assure compliance with Federal, State, and local laws and regulations. Construction site refuse and other solid waste would be collected and hauled to the Pantex Plant landfill on a regular basis. No open burning of construction refuse or other Class 2 and Class 3 would be allowed. Temporary facilities for disposal of sanitary wastewater would be provided during construction (DOE 1995a:I.E 30-31).

The design of this facility includes an energy conservation analysis. A reduction goal of 10 percent in the average annual energy requirement per gross square foot has been established. Executive Orders 12003 and 12902 and the Pantex Fuel Policy will be followed. Appendix G, Pollution Prevention and Waste Minimization, presents an additional discussion of water and energy conservation (DOE 1995a:I.E 29).

No permits are currently required and no new permits are expected to be needed.

H.5.2.7 *Health and Safety*

The proposed facility would be designed in accordance with the requirements of DOE Order 5480.7A, Fire Protection. However, the fire water run-off containment requirement would not apply because of the very small quantity of polluting liquids in the building (DOE 1995a:I.B 17, I.E 30).

Under the proposed project, speakers would be installed in the building and connected to the Pantex Plant site-wide public address system. An emergency plan for this facility would be incorporated into the Pantex Site Emergency Preparedness Plan (DOE 1995a:I.B 17, I.E 34).

The proposed Gas Analysis Laboratory would have the capacity to store the waste in a specially designed room with proper ventilation (e.g., ventilation hoods and local exhaust manifolds) and access control, so the waste would not have access to floor drains. The Glass Rack Bay would be designed for Hazard Class 2 activities (DOE 1995a:I.B 17, I.E 33).

H.5.2.8 *Safeguards and Security*

The proposed Gas Analysis Laboratory would be sited within the inhabited building distance from explosive buildings in Zone 11. Since this facility would serve more than one explosive area (Zones 11 and 12), it would be located within the inhabited building distance to explosive Building 11–45 and would be designed to protect its occupants to a level greater than or equal to that required by DOD 6055.9, Chapter 2, for inhabited building distance. Safety analysis reports for the Gas Analysis Laboratory would be developed and implemented prior to the start of facility operation (DOE 1995a:I.E 33).

The proposed facility would also provide upgrades to security. The proposed Gas

Analysis Laboratory would be located within an established Limited-Access Area at Pantex Plant. Classified weapons parts in the bays and classified and sensitive information in the offices of the existing gas laboratory are not subject to security devices, such as motion detectors, to ensure protection during off-shift hours. The design and construction of this project would follow established security practices for Pantex Plant (DOE 1995a:I.B 17, I.E 35).

H.5.3 Relationship to Other Projects

The proposed Gas Analysis Laboratory would be a stand-alone project to replace the existing gas laboratory in Building 12–21. The MCAF would be located in close proximity to the Gas Analysis Laboratory due to sequel process functions and a shared labor force. The relationship between the MCAF and the Gas Analysis Laboratory is important because they share a common funding year and schedule for design and construction. These two facilities are linked by means of a ramp. In addition, the proposed roof height of the Gas Analysis Laboratory also complements that of the MCAF in a further effort to unify the two buildings (DOE 1995a:I.A 7, I.C 18).

The Gas Analysis Laboratory would have a remote monitoring system to provide rapid response to an alarm situation. It would be operational 24 hours a day, 7 days a week to monitor the environmental chambers located in Buildings 12–94, 12–104, Bay 20, and the MCAF (DOE 1995a:I.B 12).

H.5.4 Environmental Impacts

H.5.4.1 *Infrastructure*

Electrical usage would remain the same at 548 megawatthours per year. No natural gas would be used at the facility. Steam usage would remain the same at 4.5 million kilograms per year (9.9 million pounds per year). The generation of this steam involves the use of 564,000 liters per year (149,000 gallons per year) of water and 0.3 million cubic meters per year (9.5 million cubic feet per year) of natural gas (PC 1995:Table 3).

H.5.4.2 *Land Resources*

The building site is located adjacent to the southwestern corner of Zone 11. This facility will be adjacent to the proposed Material Compatibility Assurance Facility, which is surrounded by a buffer zone. The facility is designed to be 2,537 square meters (27,304 square feet). The facility would consolidate and improve operations and increase the safety to the worker, the public, and the environment. There are no expected environmental impacts of the Proposed Action on the surrounding land resources.

H.5.4.3 *Geology and Soils*

There could be very minor impacts to the soils due to erosion during construction. The area of temporarily disturbed soil would be 5,074 square meters (54,608 square feet) (PC 1995:Table 1). Mitigation measures such as sediment traps, diversion of surface water runoff from the construction area, dikes, silt fences, and covering the disturbed area with rip rap would be used to minimize soil erosion.

H.5.4.4 *Water Resources*

Water use is not expected to increase from its current usage of 912,000 liters (214,000 gallons). The generation of wastewater is also not expected to increase from its current rate of 912,000 liters per year (241,000 gallons per year) (PC 1995:Table 3). The facility construction site is not located within a known, playa-associated 100-year floodplain (DOE 1995a:I.E 30).

H.5.4.5 *Air Quality*

Airborne particulate matter (i.e., dirt and equipment emissions) levels would be elevated during the construction period. Air pollution controls would be implemented during construction activities to mitigate air quality impacts (DOE 1995a:I.E.-30). No special nuclear material is expected to be tested in this facility. This facility is expected to generate the same types of air emissions as the existing facility it would replace. Therefore, there would be no change in the impacts from the current level (PC 1995:Table 3).

H.5.4.6 *Acoustics*

Noise levels would temporarily increase during construction from operation of heavy construction equipment such as air compressors, cement mixers, and construction vehicle traffic. During facility operations, noise would be emanating from air handling equipment (hoods) and analytical equipment. Local worker and transportation traffic would contribute to the ambient noise in the area. The operational areas design will include noise controls pursuant to OSHA standards (29 CFR 1910.95).

H.5.4.7 *Biotic Resources*

Flora and fauna that currently use the facility construction site would be permanently removed or displaced by construction. The general site area has been disturbed by construction of the existing roads, utilities, and proposed plant activities, including the Materials Compatibility Assurance Facility. In accordance with the FY 1995 *Pantex Plant Site Development Plan* natural resource management requirements, the building site does not contain any unique, unusual, or critical habitats for known threatened or endangered species, nor does it adversely restrict known or established migratory corridors used by wildlife (DOE 1995c).

H.5.4.8 *Cultural Resources*

No archaeological sites or historical resources have been identified in or near the proposed construction site and no impacts to cultural resources are expected.

No decisions have been made regarding use of existing facilities which may qualify as historic resources. The decision to reuse, modify, or demolish will be addressed in future NEPA documentation.

H.5.4.9 *Socioeconomic Resources*

The construction cost of this facility would be approximately $13.3 million. Construction of the facility is expected to employ 36 to 61 short-term employees and would probably result in a small temporary increase in local employment (PC 1995:Table 1). A substantial portion of the material costs would enter the wholesale and retail trade sector of the regional economy. This facility is designed for 20 employees. No new employees are expected since all of them would relocate from the existing facilities at the plant site (PC 1995:Table 3).

H.5.4.10 *Transportation*

The construction of this facility would result in a temporary increase in onsite and area traffic during a 26-month period. Normal day shift work hours, Monday through Friday, are expected. However, since Zone 11 conducts HE operations, some schedule changes can be expected due to workloads and HE safety issues. Since construction of the facility is in a Limited-Access Area, plant security personnel would accompany construction workers to and from the construction site. Material supplies would be transported through Building 16–15, Central Shipping and Receiving.

H.5.4.11 *Waste Management*

This facility is expected to generate the same types and quantities of wastes as the existing facility it would replace. Therefore, there would be no changes in the impacts from current levels (PC 1995:Table 3).

H.5.4.12 *Human Health Risks*

There are no radiation risks during construction, since construction activities would not involve the use of any radioactive materials or waste. Chemical human health risks during construction are mitigated through compliance with OSHA Chapter 1926 regulations and an approved project-specific health and safety plan. The Contractor Safety and Health program requires a written plan for approval by the Fire, Waste Management, Industrial Hygiene, and Safety Departments. The plan establishes permits for safety, excavation, fire department, radiation work, and hot work as necessary (Pantex 1992).

No potential sources of radiological exposures during operations are expected. Potential sources of chemical exposures during operations would be from chemicals and materials used in analysis of materials. Personal protective clothing and equipment (e.g. ventilation hoods) would be used to mitigate the potential health risks.

H.5.5 No Action Alternative

One of the alternatives to the construction of the Gas Analysis Laboratory is to conduct operations in the existing facilities without temperature control. Laboratory operations would continue under crowded conditions with a lack of adequate equipment. Quality assurance and quality control will continue to present operational and administrative problems. Finally, maintenance will most likely increase due to the age and condition of the existing building.

H.5.6 Move to An Existing Facility Alternative

This alternative to the Proposed Action would involve the modification of an existing facility not currently used for this purpose. This facility would likely be newer than Building 12-21, which was built after 1951. If a suitable facility is identified, this facility would meet all present environmental codes, regulations, and pollution control standards. Its normal operation would not have cumulative adverse effects on the environment. This facility would utilize design features and administrative controls to protect employees and the environment. However, modifications of any existing building to suit the needs of the Gas Analysis Laboratory is estimated to cost more than the construction of a new building.

H.5.7 Alternatives Eliminated from Detailed Study

Three alternatives were eliminated from detailed study. The use of temporary facilities to conduct gas analysis operations was not considered practical since DOE requires extensive design features for HE safety, emission controls, safety requirements, security, and fire protection. The second alternative requires the use of commercial laboratory facilities. However, no commercial laboratories conduct nuclear weapon analyses. If an offsite laboratory provided the necessary analyses, security and analyses turnaround would be of great concern. The third alternative is the construction of a smaller laboratory. The impacts of a smaller facility would be less than the Proposed Action, but the facility may not meet the anticipated future needs of Pantex Plant.

The 72-square meter (778-square foot) Administrative Area would provide support to the MCAF's Material Compatibility Assurance Areas and the support activities (DOE 1994b:I.A 8, I.E 25-27).

The proposed facility would be designed as a poured-in-place concrete structure. This system was selected to contain the explosives and the effects from an accidental explosion. The MCAF roof lines were determined by evaluating vertical height requirements in the testing and processing portions of the building and by consideration of adjacent building profiles. The new MCAF building has the functional goal of providing a safe environment for personnel performing materials compatibility testing. This proposed facility design follows the recommendation for decontamination and decommissioning outlined in DOE Order 6430.1A, Section 1300–11, etc. (DOE 1994b:I.A 7, I.E 20).

H.6.2.1 *Environmental Considerations*

The MCAF is a new stand-alone facility designed specifically to meet all present environmental codes and regulations. Its normal operation would not have cumulative or long-term adverse effects on the environment. Normal operation of this facility would be in compliance with Federal, State, and local air and water pollution control standards.

Mercury contaminated HW would be generated at this facility and collected in appropriate containers. Full containers would be taken offsite to a RCRA permitted HW treatment, storage, or disposal facility.

The project would be located on the west side of Zone 11, away from areas subject to flooding (EO 11988). The facility design would provide normal protection from natural phenomena and satisfy the DOE loss limitation criteria (DOE Order 6430.1A, Section 0110-99.0.7; DOE 1994b:I.E 30).

The MCAF project site would be graded to drain surface water into the existing plant stormwater drainage system. Sanitary waste would be directed and processed through the plant sanitary sewage system. Cooling tower overflow, drain, and blowdown would be discharged to the sanitary sewer. Nonhazardous construction (Class 3) waste would be taken to the plant sanitary landfill for disposal (DOE 1994b:I.E-30). All other wastes will be managed through appropriate facilities, including offsite disposal.

The MCAF would be designed to minimize the spread of HE contamination. The conceptual design calls for a ventilation system that creates a higher negative pressure in areas of higher potential HE so that air flows from uncontaminated to contaminated areas. Design of the facility and the ventilation of HE and hazardous constituents incorporate ALARA concepts.

Pollution and soil erosion controls would be implemented during construction activities to mitigate impacts on air, water, and other environmental resources to assure compliance with Federal, State, and local laws and regulations. Construction site refuse and other solid waste would be collected and hauled to the Pantex Plant landfill on a regular basis. No open burning of construction refuse or other Class 2 and Class 3 would be allowed. Temporary facilities for disposal of sanitary wastewater would be provided during construction (DOE 1994b:I.E 30).

The design of this facility includes an energy conservation analysis. A reduction goal of 10 percent in the average annual energy requirement per gross square foot has been established. Executive Orders 12003 and 12902 and the Pantex Fuel Policy will be followed. The design of the facility includes requirements of 10 CFR 435, Energy Conservation Voluntary

Performance Standard for New Buildings; Mandatory for Federal Buildings, as amended. Appendix G, Pollution Prevention and Waste Minimization, presents an additional discussion of water and energy conservation (DOE 1995:I.E 28-29).

H.6.2.2 *Health and Safety*

The MCAF would be sited within the inhabited building distance from explosive Building 11–45. Since this facility would serve more than one explosive area (Zones 11 and 12), it would be designed to protect its occupants to a level greater than or equal to that required by DOD 6055.9, Chapter 2, for inhabited building distance. Safety Analysis Reports for the MCAF project would be developed and implemented prior to the start of facility operation (DOE 1994b:I.E 32).

The explosive areas of this facility would be designed for Hazard Class 2 activities. Fire protection would be provided by a wet-pipe automatic sprinkler system throughout the building; the source of water for fire protection would be extended from the existing Pantex Plant distribution main. Fire alarm controls would be connected to the existing plant Fire Alarm System. Public address speakers would be installed in the building and connected to the Pantex Plant site-wide Public Address System. An Emergency Plan for this facility would be incorporated into the Pantex Site Emergency Preparedness Plan (DOE 1994b:I.E 33).

The proposed facility would have hazardous materials and would incorporate measures to limit dispersion and simplify decontamination and decommissioning, disposal, and reuse through specialized finishes on floors, walls, and ceilings. Ventilation hoods and local exhaust manifolds would be used for containment and collection of fumes from hazardous processing equipment (DOE 1994b:I.E 33).

H.6.2.3 *Safeguards and Security*

The MCAF would also provide upgrades to security; it would be located within an established Limited-Access Area at Pantex Plant. Seal eyelets would be installed on the outside of all exterior doors. The HE Staging Room, Container Operations Room, Leak Detection Room, Isothermal Development Chamber, IHE Chambers, and Classified Material Storage Room would be designated as vault-type rooms for securing classified material. In addition, the facility would be connected to the plant's existing security alarm network (DOE 1994b:I.E 34).

H.6.3 Relationship to Other Projects

The MCAF is located in close proximity to the Gas Analysis Laboratory due to sequel process functions and a shared labor force. The relationship between the MCAF and the Gas Analysis Laboratory is important because they share a common funding year and schedule for design and construction. These two facilities would be linked by means of a ramp. In addition, the proposed roof height of the Gas Analysis Laboratory also complements that of the MCAF in a further effort to unify the two buildings (DOE 1994b:I.A 7, I.C 17). Gas test samples, processed in the proposed MCAF would be analyzed in the adjacent Gas Analysis Laboratory. Coordination between the two facility designs would be required (DOE 1994b:I.C 17).

H.6.4 Environmental Impacts

H.6.4.1 *Infrastructure*

Electrical usage would remain the same at 1,096 megawatthours per year as for the existing facility. No natural gas would be used at the facility. Steam usage would remain the same at

4.4 million kilograms per year (9.6 million pounds per year), involving the use of 564,000 liters per year (149,000 gallons per year) of water and 0.3 million cubic meters per year (9.2 million cubic feet per year) of natural gas (PC 1995:Table 3).

H.6.4.2 *Land Resources*

The building site is located adjacent to the southwestern corner of Zone 11. This facility will be adjacent to the proposed Gas Analysis Laboratory, which is surrounded by a buffer zone. The facility would consolidate and improve operations and increase the safety to the worker, the public, and the environment. There are no expected environmental impacts of the Proposed Action on the surrounding land resources.

H.6.4.3 *Geology and Soils*

There could be very minor impacts to the soils due to erosion during construction. The area of temporarily disturbed soil would be 4,030 square meters (43,380 square feet) (PC 1995:Table 1). Mitigation measures such as sediment traps, diversion of surface water runoff from the construction area, dikes, silt fences, and covering the disturbed area with rip rap would be used to minimize soil erosion.

H.6.4.4 *Water Resources*

Water use is expected to remain at its current level of 8,630,000 liters per year (2,283,000 gallons per year). The generation of wastewater is also expected to remain at its current level of 7,610,000 liters per year (2,013,000 gallons per year). The facility construction site is not located within a known, playa-associated 100-year floodplain (DOE 1994b:I.E 30).

H.6.4.5 *Air Quality*

Airborne particulate matter (i.e., dirt and equipment emissions) levels would be elevated during the construction period. Air pollution controls will be implemented during construction activities to mitigate air quality impacts (DOE 1995a:I.E 30). No special nuclear material is expected to be tested in this facility. This facility is expected to generate the same types of air emissions as the existing facility it would replace. Therefore, there would be no change in the impacts from the current level (PC 1995:Table 3).

H.6.4.6 *Acoustics*

Noise levels would temporarily increase during construction from operation of heavy construction equipment such as air compressors, cement mixers, and construction vehicle traffic. During the facility operations, noise would be emanating from air handling equipment (hoods) and analytical equipment. Local worker and transportation traffic would contribute to the ambient noise in the area. The operational areas design will include noise controls pursuant to OSHA standards (29 CFR 1910.95).

H.6.4.7 *Biotic Resources*

Flora and fauna that currently use the facility construction site would be permanently removed or displaced by construction. The general site area has been disturbed by construction of the existing roads and utilities. In accordance with the *Pantex Plant Site Development Plan* natural resource management requirements, the building site does not contain any unique, unusual or critical habitats for known threatened or endangered species, nor does it adversely restrict known or established migratory corridors used by wildlife (DOE 1995c).

H.6.4.8 *Cultural Resources*

No archaeological sites or historical resources have been identified in or near the proposed construction site and no impacts to cultural resources are anticipated.

No decisions have been made regarding use of existing facilities which may qualify as historic resources. The decision to reuse, modify, or demolish will be addressed in future NEPA documentation.

H.6.4.9 *Socioeconomic Resources*

The construction cost of this facility would be approximately $20.6 million. Construction of the facility is expected to employ 38 to 104 short-term employees and would probably result in a small temporary increase in local employment (PC 1995:Table 1). A substantial portion of the material costs would enter the wholesale and retail trade sector of the regional economy. This facility is designed for an estimated 40 employees; no new employees are expected. Employees working in existing facilities would be relocated to new facilities (PC 1995:Table 3).

H.6.4.10 *Transportation*

The construction of this facility would result in a temporary increase in onsite and area traffic during a 31-month period. Normal day shift work hours, Monday through Friday, are expected. However, since Zone 11 conducts HE operations, some schedule changes can be expected due to workloads and HE safety issues. Since construction of the facility is in a Limited-Access Area, plant security personnel would accompany construction workers to and from the construction site. Material supplies would be transported through Building 16–15, Central Shipping and Receiving.

H.6.4.11 *Waste Management*

This facility is expected to generate the same types and quantities of wastes as the existing facility it would replace. Therefore, there would be no changes in the impacts from current levels (PC1995:Table 3).

H.6.4.12 *Human Health Risks*

There are no radiation risks during construction, since construction activities would not involve the use of any radioactive materials or waste. Chemical human health risks during construction are mitigated through compliance with OSHA Chapter 1926 regulations and an approved project-specific health and safety plan. The Contractor Safety and Health program requires a written plan for approval by the Fire, Waste Management, Industrial Hygiene, and Safety Departments. The plan establishes permits for safety, excavation, fire department, radiation work, and hot work as necessary (Pantex 1992).

No potential sources of radiological exposures during operation are expected. Potential sources of chemical exposures during operations would be from chemicals and materials used in analysis of materials. Personal protective clothing and equipment (e.g. ventilation hoods) would be used to mitigate the potential health risks.

H.6.5 No Action Alternative

One of the alternatives to the construction of the MCAF is the continued operation in seven buildings. Environmental chambers would continue to operate at or near capacity with little schedule flexibility. Overcrowding will be managed through administrative and scheduling controls. The DOE Explosive Safety Manual (DOE 1991) exemption would continue for Building 12–19. Operational conflicts with material aging operations and explosive formulation operations would continue. Future

weapon program quality assurance and quality control explosive quantity requirements are expected to exceed building design safety limits. Finally, maintenance would likely increase due to the age and condition of the facilities.

H.6.6 Move to an Existing Facility Alternative

This alternative to the Proposed Action involves the modification of an existing facility not currently used for this activity. Buildings 12–19, 12–94, and 12–104 have been identified as possible alternative locations for current operations. These facilities would require installation of a blast shield and missile netting. The construction period is considered minor and no cost analysis has been completed. These facilities will meet all present environmental codes and regulations, pollution control standards, and the normal operations would not have cumulative adverse effects on the environment. Buildings 12–94 and 12–104 utilize design features and administrative controls to protect employees and the environment. Building 12–19 would rely on administrative controls.

H.6.7 Alternatives Eliminated from Detailed Study

Two alternatives were eliminated from detailed study. The use of temporary facilities to conduct material compatibility operations was not considered practical since DOE requires extensive design features for HE safety, emission controls, safety requirements, security, and fire protection. The second alternative required the use of a design agency laboratory facility. However, material compatibility capacities at current design agencies are considered inadequate.

H.7 Nondestructive Evaluation Facility

H.7.1 Purpose and Need for Action

The Department needs a facility in which to conduct nondestructive evaluation activities. The existing facility where these activities are currently conducted does not meet the design criteria for Class 2 operations, as required in the DOE Explosive Safety Manual (DOE 1991).

