U.S. DEPARTMENT OF ENERGY

FINDING OF NO SIGNIFICANT IMPACT: INTERIM STORAGE OF PLUTONIUM COMPONENTS AT THE PANTEX PLANT, AMARILLO, TEXAS

AGENCY: United States Department of Energy

ACTION: Finding of No Significant Impact for the Interim Storage of Plutonium Components at the Pantex Plant.

SUMMARY: In compliance with the National Environmental Policy Act, 42 U.S.C. 4321 et seq., the Council on Environmental Quality regulations implementing the National Environmental Policy Act, 40 C.F.R. 1500 et seq., and the United States Department of Energy's implementing procedures, 10 C.F.R. 1021, the Department of Energy has prepared an Environmental Assessment (DOE/EA-0812, January 1994) to evaluate the potential environmental impacts of increased interim storage of plutonium components (pits) at the Pantex Plant located in Carson County about 17 miles northeast of Amarillo, Texas.

The Environmental Assessment analyzed the potential environmental impacts of interim storage of up to 20,000 pits at the Pantex Plant until decisions can be implemented on the long-term storage of plutonium required for national security purposes and on the disposition of surplus plutonium. In response to comments received from State and local officials and other stakeholders, the Department has decided to store no more than 12,000 pits at Pantex until it completes a site-wide environmental impact statement covering all current and proposed facilities and activities at Pantex. A Record of Decision for this environmental impact statement will be issued by November 15, 1996. The Department's interim storage decision will enable approximately three more years of nuclear weapons dismantlement activities at Pantex. The Department now envisions that the Pantex Site-Wide Environmental Impact Statement will address all storage requirements, including alternative locations, for all plutonium, highly enriched uranium, tritium, and classified weapons components that result from Pantex dismantlement activities. Scoping meetings for this Environmental Impact Statement will be held in Amarillo, Texas, and at other sites that might be affected by the activities at Pantex by June 30, 1994. In addition, the Reconfiguration Programmatic Environmental Impact Statement is scheduled to be completed in 1995. It will analyze all reasonable long-term pit storage alternatives and discuss the disposition options the Department is considering, and the Record of Decision will include decisions on pit storage locations. The Pantex Site-Wide Environmental Impact Statement will take into account any decisions resulting from the Reconfiguration Programmatic Environmental Impact Statement.

The Department of Energy provided a pre-approval review copy of the Environmental Assessment to the State of Texas in December 1992. Subsequently, the State provided the pre-approval Environmental Assessment to interested and affected members of the public. State and public comments were submitted to the Department for consideration during February and March, 1993. In response to these comments, the Department reviewed and revised the Environmental Assessment and added a Comment Response Document. This revised pre-approval Environmental Assessment was issued on November 11, 1993, for public review and comment.

The Department then held a public meeting on December 6, 1993, in Amarillo, Texas, to discuss the revised Environmental Assessment and Comment Response Document and to respond to comments from State and local officials and the public. Subsequent to the public meeting, the Department accepted written comments on the revised pre-approval Environmental Assessment until December 20, 1993. The Environmental Assessment was expanded to include the Department's response to the comments received on the revised Environmental Assessment.

Based upon the analyses in the Environmental Assessment and after careful consideration of all comments from State and local officials and members of the public, the Department of Energy has determined that storage of no more than 12,000 pits at Pantex does not constitute a major Federal action significantly affecting the quality of the human environment, within the meaning of the National Environmental Policy Act. Therefore, an environmental impact statement is not required and the Department issues this Finding of No Significant Impact.