H.7.2 Proposed Action

This project would provide a new Nondestructive Evaluation Facility (NDEF) that would be located in Zone 12, north of Building 12–121 and west of Building 12–108. The purpose of the proposed facility is to provide replacement capabilities for radiography and other nondestructive evaluation activities on weapons, components, and other objects. Specific operations would include: radiography, ultrasonic, digital imaging penetrant testing, laser sampling radiometry, and computer tomography of non-nuclear weapon materials. The existing nondestructive evaluation activities housed in Building 12–21 are inadequate for operations by current criteria because the existing structure is not designed to meet the DOE Explosives Safety Manual for Class 2 Operations. Other facilities at the plant were not viable due to the cost of compliance with the DOE Explosive Safety Manual (DOE 1994:I.A.1; Pantex 1996:App C).

This facility would consist of two, single-story structures joined by a ramp with a gross area of 3,734 square meters (40,196 square feet) and a net usable area of 3,009 square meters (32,386 square feet). The NDEF would have five explosive bays for nondestructive evaluation activities and areas for a vault, electronic repair and spare parts staging area, office area, film

reading room, dark room, conference room, offices, computer area and waste accumulation. The five proposed bays are: the 420 kV X-ray Bay, Miscellaneous Test Bay, High/Medium Energy Radiography Bay, High/Medium Energy Computer Tomography Bay, and Explosives Component Staging Bay. X-ray functions would be housed in three of the five explosives bays. Each of these bays are described below (DOE 1994:I.A 1-2).

The 420 kV X-Ray Bay would be used for radiography of medium size components, such as fire sets, and would have a net usable area of 107 square meters (1,151 square feet) with 6-meter (20-foot) ceilings. Operations in this bay would include radiography and packing and unpacking components. The explosives limits in this bay would not exceed 45 kilograms (100 pounds). There would be no chemicals, gases, or fume or vent hoods required in this bay; however, plant air and vacuum would be required. A 47-square meter (508-square foot) control room would be required primarily to house computer equipment.

The Miscellaneous Test Bay would be used to support the following types of tests: portable penetrant testing, portable ultrasonic testing, eddy current, acoustic emission, magnetic particle, radar testing, 150 kV x-ray, 320 kV Microfocus, temperature chambers, and cabinet x-rays. Operations would include packing and unpacking components as well as testing, radiography, and controlled temperature transfer to components. Room dimensions for this bay are 219 square meters (2,362 square feet) in area and 6 meters (20 feet) in height. The explosives limit in this bay would not exceed 45 kilograms (100 pounds). Chemicals, such as penetrant testing cleaner, developer, and fixer would be required. No gases would be required; however, plant air and vacuum are necessary. A control room would also be required in this bay to house computer equipment (DOE 1994:I.E 7-9).

A High/Medium Energy Radiography Bay would be used to perform radiography on large parts, and to pack/unpack components. Size requirements for this bay include an area of 361 square meters (3,887 square feet) and 7.6 meters (25 feet) in height. Explosives limits in this bay would not exceed 45 kilograms (100 pounds). There would be no chemicals or gases required in this bay; however, plant air and vacuum would be required in this area. Plant air should be the same as in Building 12–84, and Building 12–104A. A separate HE vacuum system or fume or vent hoods would not be required. The control room for this bay would be 71.2 square meters (767 square feet).

A High and Medium Energy Computer Tomography Bay would be used to analyze, determine the contents, and pack/unpack small to large parts. The conceptual design for this bay calls for an area of 364 square meters (3,290 square feet), a height of 7.6 meters (25 feet), and an explosive limit of 45 kilograms (100 pounds). In addition, the bay would be required to provide access to vehicles up to 11 meters (36 feet) long, 4.3 meters (14 feet) high, and have an entrance width of at least 3.6 meters (12 feet); the weight limit would satisfy the State of Texas maximum allowed over-the-road requirements. Gas and chemical requirements for this bay are similar to those described for the High/Medium Energy Radiography Bay. A 55.5-square meter (597-square foot) control room has been proposed in the conceptual design to primarily house computer equipment (DOE 1994:I.E 13-14).

An Explosives Component Staging Bay in the NDEF would occupy a 53-square meter (570-square foot) area, 6.1 meters (20 feet) high, with an explosive limit of 45 kilograms (100 pounds). Since no chemicals or gases would be required in this bay, there would be no fume or vent hood requirements.

The proposed NDEF would also contain a 37-square meter (400-square foot) vault area for film staging and retrieval. No explosives,

chemicals, or gases would be stored in this area. Less than 10-percent humidity would be required.

In addition, usable space in the NDEF would also be occupied by administrative, support, and analysis areas. The buildings would be temperature- and humidity-controlled. The facility would be secure to conduct classified activities, and would be designed in accordance with all applicable environmental, safety, and health requirements. The NDEF would be built in an area with no known soil contamination, located in accordance with the *Pantex Plant Site Development Plan* (DOE 1994:I.A 1-2; DOE 1995c).

Current plans are to include technology transfer activities inside the proposed NDEF. Approximately 30 percent of the workload for this facility would result from technology transfer operations. The *Stevenson-Wydler Technology Innovation Act of 1980*, as amended, establishes technology transfer as a mission of the Federal government to enhance the industrial competitiveness of U.S. industries in a global economy by utilizing resources at Federal facilities. One strategy to accomplish the goal is to make news from DOE laboratories and facilities available as an integrated technical resource for existing manufacturing extension and technology outreach systems. To meet this goal, planning for the NDEF has included technology transfer activities in an upgraded facility (DOE 1994:I.B 4-5).

No decisions have been made regarding future use of existing facilities. The decision to reuse, modify, or demolish will be addressed in future NEPA documentation.

H.7.2.1 *Environmental Considerations*

Waste management issues for continued operations in Building 12–21 are of environmental concern. Film processing, performed in this existing facility for many years, has generated waste (e.g., silver, fixer, and developer) that was previously released to a nearby drainage ditch. The release site is one of 144 sites currently under investigation. The waste handling system for Building 12–21 was later redesigned to meet current discharge effluent requirements. However, since the waste accumulation site was not an integral part of the facility design, the piping for waste collection was retrofit. Building 11–29 collects facility-wide film processing wastes for silver recovery. Furthermore, Building 12–21 was not designed for chemical use or accumulation sites.

The current accumulation site, a hallway, is open to all general area traffic. The new NDEF would be a stand-alone facility that would be designed specifically to meet all present environmental codes and regulations. The current waste handling requirements are incorporated into the initial conceptual design criteria. Normal operation of this facility would be in compliance with Federal, State, and local air and water pollution control standards and would not have cumulative or long-term adverse effects on the environment (DOE 1994:I.B 2-3).

The site would be graded to drain surface water into the existing plant stormwater drainage system. Sanitary wastewater would be directed and processed through the plant sanitary sewage system. Solid domestic-type waste would be taken to a municipal sanitary landfill for offsite disposal (DOE 1994:I.E 36).

During construction of the proposed facility, environmental considerations would include pollution and soil erosion controls to mitigate impacts on air, water, and other environmental resources and to ensure compliance with Federal, State, and local laws and regulations. Construction debris would be collected and hauled to the Pantex Plant landfill on a regular basis. No open burning of construction refuse or other Class 2 and Class 3 would be allowed (DOE 1994:I.E 36-37).

The design of this facility includes an energy conservation analysis. Appendix G, Pollution Prevention and Waste Minimization, presents an additional discussion of water and energy conservation (DOE 1994:I.E 36).

No permits are currently required for existing facilities and would not be required for the replacement facility.

H.7.2.2 *Health and Safety*

Most of the safety concerns deal with inadequacies in construction of the existing facility, Building 12–21. This facility is inadequate for operations by current criteria and was not designed to meet the current safety design criteria for explosive operations (DOE Explosive Safety Manual [DOE 1991] for Class 2 level of protection) or radiation protection. Because of the age of the facility, the ability to deal with these design problems in the existing structure is limited. In addition, the current ventilation and fire protection systems are inadequate. There is also contamination in this facility. Lead contamination has resulted from the paint, lead bricks, and screens used in radiography. Explosives contamination has resulted from past HE processing activities, and asbestos is present in the ceiling. The conceptual design for the new NDEF call for Safety Analysis Reports for the NDEF project to be developed and implemented prior to the start of facility operation (DOE 1994:I.B 1-2, I.E 39).

H.7.2.3 *Safeguards and Security*

The NDEF would also provide upgrades to security; it would be located within the Protected Area. Classified material would be stored in the facility within the bays and in the vault. Special nuclear material would not be stored in this facility. In addition, the facility would be connected to the plant's existing security alarm network (DOE 1994:I.E 40).

H.7.3 Relationship to Other Projects

The NDEF would be related to the Gas Analysis Laboratory, which is also located in Building 12–21. Additionally, this project would relocate the Vibration Testing, Hostile Shock Test, Mini-Air Gun Shock Test, and the Centrifuge Test to Building 12–78 as part of an interim plan.

H.7.4 Environmental Impacts

H.7.4.1 *Infrastructure*

Electrical usage would remain the same at 1,150 megawatthours per year as for the existing facility. No natural gas would be used at the facility. Steam usage would remain the same at 2.9 million kilograms per year (6.5 million pounds per year) involving the use of 451,000 liters per year (119,000 gallons per year) of water and 0.2 million cubic meters per year (6.2 million cubic feet per year) of natural gas (PC 1995:Table 3).

H.7.4.2 *Land Resources*

The building site is located in the north end of Zone 12 South, nearly equidistant to the east and west perimeters of Zone 12 South. The facility is north of Building 12–121 and west of Building 12–108. The facility is designed with 3,734 square meters (40,196 square feet). The facility would consolidate and improve operations and increase the safety to the worker, the public, and the environment. There are no expected environmental impacts of the Proposed Action on the surrounding land resources.

H.7.4.3 *Geology And Soils*

There could be very minor impacts to the soils due to erosion during construction. The area of

H.7.4.10 *Transportation*

The construction of this facility would result in a temporary increase in onsite and area traffic during a 42-month period. Normal day shift work hours, Monday through Friday, are expected. However, since Zone 12 includes the Material Access Area and conducts weapon operations and HE operations, some schedule changes can be expected due to workloads and HE safety issues. Since construction of the facility is in a Material Access Area, plant security personnel would accompany construction workers to and from the construction site. Material supplies would be transported through Building 16–15, Central Shipping and Receiving Facility. Intrasite transportation impacts are presented in section 4.12.

H.7.4.11 *Waste Management*

This facility is expected to generate the same types and quantities of wastes as the existing facility it would replace. Therefore, there would be no changes in the impacts from current levels (PC 1995:Table 3).

H.7.4.12 *Human Health Risks*

There are no radiation risks during construction, since construction activities would not involve the use of any radioactive materials or waste. Chemical human health risks during construction are mitigated through compliance with OSHA Chapter 1926 regulations and an approved project-specific health and safety plan. The Contractor Safety and Health program requires a written plan for approval by the Fire, Waste Management, Industrial Hygiene, and Safety Departments. The plan establishes permits for safety, excavation, fire department, radiation work, and hot work as necessary (Pantex 1992).

Potential sources of radiological exposures during operation are expected. Potential sources of chemical exposures during operations would be from chemicals and materials used in analysis of materials. Personal protective clothing, shielding, and equipment (e.g. ventilation hoods) would be used to mitigate the potential health risks. Plant-wide human health impacts are presented in section 4.14.

H.7.5 No Action Alternative

One of the alternatives to the construction of the Nondestructive Evaluation Facility is to continue operations in a deteriorating building. X-ray operations would continue in the existing facility through establishment of administrative exclusion areas for the protection of employees. The existing building lacks adequate engineering controls. Administrative controls will continue during explosive evaluation operations due to inadequate building design features. Workload scheduling conflicts with the Gas Analysis Laboratory are expected due to overcrowding.

H.7.6 Move to an Existing Facility Alternative

An alternative to the Proposed Action is the modification of an existing facility for evaluation operations. If a suitable facility is identified, it would be required to meet all present environmental codes and regulations and pollution control standards. The facility would be required to utilize design features and administrative controls to protect employees and the environment. No suitable facility so far has been identified for this purpose. If nondestructive evaluation operations were spread through multiple areas of the plant, it would create logistical problems with building management. The facility manager has direct line responsibility for the operation of a facility, including the authority to direct physical changes to that facility, operation reporting requirements, and providing corrective actions (DOE 1994:I.C 2).

H.7.7 Alternatives Eliminated from Detailed Study

Two alternatives were eliminated from detailed study during the preliminary evaluation of the Nondestructive Evaluation Facility project. The first alternative was to send Nondestructive Evaluation operations offsite. However, this option was deemed unacceptable because many of the parts tested are classified. The second alternative was to cease all nondestructive evaluation operations. However, these operations are required to support dismantlement, evaluation, retrofit, repair, modification, and new build activities (DOE 1994:I.C 2, I.D 3).

H.8 METROLOGY AND HEALTH PHYSICS CALIBRATION AND ACCEPTANCE FACILITY

H.8.1 Purpose and Need for Action

The Department needs to conduct metrology and health physics calibration and acceptance activities in support of disassembly and quality assurance testing.

The new facility is needed because the existing metrology and health physics calibration and acceptance activities are inadequate for operation by current criteria because the facilities were designed for assembly and not disassembly and quality assurance testing. The facilities were not designed for the level of control and support for testing facilities. Furthermore, there are no onsite facilities capable of completing calibration of neutron and gamma monitoring equipment (DOE 1994a:I1-2).

H.8.2 Proposed Action

The Department proposes to construct a facility built to current design criteria in which to conduct needed activities. The project consists of a Health Physics Calibration Area and a Product Acceptance Control Area (DOE 1994a:I-3).

This 4,474-square meter (48,156-square foot) facility would provide the capability and capacity to support weapon operations at Pantex Plant. The facility would be appropriately separated into two major areas: Health Physics Calibration and Product Acceptance Control and Storage Area.

H.8.2.1 *Health Physics Laboratory*

This 634-square meter (6,825-square foot) laboratory would provide space inside the Material Access Area for the calibration and maintenance of alpha, beta, gamma, x-ray, and neutron instrumentation, survey meters, and area monitors required for all weapons program operations at Pantex Plant. Due to the calibration source activities and isotopes involved, specially designed facilities are required to obtain National Institute of Standards and Technology traceable calibration while limiting personnel exposure to radiation. The laboratory contains a 92.9-square meter (1,000-square foot) Gamma/X-ray Calibration Laboratory, two 74.3-square meter (800-square foot) Neutron Calibration Laboratories, and a 111.5-square meter (1,200-square foot) Alpha/Beta Calibration Laboratory.

H.8.2.2 *Product Acceptance Control Area*

This 1,780-square meter (19,200-square foot) laboratory would provide the capability for calibration, maintenance, repair, examination, and final qualification of production acceptance measurement and test equipment. The area would provide control of Nuclear Explosive Area measurement and test equipment, cables, and adapters listed on the Albuquerque Operations Office Master Tester List utilized in

No permits are currently required and no new permits would be required.

H.8.2.5 *Health and Safety*

The facility would operate under an approved Final Safety Analysis Report developed prior to initial operation. Emergency lighting would comply with the National Fire Protection Association code. Fire protection would consist of automatic sprinkler systems and fire alarm systems. Laboratories would not be occupied by personnel while radiation calibration sources are exposed. Engineering controls like interlocks, airlocks, and shielding would be included in the design features. A physical barrier outside the building would be used to establish an exclusion zone. In addition, several emergency body/eyewash stations would be included in the design (DOE 1994a:I-30 to 35).

H.8.2.6 *Safeguards and Security*

The Metrology and Health Physics Calibration and Acceptance Facility would follow established security practices for Pantex Plant. Weapons-grade special nuclear material in the form of calibration sources would be stored under administrative control. In addition, the facility would be connected to the plant's existing security alarm network (DOE 1994a:I-35).

H.8.3 Relationship to Other Projects

This project is not related to any other construction project (DOE 1994a:I-12).

H.8.4 Environmental Impacts

H.8.4.1 *Infrastructure*

Electrical usage would remain the same at its current level of 1,315 megawatthours per year. No natural gas would be used at the facility. Steam usage would remain the same at 4.4 million kilograms per year (9.6 million pounds per year), involving the use of 564,000 liters per year (149,000 gallons per year) of water and 0.3 million cubic meters per year (9.2 million cubic feet per year) of natural gas (PC 1995:Table 3).

H.8.4.2 *Land Resources*

The building site is located in the southeast corner of Zone 12 South. The facility is north of Building 12–41 and east of Building 12–42. The facility would consolidate and improve operations and increase the safety to the worker, the public and the environment. There are no expected environmental impacts of the Proposed Action on the surrounding land resources.

H.8.4.3 *Geology And Soils*

There could be very minor impacts to the soils due to erosion during construction. The area of temporarily disturbed soil would be 8,947.4 square meters (96,312 square feet) (PC 1995:Table 2). Mitigation measures, such as sediment traps, diversion of surface water runoff from the construction area, dikes, silt fences, and covering the disturbed area with rip rap would be used to minimize soil erosion.

H.8.4.4 *Water Resources*

Water use is expected to remain at its current level of 10,400,000 liters per year (2,779,000 gallons per year). The generation of wastewater is also expected to remain at its current level of 9,170,000 liters per year (2,449,000 gallons per year) (PC 1995:Table 3). The facility construction site is not located within a known, playa-associated 100-year floodplain (DOE 1994a:I-27).

H.8.4.5 *Air Quality*

Airborne particulate matter (i.e., dirt and equipment emissions) levels would be elevated during the construction period. This facility is expected to generate the same types and quantities of air emissions as the existing facilities it would replace. Therefore, there would be no changes in the impacts from current operational levels (PC 1995:Table 3).

H.8.4.6 *Acoustics*

Noise levels would temporarily increase during construction from operation of heavy construction equipment such as graders, cement mixers, and construction vehicle traffic. During waste handling operations, noise would be emanating from forklift operations and loading dock operations. Local worker and transportation traffic would contribute to the ambient noise in the area. The majority of the noise sources are expected during the operation of the heating, ventilation, and air conditioning system, computer systems, and analytical equipment (DOE 1994a). The operational areas design will include noise controls pursuant to Occupational Safety and Health standards (29 CFR 1910.95).

H.8.4.7 *Biotic Resources*

Flora and fauna that currently use the facility construction site would be permanently removed or displaced by construction. The facility is sited in accordance with the *Pantex Plant Site Development Plan* (DOE 1995c; DOE 1994a:I-35). The site represents an already disturbed area and no measurable impacts to biotic resources are anticipated.

H.8.4.8 *Cultural Resources*

The facility is sited in accordance with the *Pantex Plant Site Development Plan* (DOE 1995c; DOE 1994a:I-35). The facility would be located in an already disturbed area and no impacts to cultural resources are anticipated.

No decisions have been made regarding the use of existing facilities which may qualify as historic resources. The decision to reuse, modify, or demolish will be addressed in future NEPA documentation.

H.8.4.9 *Socioeconomic Resources*

The construction cost of this facility would be approximately $11.5 million. Construction of the facility is expected to employ 11 to 60 short-term employees (PC 1995:Table 1) and would probably result in a small temporary increase in local employment. A substantial portion of the material costs would enter the wholesale and retail trade sector of the regional economy. This facility is designed for an estimated 48 employees; no new employees are expected. Employees working in existing facilities would be relocated to work in new facilities (PC 1995:Table 3).

H.8.4.10 *Transportation*

The construction of this facility would result in a temporary increase in onsite and area traffic during a 24-month period. Normal day shift work hours, Monday through Friday, are expected. However, since Zone 12 includes the Material Access Area and conducts weapon operations and HE operations, some schedule changes can be expected due to workloads and HE safety issues. Since construction of the facility is in a Material Access Area, plant security personnel would accompany construction workers to and from the construction site. Material supplies would be transported through Building 16–15 Central Shipping and Receiving.

H.8.4.11 *Waste Management*

This facility is expected to generate the same types and quantities of wastes as the existing facility it would replace. Therefore, there would be no changes in the impacts from current levels (PC 1995:Table 3).

H.8.4.12 *Human Health Risks*

There are no radiation risks during construction, because construction activities would not involve the use of any radioactive materials or waste. Chemical human health risks during construction are mitigated through compliance with OSHA Chapter 1926 regulations and an approved project specific health and safety plan. The Contractor Safety and Health Program requires a written plan for approval by the Fire, Waste Management, Industrial Hygiene, and Safety Departments. The plan establishes permits for safety, excavation, fire department, radiation work, and hot work as necessary (Pantex 1992).

Potential sources of radiological exposures during operation are expected. Potential sources of chemical exposures during operations would be from chemicals and materials used in analysis of materials. Personal protective clothing, shielding and equipment (e.g. ventilation hoods) would be used to mitigate the potential health risks. Human health risks associated with all plant activities are presented in section 4.14.

H.8.5 No Action Alternative

One of the alternatives to the construction of the Metrology and Health Physics Calibration and Acceptance Facility is the continued use of decentralized facilities. Administrative controls will continue to provide security and employee safety where facility designs are inadequate. Tritium monitor calibration process emissions will continue at 7 millicuries per year (50 percent greater than a new facility).

H.8.6 Move to an Existing Facility Alternative

Operations are currently decentralized, as discussed in section H.8.5. If a suitable facility is identified, it would be required to meet all present environment codes and regulations, and pollution control standards. The facility would be required to utilize design features and administrative controls to protect employees and the environment. However, according to the Conceptual Design Report, there are no existing operations which could be relocated to accommodate the calibration and storage activities without severely impacting assembly/disassembly operations (DOE 1994a:I-12 through I-15).

H.8.7 Alternatives Eliminated from Detailed Study

Two alternatives were eliminated from the detailed study. The first alternative was the use of existing plant temporary facilities or the acquisition of new temporary facilities. At best, this would be only a temporary solution that would delay the required facility. Use of the temporary facilities was not considered feasible due to both technical and safety considerations. Facilities would have to be arranged together in an efficient geographic location to negate the need for all functions in one building. The required environmental controls to provide personnel protection from the radiation emitted from radioactive sources used for gamma and neutron monitor calibrations would be very difficult to maintain in temporary facilities.

The second solution would be to use outside contractors. This option has been partially adopted but is considered only a temporary measure. Under this alternative, uncleared individuals would have access to the Health Physics instrumentation. Shipping of equipment could lead to additional costs incurred due to losses or damage, additional instrumentation requirements and associated

maintenance. In addition, use of outside contractors could result in extended turnaround time. To ensure that the calibrations are performed correctly and that the instruments are not damaged in transit, a significant amount of capability would still be needed for onsite verification of proper instrument response upon their return (DOE 1994a:I-12 through I-15).

REFERENCES

29 CFR 1910 — Office of the Secretary of Labor, "Occupational Safety and Health Standards", *Code of Federal Regulations,* Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC.

10 CFR 435 — DOE, "Energy Conservation Voluntary Performance Standards for New Buildings; Mandatory for Federal Buildings, *Code of Federal Regulations*, Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington DC.

40 CFR 264 Subparts A,C,D — EPA, "Standards for Owners and Operators of Hazardous Waste Treatment Storage and Disposal Facilities", *Code of Federal Regulations,* Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC.

40 CFR 264 Subparts AA, BB, CC — EPA, "Standards for Owners and Operators of Hazardous Waste Treatment Storage and Disposal Facilities", *Code of Federal Regulations,* Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC.

40 CFR 264 — EPA, "Standards for Owners and Operators of Hazardous Waste Treatment Storage and Disposal Facilities", *Code of Federal Regulations,* Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC.

Battelle 1995 — Battelle, *Draft Reference Document for the Hazardous Waste Treatment and Processing Facility*, Version 1.0, prepared for Pantex Plant, Amarillo, TX, April 1995.

DOD 6055.9 — DOD 6055.9 STD "DOD Ammunition and Explosives Safety Standards," October 1992.

DOE 1991 — DOE, *Explosive Safety Manual*, October 1991, DOE/EV/06194.

DOE 1993 — DOE, *Environmental Assessment for Hazardous Waste Staging Facility, Pantex Plant, Amarillo, TX,* Project No. 39GF71024-GPD121000000, prepared by Mason and Hanger-Silas Mason Company, Inc., Amarillo, TX, for the U.S. Department of Energy, June 1993.

DOE 1994 — DOE, *Conceptual Design Report, Part I-Design Concept, Part II-Project Management Plan, Facilities Capability Assurance Program (FCAP) Non-Destructive Evaluation Facility, Pantex Plant,* Project No. 88-D-122 (97-AA-02), prepared by Mason & Hanger-Silas Mason Company, Inc., for the U.S. Department of Energy, Amarillo Area Office, Amarillo, TX, December 1994.

DOE 1994a — DOE, *Conceptual Design Report, Metrology Health Physics Calibration and Acceptance Facility Pantex Plant,* Volume I of II, prepared by Mason & Hanger-Silas Mason, Company, Inc., for the U.S. Department of Energy, Amarillo Area Office, Amarillo, TX, October 1994.

DOE 1994b — DOE, *Conceptual Design Report, Materials Compatibility Assurance Facility Pantex Plant,* Authorization No. A37, prepared by Mason & Hanger Engineering Inc., managed by Mason & Hanger-Silas Mason, Company, Inc., for the U.S. Department of Energy, Amarillo Area Office, Amarillo, TX, April 1994.

DOE 1994c — DOE, *Revised Draft Environmental Assessment, Pit Reuse Project, at the Pantex Plant, Amarillo, TX,* prepared for the U.S. Department of Energy, Albuquerque Operations Office, Amarillo Area Office, Pantex Plant, Amarillo, TX, March 1994.

DOE 1994d — DOE, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*, DOE-STD-1020-94, U.S. Department of Energy, Washington, DC, April 1994.

DOE 1995 — DOE, *Conceptual Design Report, Hazardous Waste Treatment and Processing Facility,* Project #92–D–172, Volume I and II, prepared by Mason & Hanger-Silas Mason Company, Inc., Amarillo, TX, for the U.S. Department of Energy, Amarillo, TX 1995.

DOE 1995a — DOE, *Conceptual Design Report, Gas Analysis Laboratory Pantex Plant,* Authorization No. A36, prepared by Mason & Hanger Engineering Inc., managed by Mason & Hanger-Silas Mason, Company, Inc., for the U.S. Department of Energy, Amarillo Area Office, Amarillo, TX, January 1995.

DOE 1995b — DOE, *Conceptual Design Report, Pit Reuse Facility, Pantex Plant,* Authorization No. A56, Volumes I and II, prepared by Mason & Hanger-Silas Mason Company, Inc., Amarillo, TX, for the U.S. Department of Energy, Amarillo Area Office, Amarillo, TX, January 1995.

DOE 1995c — DOE, *FY 1995 Pantex Plant Site Development Plan,* prepared under Contract DE-AC04-91AL-65030, by Mason & Hanger-Silas Mason Company, Inc., Amarillo, TX, for the U.S. Department of Energy, Amarillo, TX, 1995.

DOE 1995d — DOE, *Environmental Assessment for the Operation of the Glass Melter Thermal Unit at the U.S. Department of Energy's Mound Plant*, Miamisburg Area Office, Miamisburg, OH, June 1995.

DOE 1995e — *Pantex Plant Federal Facility Compliance Act Agreed Order Site Treatment Plan-Compliance Plan*, September 1995 (approved October 3, 1995, revised August 1996).

DOE 1996 — DOE, *Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*, Volume I, prepared under Contract DOE/EIS-0236 for the Department of Energy, February 1996.

DOE Order 5480.11 — DOE, "Radiation Protection for Occupational Workers", Washington, DC, December 21, 1988, Revised June 17, 1992.

DOE Order 5480.7A — DOE "Fire Protection", Washington, DC, February 17, 1993.

DOE Order 6430.1A — DOE, "General Design Criteria", Washington, DC, April 6, 1989.

EO 11988 — Office of the Federal Register, National Archives and Records Administration, "Floodplain Management", *Codification of Presidential Proclamations and Executive Orders*, Executive Order 11988, Government Printing Office, Washington, DC, April 13, 1945–January 20, 1989.

EO 12003 — Office of Federal Register, National Archives and Records Administration, "Energy Conservation", *Codification of Presidential Proclamations and Executive Orders,* Executive Order 12003, Government Printing Office, Washington, DC.

EO 12902 — Office of the Federal Register, National Archives and Records Administration, "Energy Efficiency and Water Conservation at Federal Facilities", *Codification of Presidential Proclamations and Executive Orders,* Executive Order 12902, Government Printing Office, Washington, DC, March 8, 1994.

Pantex 1992 — Pantex Plant, *Contractors Safety and Health Program Brochure,* prepared by the Safety Department, Amarillo, TX, September 1992.

Pantex 1996 — Pantex Plant, *Programmatic Information Document*, prepared for the U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM, September 1996.

Pantex 1996a — Pantex Plant, *Environmental Information Document*, prepared for the U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM, October 1995 (2nd Revision).

PC 1995 — Lincoln, M., "Data Needs for the New Projects at Pantex Plant", SWEIS request for information supplied by Michelle Lincoln, Battelle Pantex, May 17, 1995.

PC 1996 — Zimmerman, T., Smaller Version-HWTPF Information, SWEIS request for information supplied by Terry Zimmerman, DOE Amarillo Area Office, September 25, 1996.

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APPENDIX I

Soil Quality Analysis

APPENDIX I
SOIL QUALITY ANALYSIS

This appendix supplements the information presented in the Soil and Sediment Quality at Solid Waste Management Units and 1994 Annual Soil and Sediment Sampling, section 4.5.1, Affected Environment for Geology and Soils.

I.1 SOIL QUALITY

I.1.1 Soil and Sediment Quality at Solid Waste Management Units

Resource Conservation and Recovery Act (RCRA) Facility Investigations (RFIs) are currently being conducted at Pantex Plant, as described in section 4.5.1.3 in volume I. The RFIs include characterization of the nature and extent of contamination at a number of Solid Waste Management Units (SWMUs) associated with the 14 waste release site groupings that have been identified at Pantex Plant. Table I.1.1–1 summarizes the SWMUs contained in each grouping and provides a brief description (Pantex 1996:15.1). RFIs have been completed for 5 of the 14 groupings, which include AL–PX–01 (Burning Ground), AL–PX–02 (High Priority Potential Release Sites), AL–PX–06 (Zone 12 Groundwater), AL–PX–08 (Ditches and Playas), and AL–PX–12 (Miscellaneous Chemical Spills/ Releases). Table I.1.1–2 summarizes the actions taken and recommendations from the five completed RFIs. (All tables are presented after the text.)

I.1.2 1994 Annual Soil and Sediment Sampling

Soil quality data were reviewed to evaluate the current soil quality at Pantex Plant Site and to compare current soil quality with historical data. This section presents the data and discusses the results of routine and nonroutine (special request) surface soil surveillance at Pantex Plant. The routine soil surveillance program plays an important role in assessing the potential environmental impacts of operations at Pantex Plant. Soil surveillance provides a direct measure of environmental contamination because soil accumulates contaminants that are deposited from the air over time. Thus, soil surveillance allows evaluation of long-term trends (DOE 1995b:12-1). This sampling program is conducted on an annual basis and is separate from the environmental restoration programs which deal specifically with SWMU sampling conducted under RCRA and the *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA) as discussed in section 4.5.1, Soil and Sediment Quality at Solid Waste Management Units.

I.1.2.1 *Overview of Methods*

From 1988 to 1993, 19 onsite and 32 offsite soil samples were collected annually in five different "routine" areas and analyzed for radionuclides, as summarized in Table I.1.2.1–1. The five areas included Firing Sites 4, 5, and 10, the Burning Ground, and offsite sampling locations. Figures I.1.2.1–1, I.1.2.1–2, and I.1.2.1–3 present the sampling locations. It should be noted that the soil data collected between 1988–1993 do not necessarily include every sample location for each year (DOE 1995b:12-1 through 12-4).

The soil data collected for radionuclides were compiled, summarized, and distributed annually in the *Environmental Report for Pantex Plant* (also referred to as Annual Site Environmental Report [ASER]) (DOE 1995b). From 1988 to 1992, beryllium was the only non-radiological

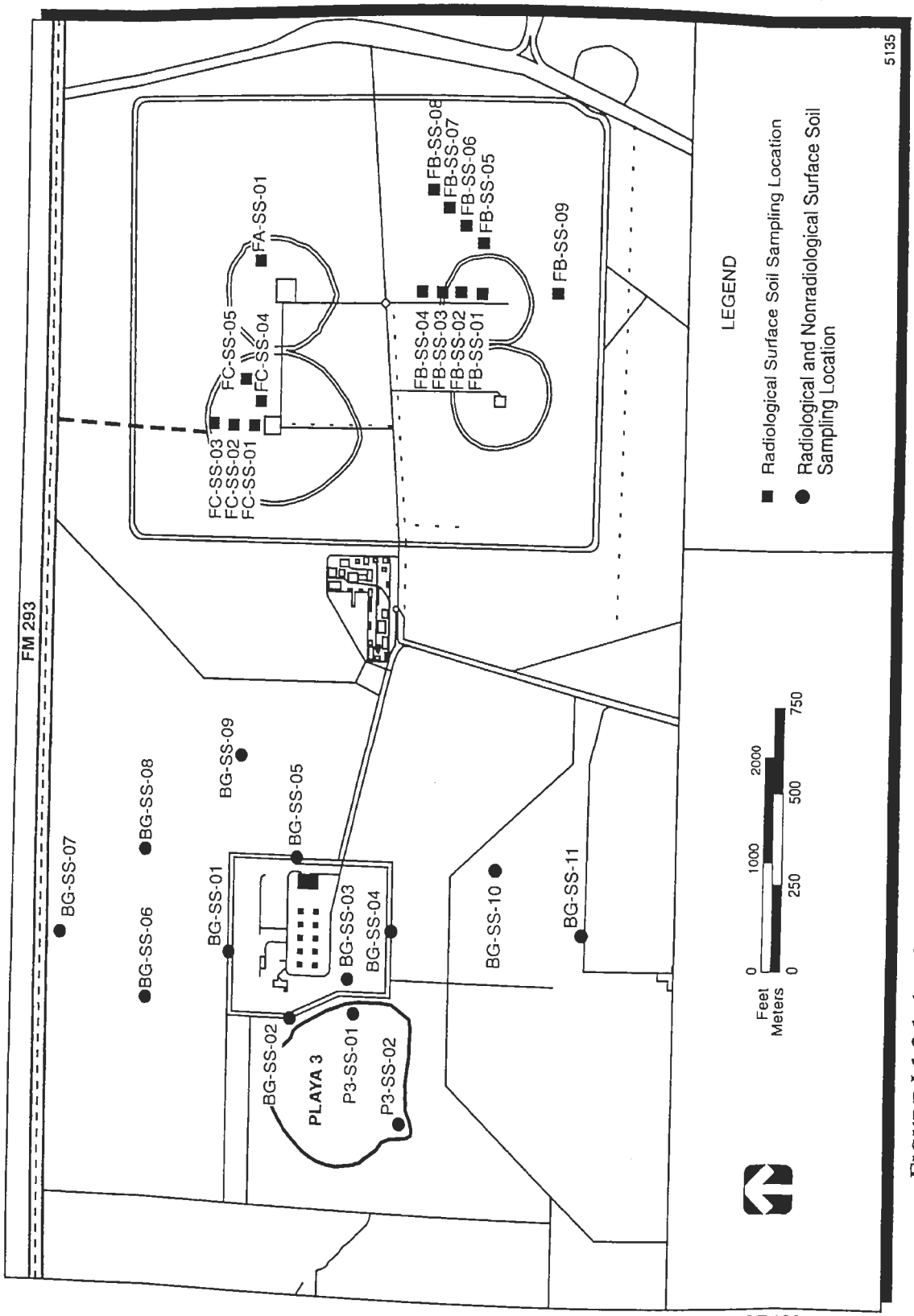
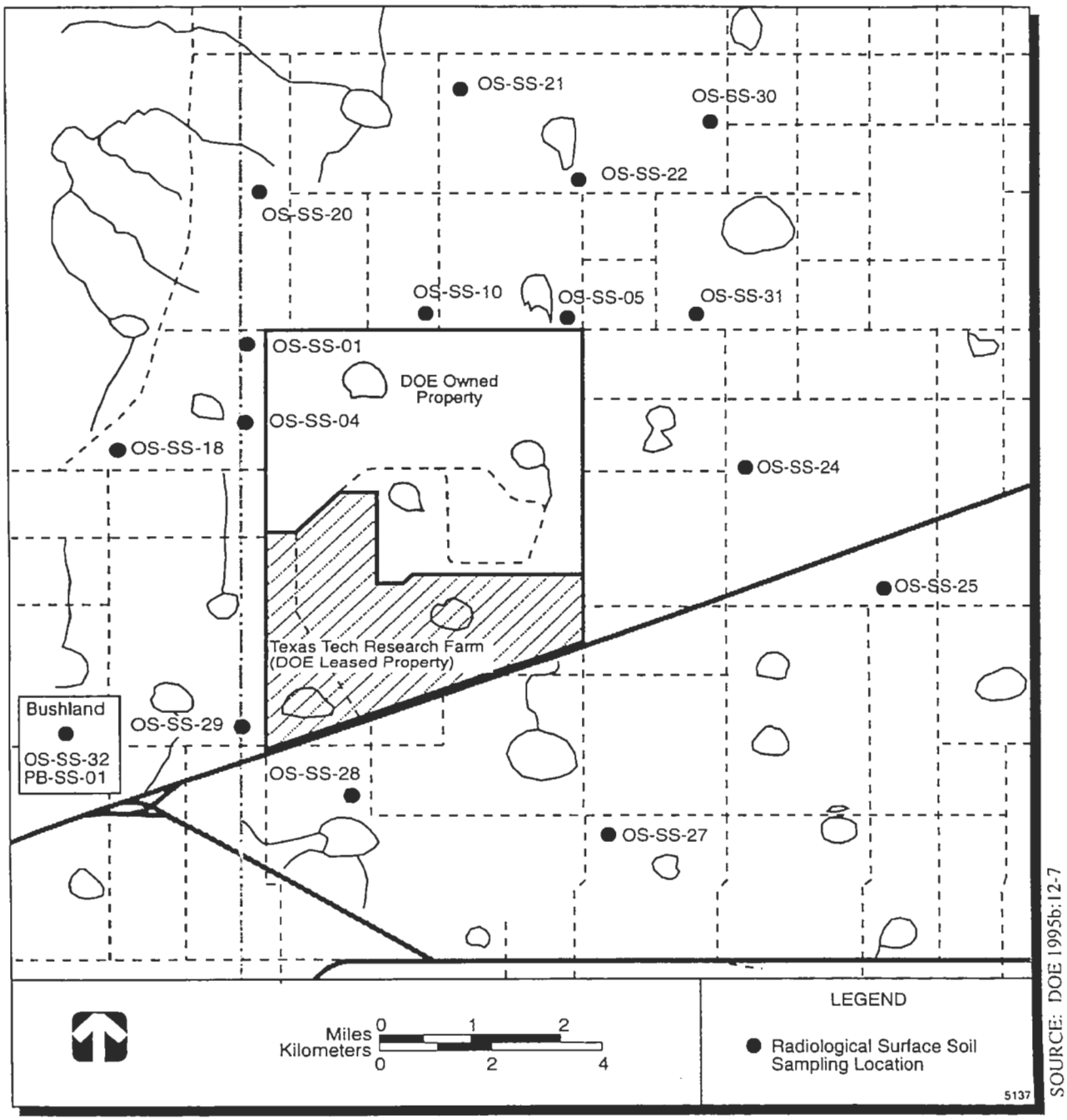


FIGURE I.1.2.1–1.—*Sampling Locations in the Vicinity of the Firing Sites and Burning Ground.*

SOURCE: DOE 1995b:12-6



SOURCE: DOE 1995b:12-7

FIGURE I.1.2.1–2.—*Offsite Soil Sampling Locations.*

TABLE I.1.1–1.—*Pantex Solid Waste Management Units and Areas of Concern Grouped by Operable Unit*

WASTE SITE	UNIT NAME/DESCRIPTION
AL-PX-1, Burning Ground	
SWMU 47	Evaporation Pit
SWMU 14-27	Burn Pads
SWMU 37-44	Landfills
AL-PX-2, High Priority Potential Release Sites	
SWMU 11	Surface Impoundment in Zone 5
SWMU 13	Former Surface Impoundment, Building 11-51
SWMU 109	Releases from Building 12-68, Outside Stump
SWMU 136	Subsurface Leaching Beds, Building 12-59
SWMU 139	Photoprocessing Leaching Bed at FS-10
AOC 12	Building 12-5D, Paint Shop Area
Unnumbered	FS-1, FS-22, FS-24
AL-PX-3, Former Cooling Tower	
AOC 13	Former Cooling Tower in Zone 12
AL-PX-4, Old Sewage Treatment Plant (OSTP) Sludge Beds	
SWMU 140	OSTP Sludge Beds
AL-PX-5, Fire Training Area Burn Pits	
AOC 11	Fire Training Area Burn Pit
AL-PX-6, Zone 12 North Groundwater	
Unnumbered	Potential TCE and Chromium in Perched Water/Unknown Source
AL-PX-7, Landfills	
SWMU 54-66	Construction Debris Landfills
SWMU 68a, b, c	Original, Landfill 1, Landfill 2
SWMU 68d	Sanitary Landfill-Hazardous Waste Staging Area
AL-PX-8, Ditches and Playas	
SWMU 1	Drainage Ditch, Building 12-17
SWMU 2	Drainage Ditch, Building 12-43
SWMU 3	Drainage Ditch, Building 11-44
SWMU 4	Drainage Ditch, Building 11-50
SWMU 5	Drainage Ditch, Other (Buildings 12-41, 12-19, Zones 11 and 12)
SWMU 6	Playa 1
SWMU 7	Playa 2
SWMU 8	Playa 3
SWMU 9	Playa 4
SWMU 10	Pantex Lake
SWMU 12	Former 11-14 Pond (Discharge to Ditch) (Inactive), and Pipeline from Building 11-36 to Pond

TABLE I.1.1–1.—*Pantex Solid Waste Management Units and Areas of Concern Grouped by Operable Unit*-Continued

WASTE SITE	UNIT NAME/DESCRIPTION
AL-PX-13, Supplemental/Verification Sites	
Unnumbered*	Denuded Area
Unnumbered*	Zone 11 Parallel Depressions
Unnumbered*	Old Pistol Range
Unnumbered*	Abandoned Zone 10 Landfills
Unnumbered*	Unnumbered Zone 7 Landfills
Unnumbered*	Landfill East of 11-13 Pad (Debris from Buildings 11-12 and 11-13)
Unnumbered*	Magazine Demolition Debris Landfills, Zones 4 and 5
SWMU 67*	Carbon Black Burial Area, Zone 10
AL-PX-14, USTs at Other Locations	
UST 9	Building 12-17 East
UST 7	Building 12-58
UST 38	Building 12-98
UST 39	Building 12-84
SWMU 133	Waste Oil Tank at Building 16-1

SWMU = solid waste management unit identified by the RCRA facility assessment, visual site inspection (VSI), January 1989.
AOC = areas of concern identified in above VSI as modified and added to at meeting with EPA on November 1, 1989.
UST = Underground Storage Tank
*Not identified as a SWMU to be investigated, but included because investigation may be warranted.
Source: Pantex 1996:15.0

TABLE I.1.1–2.—*RCRA Facility Investigation Summary Information for Solid Waste Management Units*-Continued

ALL–PX	SWMU/AOC/MISC	STATUS	ACTIONS TAKEN	RECOMMENDATIONS
AL–PX–03	AOC 13: Former Cooling Tower in Zone 12	Draft RFI completed October 1993.	Five borings drilled to depths of 50 to 60 feet below the ground surface. One boring drilled to a depth of 298 feet below ground surface and completed into a monitoring well as part of the Zone 12 Groundwater Investigation (AL–PX–06). Chemical and physical samples were collected from each boring at incremental depths. Results evaluated to determine contamination present in near-surface and subsurface soils; low levels of metals, VOCs, semivolatile organic compounds (SVOCs), and HEs found. Treatability Study fieldwork began in May 1996; soils to be analyzed for total and hexavalent chromium.	Recommended for NFA; attainment of Risk Reduction Standard (RRS) 1 or 2, as applicable, achieved. Regulatory approval is pending. Treatability/remediation activities will continue into 1997.

TABLE I.1.1–2.—*RCRA Facility Investigation Summary Information for Solid Waste Management Units*-Continued

ALL–PX	SWMU/AOC/MISC	STATUS	ACTIONS TAKEN	RECOMMENDATIONS
AL–PX–04	SWMU 140: Old Sewage Treatment Plant Sludge Beds	Draft RFI completed June 1994.	Two samples were taken from each of the six sludge bed cells, one from near each inlet and one from near each outlet, for a total of 12 samples. These samples were taken at depths of 0.3 to 1.5 feet above the concrete flooring, and analyzed for VOCs, SVOCs, HEs, metals, pesticides, and PCBs. Seven subsurface borings were drilled to depths of 31.5 to 33 feet below ground surface; 35 samples were analyzed for the same contaminants as surface samples.	Corrective Measures Study for OSTP Sludge Beds and adjacent subsurface soils is not recommended. No polychlorinated biphenyls (PCBs), SVOCs, or pesticides were detected above their quantification limits in subsurface soil samples. No HEs were detected in laboratory analysis of the borings. Recommended for NFA. Regulatory approval is pending.
AL–PX-05	AOC 11: Fire Training Area Burn Pits	Draft Final Closure Report completed November 1995.	ICM completed in July 1995. Removed the top two feet of soil and backfill and replaced with clean topsoil.	Draft Final ICM Closure Report submitted to TNRCC in November 1995.

TABLE I.1.1–2.—*RCRA Facility Investigation Summary Information for Solid Waste Management Units*-Continued

ALL–PX	SWMU/AOC/MISC	STATUS	ACTIONS TAKEN	RECOMMENDATIONS
AL–PX–06	Zone 12 North Groundwater	Draft RFI completed November 1995.	Characterization of both the groundwater contamination and the source (various SWMUs). A dual phase groundwater extraction/soil vapor extraction treatability system has been installed and implemented to determine the feasibility of several remediation options, including pump and treat, soil vapor extraction of the vadose and dewatered zones, and oxygen augmentation of the vadose and dewatered zones. Injection began in April 1996; initial results indicate that the system is injecting 42,000 gallons/day of treated water into the injection well.	Burning Ground: The presence of contaminants at depth in soil borings indicates a possibility of contaminant leaching into the perched aquifer with time. High Priority Potential Release Sites: The low concentrations and shallow depth of the contamination found during this investigation make it unlikely that any of the sites have contributed to Zone 12 Groundwater contamination. Former Cooling Tower: This area is unlikely to be a significant source of contaminants to Zone 12 Groundwater. Old Sewage Treatment Plant Sludge Beds: Unlikely to be a significant source of contaminants to Zone 12 Groundwater. Fire Training Area Burn Pits: Because of the shallow nature of contamination at this site, it has been concluded that the contamination does not pose a likely threat to Zone 12 Groundwater. Landfills: The findings for Landfill 3 (SWMU 54) identified possible sources of groundwater contamination. Ditches and Playas: Areas of Pantex Plant that may affect Zone 12 Groundwater include areas drained by Flow Systems 1 and 4. Firing Sites: It has been determined that the existing contamination has limited vertical extent and poses little risk to Zone 12 Groundwater. Leaking UST Sites at Buildings 12–35 and 16–1: Benzene has been detected at concentrations of concern in well PTX10–1013 near Building 12–35. Miscellaneous HEs/Radiation Sites: HEs have been detected at depths approaching 100 feet. The vertical extent of contamination has not been determined in the area of Buildings 12–24 and 12–43. These areas may be potential sources of HE contamination in the groundwater. Miscellaneous Chemical Spills/Release Sites: Contamination has been determined to be of a surficial nature that poses little threat to Zone 12 Groundwater. Supplemental Verification Sites: Based on the shallow nature of the contamination, these sites pose little threat to Zone 12 Groundwater. USTs at Other Location: The limited extent and low concentration of contamination at these UST sites have been determined to pose no present or future threat to Zone 12 Groundwater. Hypalon Pond: Several inorganic and organic constituents were found in the soil in excess of closure plan target levels. Low concentrations of 1,2-dichloroethane and trichloroethane were detected at similar concentrations in other Pantex Plant groundwater monitoring wells located upgradient of the 11–14 Pond. Therefore, the constituents detected in the groundwater do not appear attributable to the pond operations.

TABLE I.1.1–2.—*RCRA Facility Investigation Summary Information for Solid Waste Management Units*-Continued

ALL–PX	SWMU/AOC/MISC	STATUS	ACTIONS TAKEN	RECOMMENDATIONS
AL–PX-07	Landfills	Draft Final RFIs completed: June 1995 (Group I Landfills); January 1996 (Group II Landfills); June 1996 (Group III Landfills).	Pending TNRCC response.	Recommendation for NFA for Landfill Nos. 4 and 11 (Group I) was submitted to TNRCC on June 28, 1995. A Draft Final RFIR recommending NFA for Landfills 5, 6, 7, 9, 10, 12, and 15 (Group II) was submitted to TNRCC on January 15, 1996. A Draft Final RFIR for Landfills 1, 2, 3, 13, Original, Abandoned Zone 10, and Sanitary Landfills (Group III) was submitted to TNRCC in June 1996. This RFIR recommended NFA for many of the landfills; however, Landfill 3 may require additional corrective measures.
AL–PX–08	Ditches and Playas	Draft RFI completed September 1995.	Compilation of all data relevant to ditches and playas; evaluation of contaminants of potential concern; and determination of analytes of potential concern, contaminants of concern (COC), the nature and extent of contamination, and further action areas.	Flow System 1, Flow Pathway 1A: Several inorganic and organic COCs were detected in concentrations exceeding the cleanup criteria. Many of these exceedances were found in the source area near Building 11–44. For many of these COCs, contamination extends from this area downstream to SWMUs 12 and the western ditch of SWMU 5/13. Flow Pathway 1B: Several COCs were determined to be present at levels reasonably exceeding the cleanup criteria in SWMU 5/1. However, the contamination does not appear to have migrated very far downstream and, therefore, no further action is necessary for SWMU 5/13. Flow Pathway 1C: COCs include inorganics, pesticides, PCBs, SVOCs, and HE. For several portions of this flow pathway, further action is recommended in conjunction with building closures in those areas. In some cases, there is insufficient information to determine the extent of contamination above the decision criteria; additional sampling may be necessary. Playa 1A Area: Further action is recommended for inorganics and pesticides. Flow System 2: No further action is recommended due to the fact that no target analytes exceed the cleanup criteria. Flow System 3: Contaminants in areas requiring further action are barium and thallium in concentrations reasonably above the cleanup criteria. Further action is recommended for SWMU 8 (Playa 3). Flow System 4: Contaminants in areas requiring further action include chromium, cadmium, and antimony at SWMU 5/6; chromium and antimony at SWMU 5/8; antimony at SWMU 5/9; SWMU 5/15, portions of SWMU 5/12 that flow to Playa 4; and vanadium and antimony at SWMU 5/11. Further action is required for chromium in Playa 4. Flow System 5: Contaminants in areas requiring further action are chromium and mercury in SWMU 5/10; and antimony, cadmium, and chromium at several locations in SWMU 10 (Pantex Lake).
AL-PX-09				

TABLE I.1.1–2.—*RCRA Facility Investigation Summary Information for Solid Waste Management Units*-Continued

ALL–PX	SWMU/AOC/MISC	STATUS	ACTIONS TAKEN	RECOMMENDATIONS
AL–PX–10	Leaking Underground Storage Tanks	Draft Final Corrective Action Plan completed in October 1994.	Five USTs removed from Building 12–35 in 1988 and two USTs were removed from Building 16-1 in 1989. Benzene levels below the site in the perched aquifer exceed RRSs and will be addressed in the Zone 12 groundwater assessment.	Recommend NFA.
AL–PX–11	Miscellaneous Explosive/Radiation Sites	Draft Final RFIR completed in January 1996. Final RFIR to be completed after comments have been received.	An expedited ICM and hotspot activities will begin in October 1996. A feasibility study will be conducted for treatment of HE-contaminated soil followed by an insitu treatability study scheduled for last quarter 1996 and first quarter 1997.	Following successful completion of the feasibility study, and with TNRCC approval, appropriate further recommendations will be proposed.
AL–PX–12	SWMU 84	Draft RFI completed August 1995 and is currently under review by TNRCC.	Soil gas surveys, sediments sampling, surface and subsurface soil sampling.	Additional characterization of PCBs to the immediate north and west of PTX12–2004 is recommended to define surface soil impacts.
	SWMU 143		Soil gas surveys, sediments sampling, surface soil sampling, and soil borings.	This SWMU has not been characterized to background for several analytical groups, including pesticides, PCBs, and metals. Further sampling is recommended to define the extent of constituents identified. Leachability studies of the soils at this site may support NFA. Surface samples northwest of this SMWU should include PCB analysis.

TABLE I.1.1–2.—*RCRA Facility Investigation Summary Information for Solid Waste Management Units*-Continued

ALL–PX	SWMU/AOC/MISC	STATUS	ACTIONS TAKEN	RECOMMENDATIONS
AL–PX–12 (Continued)	SMWU 103		Soil gas surveys, sediments sampling, surface soil sampling, and soil borings.	No additional site characterization is recommended.
	AOC 14		Surface soil samples, shallow soil borings	Since extent of lead contamination is known, no additional site characterization is recommended. Leachability studies for lead could be used to support a subsequent recommendation for NFA.
	SMWU 113		Surface soil samples, soil borings	The extent of soil contamination by the Risk Drivers for the site has not been defined; therefore, additional site characterization is recommended. Since site is active, it is further recommended that any additional characterization be deferred until after operations cease.
	AOC 1		Sediment sampling, surface soil sampling, and soil boring	Additional surface soil samples are recommended to define lateral extent of PCBs.
	AOC 2		Investigation of past waste management practices.	Recommended for NFA and approved by TNRCC. Will not be considered further in the RFI/Corrective Measures Study (CMS) process.
	AOC 5		Sediment sampling, surface soil sampling, and shallow soil borings	No additional site characterization is recommended.
	Capacitor Bank Rupture in Zone 12		Sediment sampling, surface soil sampling, and soil borings	Recommended that no additional site characterization be conducted.
	AOC 3 (a)		Surface soil samples, and shallow soil borings	No further site characterization sampling is recommended. Leachability studies for soils are recommended at the site.
	AOC 3 (b)		Surface soil sampling, and shallow soil borings	Additional surface soil analysis using Synthetic Precipitation Procedure is recommended to define lateral extent of mercury and lead.
	AOC 7 (a)		Surface soil sampling, and soil borings	Recommended for NFA.
	AOC 7 (b)		Surface soil sampling, and soil borings	Recommended for NFA.
	AOC 7 (c)		Sediment sampling, surface soil sampling, and soil borings	Recommended for NFA.
	AOC 8 (a/b)		Soil gas survey, surface soil sampling, and soil borings	NFA recommended for Drum and Storage Pads 11–12 and 11–13 as drum storage areas. Any additional investigations can be more appropriately addressed under the Misc. HF/Radiation Release Sites RFI.

TABLE I.1.1–2.—*RCRA Facility Investigation Summary Information for Solid Waste Management Units*-Continued

ALL–PX	SWMU/AOC/MISC	STATUS	ACTIONS TAKEN	RECOMMENDATIONS
AL–PX–12 (Continued)	AOC 8 (c)		Soil gas survey, surface soil sampling, and soil borings	Recommended for NFA.
	AOC 8 (d)		Soil gas survey, sediment sampling, surface soil sampling, and soil borings	Recommended for NFA.
	AOC 8 (e)		Soil gas survey, surface soil sampling, and soil borings	No further characterization is recommended.
	AOC 10 (a)		Sediment sampling, surface soil sampling, and soil borings	Additional surface sampling is recommended for HE and pesticides to the north along the drainages, and to the south, east, and west of Buildings 12–43 and 12–43A. Subsurface sampling for pesticides is also recommended in the area. HE contamination should be addressed by Misc. HE/Radiation Release Sites RFI. No additional sampling is recommended for PCBs.
	AOC 10 (b)		Surface soil sampling, and soil borings	Additional site characterization is recommended to define the extent of pesticide contamination.
	AOC 15		Sediment sampling, surface soil sampling, and soil borings	Additional characterization is needed to define vertical and lateral extents of benzo(a)pyrene, benzo(a)anthracene, and benzo(b)fluoranthene. Additional characterization is needed to define the extent of pesticide contamination. Additional characterization is needed to determine lateral extent of PCB contamination.
	Evaporation Pits Near Bldg 11–20		Sediment sampling, and soil borings	No further characterization is recommended.
	Former Leaching Bed Near Bldg 11–36		Sediment sampling, surface soil sampling, and soil borings	No additional characterization is recommended for this site.
	Building 12–5 Sump		Surface soil samples and shallow subsurface soil samples	Collection of additional data is recommended to verify the Building 12–5 Sump as a source and to determine the extent of contamination. Additional surface soil samples should be analyzed for cadmium, chromium, and nickel, and leachability studies for surface soils are recommended for lead. Future investigations of this site will be addressed under the Ditches and Playas RFI.
AL–PX–13	Supplemental Verification Sites	Draft Final RFIR completed May 1996.		Recommend for NFA.

TABLE I.1.1–2.—*RCRA Facility Investigation Summary Information for Solid Waste Management Units*-Continued

ALL–PX	SWMU/AOC/MISC	STATUS	ACTIONS TAKEN	RECOMMENDATIONS
AL–PX-14	USTs at Other Locations			Recommend NFA for all USTs. Regulatory approval is pending.

Sources: Argonne 1995; EEI 1995; IT 1995; IT 1995a; Radian 1995; Pantex 1994

TABLE I.1.2.1–1.—*Radionuclide Sample Locations Collected from 1988 to 1993*

AREA OF SAMPLE LOCATIONS	NUMBER OF SAMPLE LOCATIONS IN THE AREA		
	URANIUM-234	URANIUM-238	PLUTONIUM-239/240
Firing Site 4	1	1	1
Firing Site 5	9	9	9
Firing Site 10	5	5	5
Burning Ground	4	4	4
Offsite	32	32	32

TABLE I.1.2.1–2.—*Number of Sample Locations for New Chemicals of Potential Concern and Non-Routine Sample Locations for Routine Chemicals of Potential Concern*

AREA OF SAMPLE LOCATIONS	NUMBER OF SAMPLE LOCATIONS IN THE AREA				
	RADIONUCLIDES[1]	TRITIUM	METALS[2]	EXPLOSIVES[3]	VOCs[4]
Firing Site 4	0	0	0	0	0
Firing Site 5	0	0	0	0	0
Firing Site 10	0	0	0	0	0
Burning Ground	7	10	10	10	0
Playa 1	2	0	0	0	0
Playa 2	1	0	0	0	0
Playa 3	2	2	2	2	NK[5]
Offsite	1	2[5]	2	2	NK[5]

[1]Radionuclides includes Uranium-234, Uranium-238, and Plutonium-239/240.
[2]Metals include aluminum, boron, cadmium, chromium, cobalt, copper, magnesium, manganese, molybdenum, mercury, nickel, silver, and zinc.
[3]Explosives include RDX, HMX, PETN, and TNT.
[4]VOCs include 1,1,1-Trichloroethane, 1,2-Dichloroethane, 1,2-Dichloropropane, Benzene, Bromomethane, Carbon Tetrachloride, Chlorobenzene, Chloroform, Ethylbenzene, Methylene Chloride, Perchloroethylene, Styrene, Toluene, Total Xylenes, Trichloroethylene, Trichlorofluoromethane, and Vinyl Chloride.
[5]NK = Not Known. Because all VOCs were non-detects, detailed information on sample locations were not provided.
Source: DOE 1995b; DOE 1994b

TABLE I.1.2.1–3.—*Summary of 1994 Concentration Averages and Historical Averages for Radionuclides in Soils*

AREA/ SAMPLE NO.	URANIUM–234				URANIUM–238				U-234:U-238 RATIO	PLUTONIUM 239/240				TRITIUM			
	1994 AVERAGE (pCi/g)		HISTORICAL AVERAGE[5] (pCi/g)		1994 AVERAGE (pCi/g)		HISTORICAL AVERAGE[5] (pCi/g)		1994 SITE AVERAGE	1994 AVERAGE (pCi/g)		HISTORICAL AVERAGE (pCi/g)		1994 AVERAGE (pCi/g)		HISTORICAL AVERAGE (pCi/g)	
Firing Site 4									0.21								
FA-SS-01	1.02	±0.16	4.96	±0.53	6.33	±0.60	35.8	±2.45		0.03	±0.03	0.01	±0.02	NS[3]		NS[3]	
Average			4.96	±0.53			35.8	±2.45									
Firing Site 5									0.21								
FB-SS-01	5.13	±0.55	3.86	±0.33	38.6	±3.30	26.2	±1.07		0.03	±0.02	0.01	±0.02	NS[3]		NS[3]	
FB-SS-02	0.84	±0.13	1.67	±0.21	5.36	±0.49	9.27	±0.62		0.04	±0.03	0.01	±0.02	NS[3]		NS[3]	
FB-SS-03	0.84	±0.13	1.36	±0.18	4.93	±0.47	6.93	±0.43		0.03	±0.02	0.02	±0.02	NS[3]		NS[3]	
FB-SS-04	0.9	±0.15	1.31	±0.17	5.85	±0.57	6.02	±0.36		0.03	±0.03	0.02	±0.02	NS[3]		NS[3]	
FB-SS-05	1.19	±0.17	3.09	±0.42	8.02	±0.71	20.7	±1.26		0.04	±0.03	0.01	±0.02	NS[3]		NS[3]	
FB-SS-06	0.49	±0.10	1.66	±0.18	2.4	±0.27	5.3	±0.40		0.03	±0.03	0.01	±0.02	NS[3]		NS[3]	
FB-SS-07	0.42	±0.09	0.99	±0.16	2.04	±0.23	3.25	±0.29		0.03	±0.03	0.01	±0.02	NS[3]		NS[3]	
FB-SS-08	0.35	±0.08	0.82	±0.14	0.92	±0.14	2.06	±0.22		0.03	±0.03	0.01	±0.02	NS[3]		NS[3]	
FB-SS-09	1.16	±0.16	3.01	±0.26	7.48	±0.68	18.8	±1.05		0.03	±0.03	0.01	±0.02	NS[3]		NS[3]	
Average			1.97	0.23			10.95	0.63				0.01	0.02				
Firing Site 10									0.43								
FC-SS-01	0.33	±0.08	0.85	±0.14	1.14	±0.17	2.11	±0.21		0.04	±0.05	0.02	±0.02	NS[3]		NS[3]	
FC-SS-02	0.21	±0.06	0.78	±0.13	0.44	±0.09	1.52	±0.19		0.03	±0.03	0.02	±0.02	NS[3]		NS[3]	
FC-SS-03	0.18	±0.06	0.85	±0.15	0.26	±0.07	1.28	±0.15		0.02	±0.03	0.02	±0.02	NS[3]		NS[3]	
FC-SS-04	0.59	±0.10	1.16	±0.16	2.91	±0.31	4.55	±0.32		0.02	±0.03	0.01	±0.02	NS[3]		NS[3]	
FC-SS-05	0.39	±0.09	1.77	±0.17	1.43	±0.19	12.3	±0.39		0.04	±0.03	0.01	±0.02	NS[3]		NS[3]	
Average			1.08[2]	0.15			4.35	0.25				0.02	0.02				
Burning Ground									1.03								
BG-SS-01	0.3	±0.07	0.55	±0.12	0.35	±0.07	0.7	±0.13		0.02	±0.02	0.01	±0.02	0.16	±0.56	NS[2]	
BG-SS-02	0.39	±0.08	0.56	±0.12	0.46	±0.08	0.64	±0.12		0.02	±0.03	0.01	±0.02	-0.03	±0.56	NS[2]	
BG-SS-03	0.34	±0.07	0.62	±0.13	0.34	±0.07	0.78	±0.14		0.05	±0.03	0.02	±0.02	NS[3]		NS[2]	
BG-SS-04	0.31	±0.07	0.67	±0.14	0.33	±0.07	1.14	±0.15		0.04	±0.03	0.02	±0.02	0.12	±0.61	NS[2]	

TABLE 1.1.2.1–3.—*Summary of 1994 Concentration Averages and Historical Averages for Radionuclides in Soils*-Continued

AREA/ SAMPLE NO.	URANIUM–234				URANIUM–238				U-234:U-238 RATIO	PLUTONIUM 239/240				TRITIUM			
	1994 AVERAGE (pCi/g)		HISTORICAL AVERAGE[5] (pCi/g)		1994 AVERAGE (pCi/g)		HISTORICAL AVERAGE[5] (pCi/g)		1994 SITE AVERAGE	1994 AVERAGE (pCi/g)		HISTORICAL AVERAGE (pCi/g)		1994 AVERAGE (pCi/g)		HISTORICAL AVERAGE (pCi/g)	
BG-SS-05	0.33	±0.09	FS[2]		0.42	±0.08	FS[2]			0.04	±0.04	FS[2]		0.13	±0.65	FS[2]	
BG-SS-06	0.49	±0.09	FS[2]		0.47	±0.09	FS[2]			0.03	±0.04	FS[2]		0.14	±0.49	FS[2]	
BG-SS-07	0.41	±0.08	FS[2]		0.42	±0.08	FS[2]			0.02	±0.03	FS[2]		0.06	±0.48	FS[2]	
BG-SS-08	0.52	±0.10	FS[2]		0.51	±0.09	FS[2]			0.03	±0.04	FS[2]		0.27	±0.54	FS[2]	
BG-SS-09	0.37	±0.08	FS[2]		0.4	±0.08	FS[2]			0.02	±0.03	FS[2]		0.23	±0.46	FS[2]	
BG-SS-10	0.48	±0.10	FS[2]		0.51	±0.10	FS[2]			0.01	±0.03	FS[2]		0.25	±0.56	FS[2]	
BG-SS-11	0.43	±0.09	FS[2]		0.44	±0.09	FS[2]			0.01	±0.03	FS[2]		0.11	±0.62	FS[2]	
Average			0.6	0.13			0.82	0.14				0.02	0.02	0.14	0.55		
Playa 1									1.30[4]								
P1-SS-01	0.73	±0.13	FS[2]		0.43	±0.09	FS[2]			0.02	±0.03	FS[2]		NS[3]		NS[3]	
P2-SS-02	1.44	±0.20	FS[2]		0.76	±0.13	FS[2]			0.02	±0.03	FS[2]		NS[3]		NS[3]	
Average	1.09	±0.17			0.595	0.11				0.02	±0.03						
Playa 2									0.59[4]								
P2-SS-01	0.28	±0.08	FS[2]		0.27	±0.07	FS[2]			0.05	±0.04	FS[2]		NS[3]		NS[3]	
Playa 3									0.86[4]								
P3-SS-01	0.49	±0.10	FS[2]		0.39	±0.09	FS[2]			0.03	±0.03	FS[2]		0.05	±0.57	FS[2]	
P3-SS-02	0.49	±0.10	FS[2]		0.46	±0.09	FS[2]			0.04	±0.04	FS[2]		0.12	±0.62	FS[2]	
Average	0.49	±0.10			0.43	±0.09				0.04	±0.04			0.09	±0.60		
Offsite Averaged	0.25	±0.07	0.61[6]	±0.12[6]	0.21	±0.07	0.64[6]	±0.12[6]	1.22	0.02	±0.03	0.01[6]	±0.02[6]	NS[3]		NS[3]	
Bushland									1.07								
OS-SS-32	0.35	±0.08	0.58	±0.11	0.33	±0.08	0.74	±0.11		0.02	±0.03	0.01	±0.02	0.16	±0.90	FS[2]	
PB-SS-01	0.32	±0.07	FS[2]		0.34	±0.07	FS[2]			0.03	±0.03	FS[2]		0.10	±1.04	FS[2]	

[1](±): Counting error at 95% confidence level.
[2]FS = first year sampled.
[3]NS = no sample collected.
[4]Ratios were not provided in the *1994 Environmental Report for Pantex Plant* (DOE 1995b). The most conservative ratio was calculated using 1994 sample averages.
[5]Historical averages were calculated using routine surveillance data from 1988–1993 provided in the *1994 Environmental Report for Pantex Plant*. (DOE 1995b)
[6]Averages were not provided in the *1994 Environmental Report for Pantex Plant* (DOE 1995b) and were calculated.
Source: DOE 1995b:12-8 through 12-14

13,485	±4,200
15,116	±5,600
16,050	±4,000
13,842	±3,300
15,342	±2,900

[illegible]	0.7	±0.1	20	±8.7
[illegible]	NC[1]		21	±9.1
±7	0.7			

NC[1]

NC[1]

21
22

TABLE I.1.2.1–6.—*Backup Calculations of Historical Averages[1] for Offsite Samples Including Bushland*

NO.	SAMPLE NO.	U-234 (pCi/g)		U-238 (pCi/g)		P-239/240 (pCi/g)	
		CONCENTRATION	DEVIATION	CONCENTRATION	DEVIATION	CONCENTRATION	DEVIATION
1	OS-SS-01	0.68	0.11	0.66	0.12	0.01	0.02
2	OS-SS-04	0.64	0.12	0.73	0.13	0.01	0.01
3	OS-SS-05	0.59	0.12	0.64	0.12	0.01	0.02
4	OS-SS-10	0.61	0.11	0.66	0.12	0.01	0.02
5	OS-SS-18	0.65	0.13	0.63	0.13	0.01	0.02
6	OS-SS-20	0.70	0.12	0.75	0.13	0.01	0.02
7	OS-SS-21	0.56	0.13	0.53	0.11	0.02	0.02
8	OS-SS-22	0.60	0.14	0.61	0.12	0.02	0.02
9	OS-SS-24	0.55	0.12	0.60	0.13	0.01	0.02
10	OS-SS-25	0.58	0.12	0.61	0.12	0.02	0.02
11	OS-SS-27	0.56	0.12	0.58	0.12	0.01	0.02
12	OS-SS-28	0.52	0.10	0.55	0.11	0.01	0.01
13	OS-SS-29	0.69	0.13	0.73	0.13	0.01	0.02
14	OS-SS-30	0.61	0.12	0.65	0.13	0.01	0.02
15	OS-SS-31	0.59	0.12	0.61	0.13	0.02	0.02
16	OS-SS-32	0.58	0.11	0.74	0.11	0.01	0.02
	PB-SS-01	n/a	n/a	n/a	n/a	n/a	n/a
	Averages[1]	0.61	0.12	0.64	0.12	0.01	0.02

[1]Averages were calculated.

Source: DOE 1995b:12-9 through 12-14

±1.45	1.97	
±0.14	1.08	
±1.71	0.67	
±0.27	FS[2]	
±0.09	FS[2]	
	FS[2]	
		±0.12[8]

| | | |

TABLE I.1.2.4–3.—*Summary of 1994 Results of Explosives in Soils*

AREA /SAMPLE NO.	HMX[4] (mg/kg)		RDX[5] (mg/kg)	PETN (mg/kg)	TNT (mg/kg)
"CLEANUP" LEVELS[2]					
Surf Soil (0'-2')	not determined		not determined	not determined	5.1
Subsurf Soil (2'-432')	not determined		not determined	not determined	5.1
RBCs[3]					
Industrial Levels	not determined		52	not determined	not reported
Residential Levels	not determined		5.8	not determined	not reported
BURNING GROUND					
1994 Mean Average	1.08	±0.78	NC[1]	NC[1]	NC[1]
1994 Mean Maximum	3.54	±2.47	NC[1]	NC[1]	NC[1]
PLAYA 3					
1994 Mean Average	NC[1]		NC[1]	NC[1]	NC[1]
1994 Mean Maximum	NC[1]		NC[1]	NC[1]	NC[1]
BUSHLAND					
1994 Mean Average	NC[1]		NC[1]	NC[1]	NC[1]
1994 Mean Maximum	NC[1]		NC[1]	NC[1]	NC[1]

[1]NC = mean was not calculated if fewer than four observations were above detection limits.
[2]"Cleanup" Levels are based on TNRCC Risk Reduction Standards (DOE 1994).
[3]EPA III - Risk Based Concentrations (RBCs): Soil Ingestion by Residential Standards (EPA 1995).
[4]HMX (High Melting Explosives) - Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazozine.
[5]RDX (Research Developed Explosives) - Hexahydro-1,3,5-trinitro-1,3,5-triazine.
Sources: DOE 1995b:12-20, 12-21; DOE 1994; EPA 1995

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APPENDIX J

Correspondence with Consulting Agencies

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APPENDIX J
CORRESPONDENCE WITH CONSULTING AGENCIES

This appendix includes correspondence between the U.S. Department of Energy and the agencies listed below. Copies of correspondence are attached.

Environmental Protection Agency, Region 6
Department of Interior, Fish and Wildlife Service (Arlington, TX Office)
Department of Interior, Office of Environmental Policy and Compliance
State of Texas, Office of the Governor, including input from:
- Texas Department of Health
- Texas Natural Resource Conservation Commission
- The University of Texas at Austin, and Texas A&M University
- Texas Parks and Wildlife Department
- Texas Historical Commission

State of Tennessee, Department of Environment and Conservation
State of New Mexico, Environment Department
State of Nevada, Department of Administration
Georgia Department of Natural Resources
Clark County, Department of Comprehensive Planning
All Indian Pueblo Council, Pueblo Office of Environmental Protection

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

JUN 2 8 1996

Ms. Nanette Founds
U.S. Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, NM 87185-5400

Dear Ms. Founds:

In accordance with our responsibilities under Section 309 of the Clean Air Act, the National Environmental Policy Act (NEPA), and the Council on Environmental Quality Regulations (CEQ) for Implementing NEPA, the U.S. Environmental Protection Agency (EPA) Region 6 office in Dallas, Texas, has completed its review of the U.S. Department of Energy (DOE) Draft Environmental Impact Statement (DEIS) for continued operation of the Pantex plant and associated nuclear component storage located at the existing Pantex facility near Amarillo, Texas.

EPA classifies your DEIS and proposed action as "EC-2," i.e., EPA has "Environmental Concern" and requests additional information. Although the EPA has no objections to the preferred action alternative, continued operation and storage at the Pantex site; we have identified some environmental concerns and are requesting additional information for clarification purposes. Our classification will be published in the Federal Register according to our responsibility under Section 309 of the Clean Air Act, to inform the public of our views on proposed Federal actions.

Detailed comments identifying our concerns and needed information are provided in an enclosure to assist you in preparation of the Final EIS. Should you have any questions, please contact the appropriate Regional Environmental Review Coordinator, Mike Jansky (EPA Region 6) at (214) 665-7451 or Dave Farrel (EPA Region 9) at (415) 774-1575, for assistance.

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We appreciate the opportunity to review the DEIS. We request that you send our office two (2) copies of the Final EIS at the same time that it is sent to the Office of Federal Activities (2251A), EPA, 401 M Street. S.W., Washington, D.C. 20460.

Sincerely yours,

Robert D. Lawrence

Robert D. Lawrence, Chief
Office of Planning and
Coordination

Enclosure

DETAILED COMMENTS
CONTINUED OPERATION OF PANTEX PLANT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

BACKGROUND:

Most nuclear weapons use a nuclear package with two assemblies: a primary assembly is used as the initial energy source while a secondary assembly provides additional explosive energy release. The primary assembly has a central core, called the "pit," surrounded by a layer of high explosives. A "pit" is typically composed of plutonium-239 and other materials. The Department of Energy (DOE) proposes to continue conducting nuclear weapons operations at the Pantex Plant and to increase the on-site interim storage levels of pits from 12,000 to 20,000 pits. The DEIS also evaluates relocation of some or all of the Pantex interim storage activities to 4 alternate sites. The alternative sites include: Savannah River Site near Aiken, South Carolina; the Nevada Test Site near Las Vegas, Nevada; Hanford Site near Richland, Washington; and the Manzano Weapons Area at Kirtland Air Force Base in Albuquerque, New Mexico.

GENERAL COMMENTS:

Pollution Prevention

The EPA would like to commend DOE for Appendix G in Volume II on pollution prevention and waste minimization. We find Appendix G to be comprehensive in scope, informative to the reader, and a model which other DOE NEPA documents may find beneficial.

Interim Storage

The DEIS makes reference to "interim storage"of plutonium pits at three DOE sites (Nevada; South Carolina; Washington State) and a Department of Defense site at Kirtland Air Force Base, New Mexico. However, the DEIS did not define what constitutes "interim storage," either a fixed period of years or decades, or until a permanent storage facility is approved, upgraded or built. If possible, the Pantex FEIS should define the minimum and maximum time limits expected by DOE for "interim storage" (we recognize the difficulty in this because nuclear storage projects often run into problems that delay their proposed timeliness).

Energy Efficiency and Water Conservation

EPA suggests that Appendix G should reference the requirements of Executive Order 12902, Energy Efficiency and Water Conservation at Federal Facilities (March 8, 1994), particularly for the 6 new construction projects at Pantex listed in Table 3.1.1.1-1 (gas analysis laboratory, materials compatibility assurance facility, etc.) Section 306 of Executive

Order 12902 contains specific requirements regarding the construction of new facilities owned by the United States. Additionally, the Final EIS would be strengthened if it could discuss whether this Executive Order has any implication on the proposed interim storage of plutonium pits in Nevada, South Carolina, New Mexico and Washington State in terms of energy and water conservation.

Plutonium Pit Weight

It would be helpful if the Final EIS could provide the tonnage of the 8,000 to 20,000 pits that would be relocated under the interim pit storage alternative. If allowable under the national security considerations, it is recommended that the FEIS quantify the weight in terms of plutonium, other nuclear material, and other constituents such as Resource Conservation and Recovery Act (RCRA) regulated hazardous waste.

PANTEX ALTERNATIVE
(EPA Region 6)

1. Page 4-57, second paragraph: In this paragraph and at other places in the text it is asserted that the discharge water from the plant meets the surface water quality permit requirements. Because it is acknowledged in the document that leakage from waterways and playas enters the ground, EPA guidelines for ground water quality are of concern here. Under EPA's "Strategy for the 90's" report of the Ground Water Task Force, the Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act (SDWA) are to be used as reference points in evaluating ground water quality. This draft EIS also recognizes the significance of these MCLs when it lists them as "decision criteria" for ground water analyses presented in Volume II. The requirements under the National Pollutant Discharge and Elimination System (NPDES) do not include all of the contaminants for which MCLs have been set for public water supply systems under the Safe Drinking Water Act and in many cases the limits set under NPDES are higher than those under the SDWA. Under these circumstances, we recommend that Pantex consider protecting the ground water by either lining the ditches and playas with impermeable materials or, alternatively, treating the effluent to the level required to maintain, or restore to, SDWA MCLs in the ground water. Discussion on this matter should be included in the Final Statement.

2. Page 4-62, last paragraph: The first bullet describes "unsaturated sands of the Blackwater Draw Formation and upper Ogallala" at the surface, but the diagram on page 4-64 indicates that the Blackwater Draw Formation consists of clay. This inconsistency should be clarified in the Final Statement.

3. Page 4-65, third paragraph: It is stated that the perched aquifer "exhibits radial flow." By way of clarification, the Final EIS should note that the flow is radial from Playa #1,

at NTS. The DEIS (Volume I, p. 5-16) states that earthquakes pose the greatest natural threat to storage of plutonium pits at NTS. The Cane Springs Fault was identified as the most significant seismic risk. However, the DEIS indicates that four faults in the NTS vicinity (Mine Mountain Fault, Carpetbag Fault, Yucca Flat Fault and Cane Spring Fault) "are capable of generating earthquakes of up to 0.85g," which is an 8.5 quake on the Richter scale.

According to the Tritium FEIS (Volume I, p. 4-117), the maximum credible earthquake on the Cane Spring Fault is expected to produce a peak acceleration of 0.67g, a 6.7 quake on the Richter scale. The Cane Springs Fault is three to five miles from the Device Assembly Facility.

The following comments relate to the proposed interim storage of plutonium pits at NTS in terms of seismic risk and the potential for ground water contamination should the plutonium pits be damaged in a quake:

1. The FEIS should recognize that the P-Tunnel at the NTS is due west of two parallel faults, the Carpetbag Fault approximately five miles away and the Yucca Fault approximately seven to ten miles away. The Tritium FEIS (Volume I, p. 4-117) describes both the Yucca and Carpetbag Faults as "capable faults," as defined by the Nuclear Regulatory Commission regulations 10 CFR Part 100, Appendix A. However, the Tritium FEIS reported that the "possible magni- tude, intensity, and acceleration of earthquakes along the Yucca and Carpetbag faults have not been estimated." The DEIS gives the impression that quakes along any of the four faults in the NTS area could have an 8.5 magnitude on the Richter scale (Volume I, p. 5-16).

EPA believes that the FEIS should provide more documentation as to potential ground water impacts should an earthquake harm the plutonium pit facility or render it inaccessible. In particular, we are concerned that DOE may have concluded that leaving the plutonium pits inside the P-Tunnel (should it collapse) may have less environmental impact than attempting to retrieve the pits from inside a collapsed P-Tunnel (due to wording in the Pantex DEIS that impacts to workers and the public from radionuclide releases would be "negligible" because the plutonium containers would be sealed inside the collapsed tunnel).

Additionally, potential NTS impacts to ground water such a scenario were not discussed in the Pantex DEIS. We recommend that the FEIS provide more information on the depth to ground water in the Device Assembly Facility and P-Tunnel areas and whether keeping plutonium pits in a collapsed tunnel may ultimately cause a migration of radioactivity to ground water.

The Pantex FEIS should discuss whether either of the areas is characterized by "perched water...at considerably shallower depths..." as described in the Tritium FEIS. If so, the Pantex FEIS should provide additional information on the ground water impacts that are reasonably foreseeable should the plutonium pits be damaged in a quake. The Pantex FEIS should also outline DOE's intentions regarding the retrieval of plutonium pits in such a situation, as well as, the feasibility of monitoring the pit storage facility. The DEIS (Volume I, p. 5-17) gives the impression that the plutonium pits would remain entombed.

2. We ask that the FEIS provide further discussion regarding the wording on p. 5-17 of Volume I that "Some mitigation of a tunnel collapse would be needed after a major seismic event. A separate assessment of the risk associated with the mitigation would be necessary..." The Pantex FEIS should better define what is meant by "some mitigation" and a "separate assessment" (would the separate assessment be a NEPA document?). The FEIS should discuss what risks would be analyzed in the separate assessment: radionuclide emissions, worker health and safety, ground water contamination, etc.

3. The Pantex Summary (Table S-2) identifies the environmental impacts associated with the alternative pit storage relocation sites. For NTS, the range of potential accident scenarios are limited to two: puncture of a pit due to a forklift accident and an aircraft crash. Potential seismic hazards at NTS are not recognized in Table S-2, as they were in Volume I. We, therefore, recommend that Table S-2 be modified to recognize NTS seismic hazards. Table S-2

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Stadium Centre Building
711 Stadium Drive East, Suite 252
Arlington, Texas 76011

2-12-94-I-030

February 13, 1995

Mr. Jerry S. Johnson
Assistant Area Manager for Projects and Environmental Management
P.O. Box 30030
Amarillo, TX 79120

Dear Mr. Johnson:

Per conversations on January 11 and 23, 1995, with John Sigler of Lamb Associates, Inc. and Denise Baker of my staff, we are providing the enclosed guidelines for preparation of a Biological Assessment as part of the on-going informal section 7 consultation process.

The Fish and Wildlife Service (Service) recommends the Department of Energy (DOE) request an updated list of federally endangered and threatened and candidate species. An updated list is required per 50 CFR §402.12(i) where "The Federal agency ... shall complete the biological assessment within 180 days after initiation (receipt of or concurrence with the species list)...". By letter dated December 8, 1993, the Service provided DOE with information and a list of federally listed endangered, threatened, and candidate species in response to their request dated November 23, 1993, to initiate informal consultation. The 180 day time frame to complete a BA has expired.

The Service also recommends that surveys be completed for the swift fox (*Vulpes velox*) a candidate category 2 species.

If you have any questions, please contact Jeff Reid or Denise Baker at (817) 885-7830.

Sincerely,

Robert M. Short
Field Supervisor

Enclosure

cc: DOE, Amarillo, TX (Attn: Vicki Loucks)

- Describe measures taken to avoid, reduce, or eliminate adverse effects or enhance beneficial effects to T/E species. Refer to conversations you had with species experts to achieve these results.

6. **What is your decision?**

- Will the project have no effect? "No effect" means there are absolutely no effects of the project.

- Or will the project affect listed species? If the project may affect listed species, than you must decide whether or not some or all of the effects are adverse. A decision that the project "is not likely to adversely affect" the species means that all effects are beneficial. For a project that has all adverse effects or mixed adverse and beneficial effects to a T/E species, the legally proper conclusion is that the project "is likely to adversely affect".

List the species experts you contacted when preparing the BA but avoid statements that place the responsibility for the decision of "may affect" or "no effect" on the shoulders of the species experts. For example, avoid the following kind of statement: "I contacted Janice Smith, biologist, and she said the project would have no affect on this endangered species." Remember, this decision will be made by a federal agency, which is accountable for its actions.

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threatened, or candidate species are observed at the Pantex facility with significant frequency, we would appreciate notification so that we can update our files.

The Section 7 informal consultation process provides the action agency 180 days to complete a Biological Assessment once they have received a species list from the Service. Therefore, upon receipt of this letter, your Department has 180 days to complete the Biological Assessment for proposed activities at the Pantex Plant.

Thank you for the opportunity to provide information for the biological assessment. If you have any questions, please contact Don Wilhelm at (817) 885-7830.

Sincerely,

J Cloud, Jr.

for Robert M. Short
Field Supervisor

Department of Energy
Albuquerque Operations
Amarillo Area Office
P. O. Box 30030
Amarillo, Texas 79120

MAY 9 1996

Mr. Robert Short
Field Supervisor
U. S. Fish and Wildlife Service
Ecological Services Field Office
711 Stadium Drive East, Suite 352
Arlington, Texas 76001

Dear Mr. Short:

Enclosed is one copy of the Biological Assessment (BA) recently completed for the Pantex Plant. This BA is in support of the Pantex Sitewide Environmental Impact Statement (SWEIS). The SWEIS examines the Department of Energy's (DOE) proposed action of "Continued Operation of the Pantex Plant and the Associated Storage of Nuclear Weapons Components." The draft SWEIS has been issued and is now in the review process. The BA has been prepared under the Endangered Species Act Section 7, Informal Consultation Process, and covers species and habitat protected by that Act as well as Category 1 and Category 2 candidate species identified in your letter of November 1, 1995. Due to the near completion of the BA when the Notice of Review on candidate species was published in the February 28, 1996, Federal Register, the Amarillo Area Office decided to retain the original species listing and designations, rather than complete a revision, so as to enable us to meet our delivery date to your agency.

Pantex Plant is developing management plans for incorporation into the Plant "Stewardship Strategy" as required by current DOE regulations and policy statements. Included in this process are management plans for the playas and their floodplains for agricultural areas and the industrial portion of the Plant. All of these plans incorporate best management practices and good stewardship philosophies.

Based on the information presented in the BA and on elements of the Plant's stewardship strategy, it is my determination that the proposed action is not likely to adversely affect any species afforded protection by the Endangered Species Act. If you have any questions regarding this issue or the BA, please contact Vicki Loucks of my staff at (806) 477-5906.

Sincerely,

Jerry S. Johnson
Assistant Area Manager for Projects
and Environmental Management

DE:96:53579\DE:96:53580
L-0002-5.4.4\D-0002-5.4.4

Enclosure

cc w/o enclosure:
Steve Pomeroy, EPD, BMI

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Stadium Centre Building
711 Stadium Drive East, Suite 252
Arlington, Texas 76011

2-12-96-I-236

May 29, 1996

Jerry Johnson
Department of Energy
Albuquerque Operations
Amarillo Area Office
P.O. Box 30030
Amarillo, Texas 79120

Dear Mr. Johnson:

This responds to your May 9, 1996, letter requesting review and comments on the Biological Assessment (BA) for the Pantex Plant, located in Carson County, Texas. The BA was prepared in support of the Pantex Sitewide Environmental Impact Statement which examines the Department of Energy's proposed action of "Continued Operation of the Pantex Plant and the Associated Storage of Nuclear Weapons Components."

We commend Pantex for developing a comprehensive and complete BA, and concur with your assessment that the proposed action is not likely to adversely affect any federally listed threatened or endangered species.

We also fully support Pantex's proposed plans to manage portions of their property for the benefit of native resident and migratory wildlife species, including the proposed playa basin management plans. As described in the BA, the Pantex Plant and surrounding area currently contains and supports significant wildlife resources, but with proper management, the area has the potential to support an even higher diversity and number of native plant and animal species, to the mutual benefit of both humans and wildlife.

Thank you for your efforts in support of our Nation's fish and wildlife resources and for the opportunity to provide comments on the BA. If you have any questions, please contact Don Wilhelm at (817) 885-7830.

Sincerely,

Robert M. Short

Robert M. Short
Field Supervisor

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STATE OF TEXAS
OFFICE OF THE GOVERNOR

GEORGE W. BUSH
GOVERNOR

July 12, 1996

Ms. Nanette Founds
U.S. Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

Dear Ms. Founds:

Enclosed are the comments from the State of Texas regarding the Pantex Site-Wide Environmental Impact Statement. As you know, a request has been made to extend the commenting period since the Final DOE Standard for calculating the probability of an aircraft crash into the Pantex storage areas has not been released.

While we believe it is imperative that an extension for comments should be granted on those issues related to the aircraft crash estimates, comments on the rest of the document are included in this submission.

Once again, the Office of the Governor would like to thank the U.S. Department of Energy for the opportunity to offer comments on the document. As has been stated on numerous occasions, the State of Texas remains committed to ensuring that all current and future missions at Pantex be conducted in a safe and environmentally sound manner.

This office continues to believe that the Site-Wide EIS correctly concludes that a continuation of current dismantlement and disassembly missions at Pantex will have no significant impact on the health of workers nor any significant adverse impacts on the environment in the Amarillo area.

Likewise, this office continues to believe that any future missions at Pantex related to plutonium can be successfully carried out, provided the following three criteria are met:

POST OFFICE BOX 12428 AUSTIN, TEXAS 78711 (512) 463-2000 (VOICE)/(512) 475-3165 (TDD)

1. Continued Local Support Is Earned
2. Proven Technology Is Utilized
3. Independent Oversight Is Guaranteed

During the public hearings in Amarillo on April 22 and 23, 1996, a number of issues were raised directly related to the Pantex Site-Wide EIS. A few of those are:

Comment:

In Section 4.14.2.1 (p. 4-219 of the text) and in Figure 4.14.2.1-1 (p. 2-224) a classic error is made in explaining potential latent cancer fatalities. The error is to use risk estimates for exposures to large populations and to assume that applying that risk estimate to a specific group of workers allows for definitive conclusions about that group. In this example, the figure provides the correct explanation. The text is misleading and might cause confusion in the community by indicating that the 330 plant workers would suffer a certain number of cancers.

Question:

Health effects are important to understand. The section on continued operations talks about health effects for workers. A statement is made that workers *would* experience additional cancers.

In the figure, a different explanation is used. The statement in the figure is that an average number of cancers could occur if many groups of workers were exposed. The final statement was that the *most likely outcome is zero cancers.*

What is the correct explanation?

Comment:

Table S-1 in the Summary, under intrasite transportation, presents person-rem information (Summary page-18). The table is supported by Section 4.12 in the main text. An underlying baseline person-rem appears to be incorporated into the estimates for the Proposed Action alternative. Neither the main text nor the table clearly state the assumptions used. The person-rem shown for the Pit Storage Relocation alternative adds the estimated person-rem for pit storage relocation and the person-rem from the 2,000, 1,000, and 500 weapons levels under the Proposed Action alternative. Thus, while implementing the Pit Storage Relocation alternative, plant workers are assumed to receive the person-rem associated with the Proposed Action alternative. The radiation exposures for individual workers for the alternatives are within regulatory guidelines and do not have any public health significance.

Questions:

In Table S-1 for the Proposed Action alternative, 50 workers receive 61 person-rem for 2,000 weapons. Next, 50 workers receive 48 person-rem for 1,000 weapons. Finally, 50 workers receive 41 person-rem for 500 weapons. How does one scale these numbers? The same type of calculations are made for the No Action alternative. Again, the numbers for person-rem do not follow the amount of work.

In the Pit Storage Relocation alternative, the amount of person-rem from the Proposed Action alternative appears to be added to what happens for pit storage relocation. How can one add the person-rem for these two alternatives? Is the same person-rem used two different times?

Comment:

Appendix D, "Human Health," does very little to explain how the impact to human health is derived or calculated. This appendix is more of an explanation of the risk assessment methodology than human health.

Comment:

Table 4.11.1.6-1 presents revenues for the governing bodies within the Pantex ROI (p. 4-165).

Question:

If Pantex is reduced to the 500 weapons activity level, what would be the impact to these revenues?

Again, thank you for allowing us to comment. I look forward to resolving these important issues.

If you have any questions, please call me at 512/463-1866.

Sincerely,

ROGER MULDER
Director, Pantex

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We appreciate having been provided the opportunity to participate in this process. If we can be of any further service, please do not hesitate to contact us.

Sincerely,

Joseph A. Martillotti
Pantex Special Project Coordinator
Division of Compliance and Inspection
Bureau of Radiation Control

Enclosure

cc: R. Mulder/Office of the Governor
V. Battley/DOEAAO

TEXAS DEPARTMENT OF HEALTH
Bureau of Radiation Control
Pantex Plant Sitewide Environmental
Impact Statement DRAFT Comments

In the Summary, page S-9, right column, it is stated that 8.1 E-6 Latent Cancer Fatalities (LCF) per year would result from and aircraft crash into a facility with a weapons high explosive detonation. Scenario 3, described in Volume I, page 4-229 conflicts with this statement, indicating that the increased risk is 1.8 E-11 latent fatal cancers per year. Table 3.14.2.1-4 in Volume I page 4-228, Excess Cancer Fatality Risk for Scenario 3 lists 5.1 E-6. These figures need to be verified, reconciled, and, if necessary, corrected.

In the Summary, page S-10, left column, it states that from an aircraft crash into Zone 4 facilities, 1.5 E-6 LCF per/yr for 20,000 pits and 9.8 E-7 LCF per yr for 8,000 pits would result. Table 4.14.2.1-4, Volume I, page 4.228, Scenario 9 lists 6.0 E-8 excess cancer fatality risk. For Zone 4 weapons storage, 6.8 E-7 LCF/yr is given on page S-10. Scenario 3 in Table 4.14.2.1-4 lists 5.1 E-6 excess cancer fatality risk. Page 4-250 lists the increase in fatal cancer risk as approximately 2.2 E-11 increase in fatal cancer risk (compared to a baseline risk of 1.5 E-3 per yr). These figures need to be verified, reconciled, and, if necessary, corrected.

In the Summary, page S-11, right column, the discussion on Stockpile Stewardship and Management Draft PEIS omits the "Downsize Pantex with transfer of HE Operations" option briefed as a preferred alternative at the April 22-23, 1996 meetings. The Stockpile Management Preferred Alternatives Report, pages 17 through 20 discusses fiscal impacts related to the transfer of HE operations for fiscal years 1996 through 2020. If this issue is anticipated to impact on the Texas Panhandle during the tenure of the Pantex SWEIS, the effect of transporting a large number of HE components over the roadways needs to be included.

In the Summary, page S-12, right column, the Light Water Reactor disposition alternative from the Storage and Disposition of Weapons-Usable Fissile Materials PEIS has not been removed, although it was indicated in the April meetings that the LWR was no longer being considered for Pantex. This issue requires clarification.

In the Summary, Table S-1, page S-20 gives a 4 E-12 increase in fatal cancer risk, whereas in the same table, on page S-26 a duplicate entry gives 3 E-12. Volume I, page 4-229, Scenario 3 lists an increased risk of 1.8 E-11 LCF per year. Table 4.14.2.1-4, Scenario 3 gives 5.1 E-6 Excess Cancer Fatality Risk. Volume II page 4-250, right column lists 2.2 E-11 increase in fatal cancer risk (per yr). These figures need to be verified, reconciled, and, if necessary, corrected.

In the Summary, Table S-2, page S-25 right column, sixth line, between "in" and "0.04", insert "0.11 LCF and".

In Volume I, page 4-155, right column, the projected population in the ROI in 2055 ranges between 214,353 and 246,464. Figure 4.14.2.1-1, page 4.223 gives the ROI population of 267,107 for risk estimates. Volume II, page D-28, left column, gives the population in the ROI as 267,107 for fatal cancer estimates. An explanation of the different populations is necessary, or one of the ROI needs to be re-named.

In Volume I, page 4-215, right column, the statement concerning the Pantex Epidemiologic Surveillance 1994 Annual Report should be updated to indicate that the report has been released. (The 1995 Annual Report may also be available by the time the Final Report is issued.)

Barry R. McBee, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
John M. Baker, *Commissioner*
Dan Pearson, *Executive Director*

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

June 27, 1996

RECEIVED
JUL 02 1996
GOVERNOR'S BUDGET OFFICE

Mr. T.C. Adams
Governor's Office of Budget and Planning
P.O. Box 12428
Austin, Texas 78711

Re: U.S. Department of Energy (DOE)
Draft Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components
TX-R-96-04-03-0001-50-00

Dear Mr. Adams:

The Texas Natural Resource Conservation Commission (TNRCC) has reviewed the above-referenced Environmental Impact Statement, and our technical review comments are enclosed. The joint comments of the State's natural resource trustees are also enclosed.

The TNRCC is concerned that contamination in the perched aquifers beneath the site indicates that past and present industrial discharge practices at the Pantex facility have not been fully protective of natural resources at the site. The DOE should insure that the threat of increased contamination to the Ogallala aquifer and contaminant exposure to ecological receptors is limited to the maximum extent practical.

In order to reduce DOE's residual liability for injury to natural resources, the State and Federal trustees encourage DOE to continue to work with the trustees during the remedial process so that appropriate restoration will be incorporated into remedial activities.

We applaud DOE's willingness to share its information concerning radioactive contaminants; however, the TNRCC permit does not include radionuclide parameters. And as we have stated before, the TNRCC recommends that the DOE share regulatory oversight with another federal or state agency to minimize the potential for further injury to natural resources.

Thank you for the opportunity to participate in this review process. I believe these comments will assist the DOE in considering use of the Pantex facility. If you have any questions regarding these comments, please feel free to contact Mr. David Duncan, Director, Intergovernmental Relations Division, at (512) 239-3510.

Sincerely,

Dan Pearson
Executive Director

Enclosures

cc: Commissioners

Texas Natural Resource Conservation Commission

INTEROFFICE MEMORANDUM

TO: Sidney Wheeler, Intergovernmental Relations DATE: June 14, 1996

FROM: Ginny King, TNRCC Natural Resource Trustee Program

SUBJECT: **Joint Trustee Comments to the Draft Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components**

As Lead Administrative Trustee (LAT) on behalf of the State Trustees, Texas General Land Office (TGLO), Texas Parks and Wildlife (TPWD), and Texas Natural Resource Commission (TNRCC), this memo is written to provide the State Trustees' comments on the "Draft Environmental Impact Statement for the Continued Operation of the Pantex Superfund Site and Associated Storage of Nuclear Weapon Components."

General Comments:

The Trustees for the State of Texas strongly support the President of the United States and the Department of Energy (DOE) in the unilateral efforts to reduce the number of armed nuclear warheads worldwide. We further recognize the difficult responsibility of storing and stockpiling the Nation's disassembled nuclear weaponry. However, the DOE is one of the Federal Trustees for natural resources and has the responsibility of protecting those natural resources from injury on behalf of the public. In order to protect those natural resources from further injury, the Trustees recommend that the DOE incorporate more stringent environmentally protective practices at the Pantex Superfund site.

The Trustees do not oppose the DOE plan to construct an expanded Hazardous Waste Treatment and processing Facility (HWTPF). However, contamination in the perched aquifers beneath the site indicate that past and present industrial discharge practices at the Pantex facility have not been fully protective of natural resources at the site. A treatment facility that is constructed and maintained properly will prevent further injury to natural resources. In addition, the increase of industrial discharge volume to 2.9 million liters may exacerbate contamination problems if additional measures are not taken by DOE to protect valuable groundwater resources. DOE should insure that the threat of increased contamination to the Ogallala aquifer and contaminant exposure to ecological receptors is limited to the maximum extent practical.

Specific Comments:

1. Page 1-12, Section 1.2.2.3 Environmental Restoration: The information communicated in this text does not necessarily constitute restoration of the natural resources that have been injured as a result of the releases of hazardous substances at this site. In order to perform actual environmental restoration, the nature and extent of contamination must be determined to evaluate the potential injuries to natural resources. After such a determination, and in

cooperation with the other Federal and State Trustees, restoration projects should be designed that will appropriately compensate the public for injury to natural resources. Performing remediation as needed to comply with all appropriate regulatory requirements does not necessarily constitute compensatory restoration for injury to natural resources. In order to reduce DOE's residual liability for injury to natural resources, the State and Federal Trustees encourage DOE to continue to work with the Trustees during the remedial process so that appropriate restoration will be incorporated into remedial activities.

2. Page 3-2, Section 3.1.1 Proposed Action: Care should be taken to ensure that the continued operation of Pantex Plant activities including "quality assurance testing of weapon components and the research and production of weapon components" is conducted in a fashion that will not increase DOE's liability for injury to natural resources.

3. Page 3-3 Performing environmental protection and environmental restoration activities: please see specific comment #1.

4. Page 4-2, Affected Environment: The document states that an area of 50 miles surrounding the Pantex site will be considered the region of influence. The Trustees are concerned that this area will not encompass the potential area of natural resources that could be impacted since:

   a) the lateral extent of the perched aquifer has not been determined; and

   b) documented contamination in the Ogallala and its flow direction provide the potential for this contamination to impact various environmental receptors outside this radius.

5. Page 4-3, section 4.2 Impact Assessment Methodologies, geology and soils: Impacts should be assessed on the destruction of any geologic feature not just those specified unique.

6. Page 4-3, Section 4.2 Impact Assessment Methodologies, water resources: The qualitative assessment of water quality impacts from wastewater and stormwater runoff does not adequately address potential impacts to surface water and groundwater resources at the Pantex Plant. Furthermore, it does not consider existing contamination in the sediments, surface water and groundwater and their cumulative impacts. The text should be corrected to reflect what actions would be necessary to thoroughly address the potential impacts to these natural resources.

7. Page 4-4, Biotic Resources: The text states that US Fish and Wildlife Service and appropriate State agencies have been used in the process of determining whether Pantex Plant operations would impact any plant or animal. This is incorrectly stated. The Trustees understand that an ecological screen has not yet been completed for this site and an ecological risk assessment has not been performed. The text should be corrected to reflect what has actually been assessed at this site and which agencies were involved.

8. Page 4-37 Environmental Restoration Process at Pantex Plant: see comment #1

9. Page 4-55 Affected Environments: The text states that there is not evidence that contaminants found in the perched zone have migrated to the Ogallala aquifer. This is inaccurate and should be corrected to reflect that there is documented contamination in the Ogallala aquifer.

10. Page 4-62, Section 4.6.1.2 Groundwater: While the discharges that are permitted by EPA and TNRCC have protective standards which presently do not allow excessive levels of contaminants, existing contamination is already present in the perched aquifer and the playas. Therefore, the continual discharge of wastewater provides a hydraulic head potentially driving those contaminants into the Ogallala. Contamination in the Ogallala has been documented and more stringent actions are required in order to prevent further migration of contamination which could result in greater injury to an extremely valuable groundwater resource.

11. Page 4-69, Section 4.6.1.2 Groundwater, Perched Aquifer portion: see comment #9

12. Page 4-72, Groundwater Quality: The absence of trinitrotoluene in the perched aquifer may not be due to a reduction in the discharge of this contaminant but rather an indication of it breaking down to degradation compounds in the environment. Also, the text states that levels of trichloroethene occurring at the site barely exceed the Risk Reduction Standards (RRS) decision criteria of 5 micrograms per liter. Data used to make this determination may not be representative of actual levels of contamination at the site. To accurately determine what is occurring at this site, properly screened intervals in groundwater monitoring wells to accurately measure "sinking chemicals, metals, radio nuclides and high explosives," as well as the proper suite of analyses, should be employed for all potential contaminants of concern.

13. Page 4-78, Section 4.6.2.1 Impacts of Continued Operations; Weapon-related activities, Surface water: A thorough evaluation and consideration of existing contamination in surface water and sediments of receiving waters at the Pantex site is needed to adequately assess the potential impacts of waste water discharges. Cumulative impacts of preexisting contamination and projected waste loads must be considered.

14. Page 4-79, Section 4.6.2.1 ... Groundwater: Potential impacts to the groundwater quality from wastewater discharge activities are not negligible. See comment #10.

15. Page 4-80, Section 4.6.2.1 Groundwater: The TNRCC permit does not include radionuclide parameters. In order to prevent further injury to natural resources, DOE regulatory oversight should be shared with another appropriate agency. Also, see comment #10 and 15.

cc: Richard Seiler, Manager, TNRCC NRTP
Don Pitts, TPWD
Diane Hyatt, TGLO
Bob Short, USFW Arlington
Steve Spencer, DOI
Ron Gouguet, NOAA CRC Region 6
Geof Meyer, TNRCC RCRA

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6. Risk - The risk from ingestion of hazardous substances should also be included when calculating risk to on-site workers. The EIS only accounts for risk from inhalation.

7. Pantex Plant Playas - The Risk Reduction Rules (RRR) (30 Texas Administrative Code (TAC), §335, Subchapter S), which include references to the Texas State Water Quality Criteria (30 TAC §307), do apply directly to the Pantex Plant Playas, contrary to the statement on page C-2.

8. Surface Water Quality Values - The surface water quality values determined in accordance with the RRR take precedence over the Risk Based Concentration Guidelines from EPA Region 3 (Section C.1.2). The EPA Region 3 Guidelines are not appropriate standards to apply when values are available in the Texas Surface Water Quality Criteria, the Federal Safe Drinking Water Act, or the Texas Regulations for Control of Radiation (TRCR) (30 TAC §336).

9. Tables C.1.2-1 through C.1.2-3 - The standards listed in Table C.1.2-1 should cite values based on the RRR, rather than EPA Region 3 Guidance. For instance, the standard for antimony should be 0.006 milligrams per liter (mg/L), based on the RRR, rather than 0.015 mg/L cited for EPA Region 3 Guidance.

   The standard for gross alpha activity, according to the RRR, should be 15 picocuries per liter (pCi/L), rather than N/A. No water quality standard is provided by the Texas Surface Water Quality Criteria; therefore, the RRR specify use of the drinking water standard.

   The proposed drinking water standard of 50 pCi/L (4 millirems per year) should also be cited for beta particle activity.

   The TNRCC requests that DOE revise Table C.1.2-1 to cite the more stringent surface water quality standards for radionuclides that are developed in accordance with the RRR. As such, the standard for plutonium-239/240 would be 2E-8 microcuries per milliliter (μCi/ml), based on the TRCR standards. Radium-226 and Radium-228 would be 6E-8 μCi/ml, based on proposed federal Drinking Water Standards. Tritium would be 1E-3 μCi/ml, based on the TRCR standards. Uranium-234 and Uranium-238 would be either 3E-7 μCi/ml, the TRCR standards, or 20 μg/L, the proposed Drinking Water Standard, which ever is more stringent.

10. Constituents of Concern - The constituents of concern for groundwater should not be limited to those constituents that exceed risk based concentrations (Section C.2.2, page C-4). In addition, the nature and extent of contamination must be based on background values or laboratory Practical Quantitation Limits (PQL), rather than risked based values. These issues were addressed in DOE's revised Sampling and Analysis Plan and the TNRCC's subsequent approval with modification.

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
OFFICE OF AIR QUALITY
REVIEW COMMENTS
OF THE
DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE CONTINUED OPERATION OF THE PANTEX PLANT AND ASSOCIATED STORAGE OF NUCLEAR WEAPONS COMPONENTS (March, 1996)

Monitoring Operations Division/Ambient Monitoring Section:

1. The footnote on National Ambient Air Quality Standards (NAAQS) in Table 4.7.1.3-1 in Volume 1 is inaccurate. Both ozone and PM10 NAAQS are based on expected exceedances, meaning that non-sampling days must be accounted for when calculating attainment determination. The NAAQS is attained when the expected number of days per calendar year, averaged over a three-year period, with maximum hourly average concentration for ozone and 24-hour average concentration for PM10 above the standard is equal to or less than one. SO2 annual, NO2 annual, and lead quarterly NAAQS are not to be exceeded. CO one-hour and 8-hour and SO2 3-hour and 24-hour standards cannot be exceeded more than once per calendar year.

2. In the discussion of air monitoring results on page 4-93 of Volume 1, it is stated that methylene chloride was found at 213 ppbv on July 6, 1993. There is no mention that this concentration was seven times the effects screening level (ESL). Further review and analysis of the methylene chloride data by Toxicology and Risk Assessment staff concluded that this one time episode would not result in any long- term health effects. Although there is detailed discussion of slightly above ESL concentration of 1,2 dibromoethane, this additional discussion on methylene chloride is left out.

3. TNRCC air monitoring at Pantex has found a number of exceedances of the PM10 NAAQS. Although modeling by TNRCC and the EIS staff did not predict possible PM10 violations, actual exceedances happened mainly due to blowing dust and localized earth moving activities. Precisely this kind of scenarios are anticipated in the Consolidation Alternative if additional construction activity takes place at Pantex. The EIS addresses this issue in section 4.7.6 on page 4-118 by stating that mitigation measures will be undertaken to alleviate temporary dust emissions from construction activities. These are standard TNRCC- approved mitigation measures for particulate emission control.

4. TNRCC Modeling staff reviewed Appendix B, Air Quality Analysis, of the Sitewide EIS and their comments are submitted separately. Additionally, the EIS used the same model, the Industrial Source Complex Model, that the TNRCC used for modeling Pantex emissions. EIS modeling was performed in accordance with the EPA guidance document, "Guidelines for Air Quality Models" (revised) and TNRCC guidance document, "Air Quality Modeling

Guidelines." The modeling approach used by the EIS is different from the one used by TNRCC. However, both models arrived at the same conclusion.

5. TNRCC used a tiered modeling approach that included a blend of screen and refined modeling techniques because of the large number of fugitive emission locations, buildings, and pollutants, whereas the EIS modeling used a refined dispersion model to accommodate the large number of emission sources and pollutants.

6. In the TNRCC approach, the TNRCC modeling results were added to the results of the modeling conducted by Radian Corporation in support of a permit application. Radian modeling addressed predicted impacts of emissions from the burning ground and container storage area. Therefore, TNRCC used an additive modeling approach to account for emissions from some of the buildings to assess plant wide emission impact. Using this approach, TNRCC modeling concluded that no predicted exceedances of the criteria pollutant impact public health. The maximum concentrations of alcohols predicted at the property line was slightly above the ESL, but concentrations of alcohols predicted at the nearest residence was below the ESL.

7. Using a different approach, EIS modeling also concluded that there would be no exceedance of the NAAQS for criteria pollutants and that the only hazardous air pollutant that exceeded its ESL was alcohols. Again, predicted maximum concentrations of alcohols for 11 residences located near Pantex were below ESL.

The nonradiological air quality impacts due to the No Action Alternative and the Consolidation Alternative will be minimal, especially if mitigation measures are taken to control particulate emissions due to increased vehicular traffic and construction activity.

Acetylene
Aluminum
Ammonia
Barium
Benz(a) anthracene
Benz(a) pyrene
Bismuth
Butadiene
Butane
Butene
Calcium
Chlorinated Fluorocarbon
Copper
Cyanogen
Cyclohexane
Cyclohexanone
Dimethylformamide
Dioxane
EthaneEthyl Acetate
Ethyl Ether
Ethylene
Formic Acid
Iron
Isobutane
Isobutanol
Ketene
Lithium
Magnesium
Methane
Methane, dichloro
N-Butyl Alcohol
Non-F Solvents
Ortho-dichlorobenzene
Propane
Propene
Pyrene
Pyridine
Silicon
Tetrahydrofuran
Titanium
Total Suspended Particulate
Trichlorofluoromethane
Trichlorotrifluoroethane

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
OFFICE OF AIR QUALITY
REVIEW COMMENTS
OF THE
DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE CONTINUED OPERATION OF THE PANTEX PLANT AND ASSOCIATED STORAGE OF NUCLEAR WEAPONS COMPONENTS (March, 1996)

Toxicology & Risk Assessment Section:

1. On Page 4-93, Paragraph 2, 2nd Sentence: "AQCR 211 is designated by EPA as "better than national standards" for total suspended particulates..."

   Comment: To our knowledge there is no national standard for total suspended particulates. EPA replaced the Total Suspended Particulate standard with the particulate matter standard during the late 1980's.

2. On Page 4-95, Paragraph 5, 2nd Sentence, there is a typographical error.

   Comment: "TRNCC" should be changed to "TNRCC".

3. On Page 4-95, Section: Air Quality Modeling and Corresponding Tables:

   Comment: It is not clear in the narrative whether the air dispersion modeling referenced was conducted as part of the Agreement in Principle or as part of the permit application submitted by the DOE.

4. On Page 4-97, Table 4.7.1.3-4:

   Comment: The following ESLs need to be corrected:

Ethene, Trichloro:	135 ug/m3 for the annual ESL 1350 ug/m3 for the 30-minute ESL.

5. On Page 4-98, Table 4.7.1.3-4:

   Comment: The following ESLs need to be corrected:

Methanol:	262 ug/m3 for the annual ESL 2620 ug/m3 for the 30-minute ESL.

6. On Page 4-99, Table 4.7.1.3-4:

   Comment: The format of the ESL should be converted to be consistent with the other ESLs represented in the table (e.g., 135 ug/m3 should be 1.35 x 10E2).

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BUREAU OF ECONOMIC GEOLOGY
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10100 Burnet Road, Bldg 130 · Austin, Texas 78758-4497

July 10, 1996

U.S. Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, NM 87185-5400

Attention: Ms. Nanette Founds

Dear Ms. Founds:

The following are review comments on the "Draft Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components" from staff at the Bureau of Economic Geology of The University of Texas at Austin.

General Comments:

Sections 4.5 and 4.6, which describe water resources and geology and soils, do not provide sufficient information for the reader to determine if environmental impacts could result from continued operations and storage of nuclear weapons at Pantex.

Some of the maps in this document are used without referencing or obtaining permission of the author. Figure 4.5.1.2-1 was published by Gustavson (1981), but attributed to DOE (1981). Figure 4.5.1.2-2 was prepared by Davis, Pennington and Carlson (1989), but attributed to DOE 1995.

Specific Comments:

Page 4-27, Geomorphology, para. 1, ln 13. It is inaccurate to state that playa basins <u>could</u> play a role in the contamination of ground water at Pantex Plant. Playa basins and ditches have been shown to be the sites where contaminated surface water is recharged to the subsurface (Gustavson and others, 1995).

Page 4-27, Stratigraphy, para. 1, ln 4. The Blackwater Draw and Ogallala Formations beneath the Pantex Plant are not lithified and therefore are not rocks. The correct term is sediments. Rephrase sentence to "The stratigraphy of the *sediments and* rocks . . ."

Page 4-27, Stratigraphy, para. 2, ln 6. The upper unit of the surface soil (Pullman clay loam) of the Blackwater Draw Formation is the A horizon and it contains no caliche. The first soil carbonate is found at a depth of about 24 inches in the upper part of the B horizon (US Department of Agriculture, Soil Conservation Service, 1972, Pullman Series: Established Series, 4 p).

Page 4-62, Ground water, para. 1. There is no discussion of sediment heterogeneity, which strongly affects ground water flow rates.

Page 4-63, Figure 4.6.1.2-1. Why are there no monitor wells in the area of playa 4 ? Considering all of the discharge that has occurred from zone 12 south to playa 4, it would seem appropriate to determine the nature of the hydrogeology in this area.

Page 4-65, Perched Aquifer, para. 2, ln 1. Contrary to this confusing statement, there are areas at Pantex where perched ground water is present, but where gravel channels are not present and vice versa. The presence of gravel channels does not control the presence of perched aquifers; it is the presence of a stratigraphic horizon (in this case the fine grained zone) with a vertical hydraulic conductivity lower than the flux of recharge water moving through the unsaturated zone. It is quite obvious that if the gravel channels were underlain by a coarse sand then no perched aquifer would have formed.

Page 4-69, para. 4, ln 6. If the spread of contaminants in the perched aquifer is limited to the confines of the perched aquifer in buried channel deposits, then why are there so many perched aquifer monitor wells in Zone 12 with contaminants, but located outside the gravel channel as mapped on page 4-66? It seems obvious that something other than gravel channels is, at least in part, controlling flow in the perched aquifer and that contaminants are present in perched aquifer water outside the gravel-filled channel.

If you have any questions concerning these comments, please call me at (512) 471-0232.

Sincerely yours,

Thomas C. Gustavson
Senior Research Scientist

TCG:mk

cc: R. Mulder, Governor's Office
T. Grimshaw, BEG
J. Raney, BEG

COLLEGE OF ENGINEERING
THE UNIVERSITY OF TEXAS AT AUSTIN

Center for Transportation Research · Suite 200
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July 12, 1996

Mr. Roger Mulder
Director, Pantex
Office of the Governor
P. O. Box 12428
Austin, TX 78711

Dear Mr. Mulder,

We have reviewed both the Draft Site Wide EIS and the draft working documents used for preparing the Final EIS. We have also met with DOE personnel and contractors preparing the DOE Standard for evaluating probabilities for aircraft accidents. After this review, we present the following written comments and request that they be addressed in the Final EIS.

1. As of this date, July 11, 1996 - the eve of the closing of the comment period for the draft EIS - those personnel from Tetra Tech responsible for preparing the Final EIS have not (1) received the Final DOE standard, (2) have not received the final technical support documentation, and (3) have no idea if the probability of an aircraft crash into a Pantex plutonium storage facility is 1 or 100 in a million. Therefore, at the close of this comment period, we can not verify their results because none is available. What is known is that everything published in the draft EIS will be changed based upon the new DOE standard.

2. The aircraft crash rates are fixed in the DOE standard; however, do not have access to either the Technical Support Documentation nor the data from which the accident crash rates (usually reported as accidents per hundred thousand flying hours) have be calculated into a crash probability for each takeoff, for each landing, or an inflight rate per square mile. This calculation requires many assumptions and several different steps. From interviews, we have determined the draft DOE standard does a credible job in establishing these crash rates. However since DOE contractors have denied access to both the data and the technical support documentation, we request that that the following points of potential errors be addressed by the DOE contractor, reviewed by a competent authority, and be included in the Final EIS:

A. Military Crash Rates - Military aircraft perform touch and go landings for proficiency training only with an instructor on board. Additional landing practice is accomplished as a low approach with the wheels not touching the runway. The civilian tower counts this low approach as two operations (1 takeoff and 1 landing) but no record of a landing is recorded in the military records. We request details of how this discontinuity in the raw data is accounted for in the DOE standard. We request that following data be published in the Final EIS for all military aircraft with significant impact at the Pantex facility: accident and crash rates per hundred thousand flying hours; average hours per sortie; average landings and low approaches per sortie; and number of crashes attributed to landing, takeoff, and inflight categories.

E. The Pantex facility has super stout structures and consideration of the structural capacity and resistance to aircraft penetration should be accurately modeled.

F. The effective aircraft crash skid length should be localized to consider the local conditions at the Pantex facility.

G. The FAA and DOE have agreed to several mitigation measures to reduce the probability of aircraft impact into Pantex and we applaud those efforts. The draft EIS provided an estimate of the effectiveness of these measures using the Solomon model which were significant. Although the application of this new model in the DOE Standard will probably estimate the effectiveness of these measures as insignificant, we believe they are significant and should be estimated separately.

5. We recommend that DOE continue to collect radar data at the Amarillo airport as a mitigation item for the Site Wide EIS We highly recommend that the current method of tracking radar should be improved with DOE funding a state-of-the-art system that is equal to the noise monitoring systems installed at many major airports in the US. This system should be automated and integrated with a geographical information system and be turned over to the airport for their use in airport planning.

Sincerely,

Michael T. McNerney, Ph.D., P.E.
Director
Aviation Research Center

MTM:ls

5. The proposed DOE Standard 3014-96, uses a hierarchical accident analysis scheme starting with simple, conservative models and progressing towards complex, accurate models. A screening level of risk < 1E-6 / yr is recommended. If at any point in the progression, the aircraft crash probability falls below this level, no further analysis is required. It is presumed that other initiating events become more important than aircraft accidents at this probability level. There are two problems with this approach. First, it leads some to believe that only when the aircraft accident probability is below 1E-6 / (sq mi* yr) has an adequate margin of safety been provided. Second, the base accident rate for general aviation aircraft is on the order of 500 /yr over 4,000,000 sq mi, or about 1E-4/(sq mi * yr). There are four other categories of aircraft in the DOE guidelines, each with their own accident rate: large military, small military, commercial air carrier and commercial air taxi. Thus, the total aircraft accident probability in the continental United States is above the screening rate, and full analysis is mandated by the DOE standard.

COMMENT: DOE should very clearly explain the meaning of their screening level and of any aircraft accident probabilities computed for the Pantex SWEIS. The Pantex SWEIS will be the first to use the new geographic based guidelines. Other DOE laboratories and locations have analyzed their aircraft accident risk using earlier draft guidelines. Since DOE claims the aircraft accident model is designed to compare relative risk among DOE facilities, the revised prediction for all DOE sites should be included in the Pantex SWEIS. This means that the new guidelines need to be applied to all DOE operating locations so that Pantex can be viewed in proper relationship to the others.

6. Although the geographic modeling approach is an interesting exercise, the SWEIS should also contain complete Amarillo Aircraft accident data from 1970 to 1996. This data should then be explained in the context of the aircraft accident model. That is, based on the accident model, is the real experience an expected outcome?

COMMENT: Suggest using the binomial distribution to estimate the confidence in the predicted accident rate. Use confidence interval principles to determine if the location and frequency of observed accidents are in reasonable agreement with the model.

7. Personnel at HQ DOE understand the difficulty of explaining the aircraft accident probabilities to the public. In a lively discussion at SAIC on 9 Jul 96, hosted by Tim Haley and chaired by Kamiar Jamali, the suggestion was made that EIS analyses not report the aircraft accident probabilities. These probabilities are intermediate results from the model and do not indicate public health risk. An accident is merely a potential initiating event. The suggestion was that the EIS should focus on the release probabilities, instead. This movement from "hit probability" to "release probability" involves many intermediate layers of modeling. First, one must assume the angle of impact for the aircraft. Second, assume an impact velocity and

10. In the aircraft accident consequence analysis, the DOE model assumes that either a direct impact or a skidding impact can lead to a release. The model assumes that the aircraft (or its dense structures acting as kinetic missiles) retains dangerous velocities for the entire skid. In reality, the velocity slows continuously during the skid. The target area is computed from the actual facility dimensions, the aircraft wingspan and the skid distance. The skid distance is the dominant factor in target area.

QUESTION: Why not use a linearly decreasing velocity as a conservative means for estimating remaining kinetic energy during a skid? This would dramatically reduce the area involved in target zones and would refine the point estimate of critical aircraft accident probability.

11. The structural damage modeling assumes all aircraft in a single FAA category pose similar risk to structures. These categories are useful for licensing, air traffic control and taxing purposes, but may not be ideal for accident analysis. For example, both a T-37 and an F-15 are included in the small military category. The T-37 has much less kinetic energy than an F-15, and has much smaller components that could become missiles. The damage potential of a T-37 matches that of many general aviation aircraft better than it does an F-15. Nevertheless, the default portions of the DOE guidelines treats them identically.

QUESTION: Why does DOE use FAA categories rather that a more technical criteria to group aircraft? Suggest a product of wing loading and gross weight as a better metric. Aircraft with high wing loading always approach faster than those with low wing loading. Aircraft with high gross weights always have more stout pieces in their structures and engines than aircraft with low gross weights.

12. Dr Lin's analysis of nearest point of approach for each flight trajectory provides an alternative for site-specific accident modeling. It is not likely that his work can be extended to a full analysis of RAMS data within the promised schedule for the final SWEIS. However, his work does suggest that a careful examination of consequence analysis assumptions may be in order. One is tempted to believe that aircraft flying directly over a facility may pose the greatest risk. However, any aircraft impacting a facility from within a cone above that facility must impact at a very large glide slope angle. At angles greater than 30 degrees, there is virtually no skid distance. Thus the facility floor plan is the target area for impact from above. Because this area is much smaller than that assumed in the DOE guidelines, the probability of this accident is much smaller.

QUESTION: Can the distribution of the points of closest approach be used to determine both the slant range and the line of sight angle to critical facilities? The effective target area for each facility will depend strongly on the impact angle. This effect is not included in the DOE guidelines because they default to a specified point estimate of the impact angle. The basis for

this assumption is apparently discussed in the technical support documents for the DOE Standard, but that is not yet published, and may not be published for several more months.

COMMENT: A Monte Carlo analysis is likely the right means for accommodating this important effect.

13. A full risk assessment of aircraft accident potential would include a term for a collision between an aircraft and a transport trailer, either on site during transport between structures or off site during cross country transport. No such term is evident in the draft SWEIS.

COMMENT: Suggest that the probability of an aircraft accident impacting a transporter be computed. Due to the short duration of exposure while in transit, it is expected that this risk will be shown to be negligible compared with other risks associated with fixed storage facilities.

14. The tiered approach to aircraft accident modeling encourages the analyst to perform increasingly complex computations if the screening level has been exceeded in the prior step. The next step for the Pantex modeling effort involves using actual aircraft specific accident rates rather than using average accident rates for each of the identified five aircraft categories. It is also possible to use available accident rates for the most commonly observed aircraft in a category and to use the category specific rates for the remainder.

COMMENT: If accident rates are assigned to specific aircraft (such as the USAF T-1, T-37 and T-38 aircraft), then verify that the appropriate rates are used for the remaining aircraft in that category. These may be derived from aircraft specific accident data or estimated by marginal analysis of the entire category to determine the portion of the accident rate appropriate to the remaining aircraft types.

Copy to:
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ANDREW SANSOM
Executive Director

May 22, 1996

Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

Attention: Nanette D. Founds
SWEIS Project Manager

Dear Ms. Founds:

Texas Parks and Wildlife Department (TPWD) staff has reviewed the Draft Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components, Summary, Volume I-Main Report, and Volume II-Appendixes. TPWD has the following comments for your consideration.

While we recognize Pantex efforts to discover the amount and extent of the historical contamination and Pantex current contaminant reduction in progress, we are concerned about impacts to wildlife from historic contamination listed in the report. Due to the unknown extent of the historical contamination, TPWD requests Pantex continue to describe the extent of contamination and encourages efforts to clean up or rectify the contaminant impacts. Consider incorporating a time line showing past efforts and future efforts in contaminant identification and clean up. If available, please send Joan Glass of our staff copies of completed reports describing potential wildlife impacts.

TPWD is also concerned about the unidentified minnow species from Pantex Lake. Because there are 6 Federally listed *Notropis* with 2 additional State listed *Notropis* species, the minnow species should be identified by a competent scientist. You may request assistance in identification of the minnow by contacting the TPWD Freshwater Studies Program aquatic biologist, Kevin Mayes at 512/754-6844. Upon contacting Mr. Mayes for identification, a minimum of 5 specimens can be sent to him at 300 C.M. Allen Parkway, Bldg. B, San Marcos, TX 78666.

Thank you for the opportunity to review the Draft Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components. Please call Dave Buzan at 512/389-4634 or Joan Glass at 817/867-7956 if you have any questions.

Sincerely,

Bob Spain

Robert W. Spain, Chief
Habitat Assessment Branch
Resource Protection Division

RWS:JG:bsl

cc: Joan Glass, Texas Parks & Wildlife Department, Waco Office
Kevin Mayes, Texas Parks & Wildlife Department, San Marcos Office

TEXAS HISTORICAL COMMISSION

George W. Bush • Governor
John L. Nau, III • Chairman
Curtis Tunnell • Executive Director

The State Agency for Historic Preservation

May 1, 1996

Mr. Bruce G. Twining
Manager
Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, NM 87185-5400

Re: Draft Environmental Impact Statement (EIS) for the Continued Operation of the Pantex Plant and Associated Nuclear Component Storage.
(DOE, F2)

Dear Mr. Twining:

This letter replaces our letter of April 22 and provides clarification of our comments regarding the Pantex Draft EIS. We have learned that the EIS addresses Section 110 of the National Historic Preservation Act, not Section 106 as we had assumed in our letter of April 22. With the clarification of this issue by DOE at a May 1 meeting, we agree that the EIS addresses Section 110 issues. Moreover, the EIS is a good step toward achieving compliance with Section 110.

Concerning our comment that consultation with Section 106 has not taken place for archeological studies, we have found evidence in our files that DOE has consulted with this office about archeological sites at the Pantex Plant. Extensive consultation has occurred regarding historic buildings with representatives of the National Register Programs Office and Division of Architecture at the Texas Historical Commission. Our primary concern, however, was that the archeological reports listed on page 4-148 of the Draft EIS have not been formally submitted to us for review. This situation was also resolved at the May 1 meeting, with DOE agreeing to have its contractor prepare a timetable for the submission of the reports along with National Register eligibility determinations for archeological sites.

We regret any misunderstanding our initial comments may have caused. In an effort to prevent future miscommunication, DOE and our agency have exchanged letters specifying the appropriate points of contact for issues related to archeology and architecture at Pantex. If we may be of further assistance concerning archeological issues, please contact Mr. Bill Martin of my staff at 512/463-5867.

Sincerely,

James E. Bruseth, Ph.D.
Deputy State Historic Preservation Officer

Sincerely,

Tim Perttula

Timothy K. Perttula, Ph.D.
Assistant Director for Antiquities Review

JEB/TKP/wam

cc: Ms. Vicki Bartley, Pantex Plant
Mr. Roger Mulder, Governor's Office

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NTEX
OF EXCELLENCE
EMO

Date: September 15, 1994

From: C. J. Phagan **Location:** Environmental Prot., 12-100

To: Distribution **Location:**

Subject: Summary Notification of Native Americans; NEPA/EIS, NHPA Activities. Revision 1

Two sets of compliance-related activities at Pantex Plant involve various public notification, including concerned Native American Tribes: the Site-Wide Environmental Impact Statement (EIS) for Plutonium components storage, done under the National Environmental Policy Act (NEPA), and the development of Programmatic Agreements for the management of archeological sites and other historic properties, done under the National Historic Preservation Act (NHPA) and related legislation. Both activities require the identification of potentially concerned groups, including Native American tribes, providing them with relevant information, soliciting their comments, and addressing those comments in any final project documentation.

In April 1993, preliminary notification of NEPA-related activities at Pantex Plant was provided, via registered mail, to a list of seven Native American Tribes identified by the Texas State Historic Preservation Office (SHPO) as potentially interested parties with traditional interests in the area. Those tribes were: Comanche Tribe of Oklahoma, Kiowa Tribe of Oklahoma, Apache Tribe of Oklahoma, Mescalero Apache Tribe, Jicarilla Apache Tribe, Cheyenne-Arapaho Tribe of Oklahoma, and the Wichita and Affiliated Tribes. No responses were received at that time.

By early 1994, the same NEPA-related activities were continuing at Pantex Plant, and Site-Wide EIS activities under NEPA were started. The Environmental Protection Department (EPD), and others, felt that additional actions by the Plant were needed to demonstrate a good-faith effort to locate and inform potentially concerned Native American Tribes of these Plant activities, and to encourage their participation in the NHPA and NEPA processes. The EPD Cultural Resources Staff contacted both the Texas SHPO and the Anadarko, OK, office of the Bureau of Indian Affairs (BIA) to identify potentially interested tribes with historical/traditional concerns in the Texas Panhandle area. As a result, three additional tribes were added to the above list of potentially interested parties: the Caddo Tribe of Oklahoma, the Delaware Tribe of Western Oklahoma, and the Fort Sill Apache Tribe.

These ten tribes were contacted by telephone during the period May 18-25, 1994. On May 18, 1994, Mr. Leonard Atole, Tribal President of the Jicarilla Apache Tribe, stated that the Jicarilla Apache did not have concerns in the central Texas Panhandle. He thanked us for our call. On May 19, 1994, Mr. Fred Peso, Vice President of the Mescalero Apache Tribe, stated that

traditional interests were further to the south than the Texas Panhandle. However, they were interested in the EIS process, they would like to be placed on the EIS mailing list, and they would contact us if they needed additional information. The remaining eight tribes expressed an interest in knowing more about either the EIS/NEPA activities or the NHPA activities, or both.

On June 14 and 15, 1994, a second telephone contact was made with the eight interested tribes by EPD Cultural Resources Staff to schedule a visit to the tribes to provide detailed information on both EIS/NEPA and NHPA activities, to respond to questions, to explain the EIS scoping and comment process, and to encourage tribal comments. These visits were scheduled for June 22-24, 1994.

A packet of information was prepared for each of the eight tribes that included:

1. EIS/NEPA information

   - A letter from the Pantex Plant EIS Program Manager to the Tribal official

   - maps showing the location and layout of the Pantex Plant

   - multiple copies (5) of four EIS News fact sheets ("Pantex's New Environmental Impact Statement," "What is an EIS?," "What is the Purpose of the EIS for the Pantex Site?," and "Issues to be Addressed in the Pantex Environmental Impact Statement")

   - multiple copies (5) of a "checklist for Scoping Comments"

   - multiple copies (5) of a brochure entitled "Public Involvement Opportunities in the Site-Wide Environmental Impact Statement for the Pantex Plant"

2. NEPA information (separately packaged)

   - a letter from the Department of Energy, Assistant Area Manager for Projects and Environmental Management, to the Tribal official

   - a "Cultural Resources Management Overview" for the Pantex Plant, with detailed information on NHPA compliance program status, and comment opportunities

An example packet is on file in the EPD Cultural Resources Office. In addition to the information packets, an aerial photograph of the Plant site was available to provide a visual image during discussions, and an information video on the Site-Wide EIS was available for those who wished to view it.

C. J. Phagan
Sr. Project Scientist

CJP:sw

cc: R. H. Gray
C. N. Clark
P. S. Allison
G. D. Greenly
S. E. Pomeroy
D. Halliday
D. F. Triebel
C. L. Cizan
W. A. Bowman

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STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
401 Church Street
Nashville, Tennessee 37243

July 12, 1996

Ms. Nanette D. Founds
US Department of Energy
Albuquerque Operations Office
PO Box 5400
Albuquerque, NM 87185-5400

Dear Ms. Founds:

As the Governor's Lead Contact for State of Tennessee National Environmental Policy Act (NEPA) reviews, I am providing comment in response to the *Draft Environmental Impact Statement (DEIS): Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components, DOE/EIS-0225D, March 1996.* The attached comments from our DOE Oversight Office in Oak Ridge, Tennessee represents the official response of the State of Tennessee. Please give these comments your full consideration.

We appreciate the opportunity to comment and will respond to additional opportunities in the future. If you have any questions, please contact our NEPA coordinator at (615) 532-8545.

Sincerely,

Justin P. Wilson
Commissioner

c: Ken Bunting, Administrator (for WKS)
Earl Leming, DOE-Oversight
Mike Mobley, RH
Dodd Galbreath (NEPA coordination file)
James C. Hall, Manager, DOE ORR
Dr. Amy S. Fitzgerald, Ph.D., ORR LOC

amount of depleted uranium currently stored on the Oak Ridge Reservation (ORR) and the metric ton amount that will be shipped from the Pantex facility. Please provide the historical metric ton amount of depleted uranium at the ORR. Also provide information on the environmental impacts for the interim storage of depleted uranium at the ORR. The Division contends that if the historical levels of depleted uranium stored (interim) at the ORR are exceeded, additional NEPA documentation should be prepared to adequately address the impacts to human health and environment.

The Division requests these comments be given full consideration in the preparation of the Final Environmental Impact Statement for Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components.

The Division looks forward to receiving future project documents and correspondence. If you have any questions regarding this Division's review, please contact Dale Rector at (423) 481-0995 or Steve Nisley at (423) 481-0163.

Sincerely

Earl C. Leming
Director

em340.99

State of New Mexico
ENVIRONMENT DEPARTMENT
Harold Runnels Building
1190 St. Francis Drive, P.O. Box 26110
Santa Fe, New Mexico 87502
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ARY E. JOHNSON
GOVERNOR

MARK E. WEIDLER
SECRETARY

EDGAR T. THORNTON, III
DEPUTY SECRETARY

July 3, 1996

Nanette Founds
U.S. Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, N.M. 87185-5400

Dear Ms. Founds:

RE: DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE CONTINUED OPERATION OF THE PANTEX PLANT AND ASSOCIATED STORAGE OF NUCLEAR WEAPON COMPONENTS; U.S. DEPARTMENT OF ENERGY (MARCH 1996)

The following transmits New Mexico Environment Department (NMED) staff comments concerning the above-referenced Draft Environmental Impact Statement (DEIS).

(1) Some of the actions appear to (potentially) be in conflict with NMED laws and regulations.

a) Vol. I, page 6-4. **6.5 Pit Storage Sites**, under the paragraph referring to Kirtland Air Force Base. The U.S. Department of Energy (DOE) must be in compliance with the Federal Facility Compliance (FFC) Order issued by New Mexico under the provisions of the Federal Facility Compliance Act. The FFC Order has jurisdiction over generation and storage of mixed waste and site treatment plans for its disposition. (p.5-60, **5.5.1.10 Waste Management**, "The pit storage operations would generate less than 1 cubic meter (1.3 cubic yards) of mixed, low-level, and hazardous wastes.")

Mention of the New Mexico unilateral FFC Order is not included in Table 6.5-4.

(2) There are some deficiencies in the information provided which prevent an adequate environmental assessment of the project. Specific areas in the DEIS exhibiting information deficiencies include the following:

a) Vol.I, page 5-63, **5.5 KIRTLAND AIR FORCE BASE, 5.5.1.12 Aircraft Accidents**, "An analysis was performed to determine whether expected bomb loads (one to four 909-kilogram [2000-pound] bombs) could damage the Manzano storage magazines

- Does the close proximity of the pit storage to weapons presently stored in the Manzano WSA pose an increase in potential nuclear accidents? Why would they not pose a problem?

- One alternative considered in the DEIS could have been placing plutonium in a permanent disposal, deleting interim storage (especially at Manzano WSA) as an alternative.

- Transportation of the pits is a very serious task. What assurances exist for safe transportation? For example, are the transporters meeting speed limits, obeying other traffic rules and using defensive driving techniques to reduce transportation risks? If drivers are not complying with safe driving techniques, accident risks are increased. These concerns should be addressed in the DEIS.

We appreciate the opportunity to comment on this document. Please let us know if you have any questions.

Sincerely,

Gedi Cibas, Ph.D.
Environmental Impact Review Coordinator

NMED File No. 982ER

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B. MILLER
Governor

STATE OF NEVADA

JOHN P. COMEAUX
Director

DEPARTMENT OF ADMINISTRATION
Capitol Complex
Carson City, Nevada 89710
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July 12, 1996

Ms. Nanette Founds
U.S. Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

Re: SAI # 96300158: State of Nevada's Comments on the Draft Environmental Impact Statement for the Continued Operations of the Pantex Plant and Associated Storage of Nuclear Weapons Components (DOE/EIS-0225D)

Dear Ms Founds:

Thank you for providing the State of Nevada the opportunity to comment on the Draft Environmental Impact Statement (DEIS) for the U.S. Department of Energy's (DOE) Pantex Plant located near Amarillo, Texas. As you may recall, in June of 1994, we provided extensive scoping comments on the Notice of Intent for this DEIS. In those comments, we noted that the Nevada Test Site was being considered as an off-site storage location for up to 8,000 plutonium pits. After reviewing the subject DEIS, we found that Nevada is still under consideration, along with three other off-site locations, for the storage of plutonium pits. To reiterate our comments presented in June 1994, the State of Nevada remains firmly opposed to storing nuclear components such as plutonium pits at the Nevada Test Site.

Proposed Action:

For the reasons discussed below, Nevada officials strongly support the Proposed Action in the DEIS, which stipulates that Pantex would retain storage of the plutonium pits and would provide for future storage of up to 20,000 pits over the next ten years. We support this interim action without regard to pending decisions concerning the long-term storage of strategic reserve pits and/or storage and disposition of surplus pits. As you know, these concurrent decisions are being evaluated in DOE's Stockpile Stewardship and Fissile Materials Programmatic Environmental Impact Statement (PEIS) documents.

In reference to interim storage of plutonium pits at Pantex, Nevada's position on this issue continues to be that DOE should adopt a proposed action for the permanent disposition of surplus plutonium pits before selecting new interim or long-term storage sites for this long-lived material. In addition, to reduce duplication in storage, transportation, and security costs and to address risks associated with the proliferation of weapons-grade plutonium, DOE should consider adopting a program that combines materials disposition (e.g. plutonium vitrificat[illegible]) [illegible]

Proposed Action.

transportation of plutonium on public roads remains controversial and is generally unacceptable to the public. For all of these reasons, officials in Nevada have long stated that "DOE should link long-term materials consolidation and management with options for final materials disposition."[2]

Pit Storage Relocation Alternative:

In reference to the detailed analysis of potential environmental effects at the two sites under consideration for pit storage at the Nevada Test Site (the Device Assembly Facility [DAF] and the P-Tunnel Complex), we concur that pit storage at either of these sites would not have any direct "significant" environmental impacts on existing environmental resources.[3] We note that new construction at the Test Site would occur within existing facilities [inside the DAF or P-Tunnel complex] and/or on adjacent lands that are already disturbed. Because of this, we have purposely forgone a detailed review of the "direct" environmental impacts presented in the DEIS. There are, however, certain "indirect" and largely cumulative impacts that could result from pit storage at the Nevada Test Site. For example, if plutonium pits were placed in the P-Tunnel complex, local and/or regional earthquakes could pose significant seismic risks that might lead to tunnel collapse. In this regard, we concur that, if Nevada is

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2 Letter dated October 29, 1993 from Robert R. Loux, State of Nevada, to Mr. Howard Canter, Deputy Assistant Secretary, Office of Weapons Complex Reconfiguration.

3 In this context, environmental resources include: facilities and infrastructure; land resources; geology and soils; water resources; air quality; acoustics; biotic resources; cultural resources; socioeconomic resources; waste management; intrasite transportation; and aircraft accidents.

Summary:

As previously suggested, State officials in Nevada believe that DOE should link long-term fissile materials consolidation and storage with options for final materials disposition, and we believe the proposed action presented in the Draft EIS for Pantex supports this concept. As such, we continue to advocate a strategy that would bring together long-term pit storage with one or more of the plutonium disposition treatment options being considered in DOE's Storage and Disposition PEIS.

Embracing this strategy will reduce risks and risk perception issues associated with the unnecessary transportation of fissile materials on public roads and highways throughout the country. Clearly, a prolonged shipping campaign of plutonium pits along the nation's highways, especially through large urban areas like Las Vegas, will cause significant adverse socioeconomic and cultural impacts even if no accidents occur. Research has demonstrated that nuclear-related activities such as radioactive material transportation have the potential to result in significant socioeconomic impacts.[10] These impacts originate in intense negative perceptions and avoidance behaviors by the public, and public and media interest in "things nuclear" makes it almost certain that these negative perceptions will adversely affect a community's quality of life and subsequently its commercial, residential, and business investment opportunities. Thus, we contend that DOE should do everything possible to limit the movement of these dangerous materials.

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[10] See State of Nevada, Nuclear Waste Project Office. Publication numbers NWPO-SE 022-89; 056-93; and 063-95.

Again, we appreciate the opportunity to provide comments on the Draft EIS for the Pantex Plant. If you have any questions about these comments, please contact me or Mr. John B. Walker, Nuclear Waste Project Office, at 702-687-3744.

Sincerely,

Julie Butler

Julie Butler, Coordinator
State Clearinghouse, DOA/SPOC

JB\jbw

cc: Governor Bob Miller
Nevada Congressional Delegation
Perry Comeaux, Dept. of Administration
Robert R. Loux, NWPO
Harry Swainston, Deputy Attorney General
Lew Dodgion, Nevada Division of Environmental Protection
Affected State Agencies
Leo Penne, State of Nevada, Washington Office
John Thomasian, NGA
Terry Vaeth, Joseph Fiore, Don Elle, DOE/NV
Carol M. Borgstrom DOEHQ\NEPA
Ann Morgan, State Director, BLM
Members – NTS CAB

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Georgia Departm

!rice C. Barrett, Commissioner

Mark R. Edwards, Division
500 The Healey Building, 57
Te

Nanette D. Founds
SWEIS Project Manager
Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

RE: Draft EIS—Pantex Plant and Associated Storage of Nuclear Weapons Components

Dear Ms. Founds:

The Historic Preservation Division (HPD) has received on *Draft Environmental Impact Statement (EIS) for the Continued C and Associated Storage of Nuclear Weapons Components*. Thanl with an opportunity to review this document.

Based on our review of the Draft EIS, it is our opinion tha qualify as an "undertaking," as defined in 36 CFR Part 800 of the Preservation's regulations, and are not subject to our review unde Historic Preservation Act of 1966, as amended. Therefore, we ha document at this time.

If we may be of further assistance, please contact David R. Review Associate Planner, at (404) 656-2840.

Sincerely,

Jeffrey L. Durbin
Environmental Revie

JLD:drb

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Clark County

Department of Comprehensive Planning

RICHARD E. HOLMES
DIRECTOR

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July 5, 1996

Ms. Nanette Founds
U.S. Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

SUBJECT: Draft Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components [The "DEIS"].

Dear Ms. Founds:

With this letter, the staff of the Clark County Department of Comprehensive Planning is submitting its formal comments on the above-referenced *DEIS*. Members of our respective staffs have already identified or discussed many of these matters at a public hearing in Las Vegas on 25 April 1996 and at a teleconference on 5 June 1996 [See letter dated June 17, 1996, Bechtel to Bergman]. We feel that these exchanges were beneficial in that we were able to readily share our views and knowledge regarding the *DEIS* and related issues. Thus, the following comments either reiterate or expand upon our previous discussions.

We recognize that the *DEIS* follows the standard NEPA-mandated DOE format of identifying alternatives and then comparing and contrasting these alternatives by describing potential impacts on a number of environments. This standard format is well-recognized as a reliable and valid process to identify traditional impacts that may result from a major federal activity such as that described in the *DEIS*. However, we feel that the approach falls short of addressing the concerns of those persons and institutions most affected by the proposed project, namely those located in proximity to the site of the proposed activity and those located along related transportation routes.

Residents of Clark County and visitors to the area certainly fall within this definition and we would expect that their perceptions and concerns would be taken into account as the *Pantex EIS* is finalized and the record of decision is reached. Accordingly, we have made comments in two areas, one covering general issues [Section 1.0] and the other addressing procedural issues [Section 2.0]. We appreciate your full consideration of our comments and we would be happy to elaborate on any of the points raised in this letter.

COMMISSIONERS
Yvonne Atkinson Gates, Chair • Paul J. Christensen, Vice-Chairman
Jay Bingham, Lorraine Hunt, Erin Kenny, Myrna Williams, Bruce L. Woodbury
Donald L. "Pat" Shearer, County Manager

1.0 General Issues

1.1 The EIS must take into account cumulative impacts on Clark County that may result from the selection of the Nevada Test Site [NTS] as a storage or disposal site for a number of DOE activities.

Given the approach taken in the *DEIS* that identifies only impacts from this one activity, it is not possible to reliably estimate the impacts to a geographic area or jurisdiction that may result from a number of initiatives taken by DOE. That is, even though other related NEPA studies are mentioned, there appears to be no analysis of potential interaction among the various DOE activities that are referenced. While any one activity may have negligible impacts on Clark County, significant impacts would result from a scenario where the NTS is selected a major site for storage or disposal of nuclear materials. Based upon the fact that the NTS is mentioned prominently in a number of ongoing DOE EISs, this latter situation is a distinct possibility.

1.2 Clark County questions the intent of DOE to actively pursue the proposed action alternative of storage of pits at the Pantex Plant.

The *DEIS* makes reference to extensive restoration work that is being planned or is in progress at the Pantex and Hanford sites. We question whether it is sound policy to conduct such environmental restoration work at Pantex, a majority which will be completed by 2000, and then store the plutonium pits on site, even for the short term. Given this, it would appear the pit storage relocation alternative may be more attractive than is presently represented in the *DEIS*. And, the NTS may emerge as the most feasible site for such relocation, since it is relatively close to the Pantex Plant, there are minimal environmental restoration plans for the NTS [as compared to other candidate sites] and there are frequent mentions of the NTS as a disposal or storage site in other DOE EISs.

For example, the *Stockpile Stewardship and Management PEIS* includes an alternative which describes the complete closing of the Pantex Plant with its capabilities relocated to NTS, Los Alamos and Lawrence Livermore facilities. The Pantex *EIS* does <u>not</u> address the implications of this alternative. This issue should be addressed in the final *EIS* and the *Record of Decision*.

2.0 Procedures

2.1 The Region of Influence [ROI] for the NTS alternative must be expanded to include the Clark County Urban Area through which all shipments are planned.

As with other DOE EISs, the defined region of influence for the assessment of impacts is 50 miles around a potential site. From Clark County's standpoint, this is a major flaw in the study since the bulk of the impacts would result from the transportation of the plutonium pits and not the storage itself. This is because the storage technology is relatively advanced and the possible NTS storage sites are well isolated and controlled. Use of the ROI around the specific storage site practically guarantees findings of no impact.

2.2 **Transportation route selection processes should employ techniques that provide for comparisons among routes based on variables agreed upon by DOE, officials of affected local jurisdictions and other stakeholders.**

While we accept the findings of the transportation risk analysis that is based on the probability of a occurrence times its consequences, we are not convinced of the validity of this approach for shipments to the NTS. The Clark County Urban Area, with Las Vegas as its hub, contains the major concentration of traffic and congestion in this mainly rural county. When the population, traffic, impedance, distance and other variables for links in the urban area are aggregated with those of all other links on a potential route, inside and outside Nevada, the relative weight and importance of the urban links is diminished. This then leads to a smoothing of the data and the usual result of insignificant risk.

We ask that the DOE take another approach in assessing risk and impact of transportation of nuclear materials - that of comparative risk assessment as endorsed by the U.S. Department of Transportation in its *Guidelines for Selecting Preferred Highway Routes for Highway Route Controlled Quantity Shipments of Radioactive Materials*, August 1992. This approach places emphasis on comparison of routes on variables that are important in decision-making processes, rather than on probability figures that are almost always insignificant and not interpretable to government decision-makers. For example, comparisons may be made on exposure of special populations, impact on environmentally sensitive areas and even relative risk of negative perceptions. This type of analysis on prospective routes selected for analysis in cooperation with affected jurisdictions would provide understandable results and a higher level of confidence in DOE actions than is now the case. As you know, Clark County is willing to provide up-to-date information for your use in such an approach.

We hope that these comments are helpful to you as you complete the *Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components*. We look forward to continuing dialogue with your staff regarding this important project.

Sincerely,

Richard B. Holmes

RICHARD B. HOLMES
DIRECTOR

cc: Clark County Board of County Commissioners
J. Ley, Clark County Manager's Office
D. Bechtel, Nuclear Waste Division

11pantex.eis

ALL INDIAN PUEBLO COUNCIL
Pueblo Office of Environmental Protection
Post Office Box 3256 • Albuquerque, New Mexico 87190 • (505) 884-0480 • FAX (505) 883-7682

May 28, 1996

Nanette D. Founds
U.S. Department of Energy
Albuquerque Operations Office
P.O.B Box 5400
Albuquerque, NM 87185-5400

Dear Ms. Founds,

This letter is in response to the Draft Environmental Impact Statement (EIS) for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components. The All Indian Pueblo Council's Pueblo Office of Environmental Protection are glad for the opportunity to comment of this document.

The Pueblo Office of Environmental Protection has the responsibility of protecting the environment of the nineteen Indian Pueblo tribes in the state of New Mexico. We have reviewed the draft EIS with this in mind.

There should be an addition to Table 6.5-4 in the Water Resource row. This table in the draft EIS has only the New Mexico state environmental statutes. Of these 19 Pueblo Indian tribes, six have received EPA approval for water quality standards under the treatment of state designation. These six are Isleta Pueblo, Sandia Pueblo, San Juan Pueblo, Santa Clara Pueblo, Picuris Pueblo and Nambe Pueblo. And of the six, Isleta Pueblo is the closest in proximity and downstream on the Rio Grande river from the Manzano Weapon Storage Area at the Kirtland Air Force base which is one of the alternative sites. Other Pueblo tribes have draft water quality standards that they anticipate approval soon.

It is only proper and respectful to mention the Pueblo water quality standards in table 6.5-4.

Sincerely,

Toney R. Begay, Sr. Environmental Scientist
All Indian Pueblo Council
Pueblo Office of Environmental Protection

CC: Everett Chavez, AIPC/POEP
Blane Sanchez, Isleta Pueblo
File

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