ADDRESSES AND FURTHER INFORMATION: Persons requesting additional information regarding this action or desiring a copy of the Environmental Assessment should contact:

Mr. Thomas Walton, Public Affairs Officer
Amarillo Area Office
P.O. Box 30030
Amarillo, Texas 79120
(806) 477-3120

Copies of the Environmental Assessment are available for public review at the following Department of Energy reading rooms:

U.S. Department of Energy
Freedom of Information Reading Room
Forrestal Building, Room 1E-190
1000 Independence Avenue, SW
Washington, DC 20585
(202) 586-6020

U.S. Department of Energy
Reading Room
Amarillo College
Lynn Library/Learning Center
P.O. Box 447
Amarillo, Texas 79178
(806) 371-5400

U.S. Department of Energy
Reading Room
Carson County Library
P.O. Box 339
Panhandle, Texas 79068
(806) 537-3742

For general information regarding the Department of Energy National Environmental Policy Act process, please contact:

Ms. Carol M. Borgstrom
U.S. Department of Energy
Office of National Environmental Policy Act Oversight
1000 Independence Avenue, SW
Washington, DC 20585
(202) 586-4600 or (800) 472-2756

SUPPLEMENTARY INFORMATION:

The Pantex Plant is located in Carson County, about 17 miles northeast of Amarillo, Texas, and central to the panhandle of Texas. As a component of the national nuclear weapons research, development, and production complex administered by the Department of Energy, the primary mission of Pantex is the assembly, disassembly, and surveillance of nuclear weapons. Within the disassembly portion of the Department of Energy mission, weapons are returned to Pantex from the Department of Defense, disassembled and the plutonium pits stored at Pantex.

Two factors combine to create the need for increased interim storage of pits. First, decisions to reduce the size of the nuclear weapons stockpile have accelerated the accumulation of pits. These pits need to be stored on an interim basis until decisions can be implemented on the long-term storage of plutonium required for national security purposes and on the disposition of surplus plutonium.

Second, pits are no longer being shipped from Pantex to the Rocky Flats Plant, near Golden, Colorado, to be recycled. This function was temporarily halted at the Rocky Flats Plant in 1989 to make improvements in the operations and facilities. In January 1992, pit recycle operations were suspended indefinitely. Subsequently, the Department has decided to no longer maintain a nuclear component production capability at the Rocky Flats Plant.

PROPOSED ACTION DESCRIBED IN THE ENVIRONMENTAL ASSESSMENT AND DECISION: The proposed action as described in the Environmental Assessment was to provide additional storage beyond the present pit storage capacity (6,800 pits) for up to 20,000 pits for an interim time period. In response to comments received from State and local officials and other stakeholders, the Department has decided to increase the interim storage of pits at Pantex under this Finding of No Significant Impact to no more than 12,000 pits. There would not be a need to construct or demolish any additional facilities; nor would there be any increased generation or management of wastes, uncontained plutonium handling, or plutonium processing as a result of this decision. The Department will implement this decision in the same manner as described in the proposed action for storage of 20,000 pits with one exception, the number of magazines that will be utilized. Approximately 31 magazines will be used instead of 49. The operations will remain the same in that inspections and inventories of pits will be carried out in the same manner, the method of storage will remain as described in the proposed action, and the number of pits stored in each magazine will remain the same.

Two types of magazines exist at Pantex. There are 18 Modified-Richmond magazines, and 42 Steel Arch Construction magazines. Currently, Steel Arch Construction magazines are not utilized for pit storage. Dismantlement activities at Pantex will continue and pit storage will be expanded to include the Zone 4 Steel Arch Construction magazines consistent with the Environmental Assessment and the Final Safety Analysis Report for Zone 4 and all magazines will use the preferred interim storage configurations in the Environmental Assessment. The preferred interim storage configurations are either multiple stacking of containers placed horizontally on pallets or a single layer of containers placed vertically on the floor with aisles to facilitate access for inventory and surveillance activities. Because of its overall advantages, storage eventually will be accomplished using the multiple stacked configuration. After successful completion of the Department's Operational Readiness Review for horizontal stacking, scheduled for mid-February 1994, storage using this configuration will begin. Until then, storage will be undertaken using the vertical configuration previously described. The number of pits that could be held within each of the 18 Modified-Richmond magazines will increase from 378 pits to a maximum of 440 as accomplished by using a horizontal palletized multiple stacking configuration. In addition, each Steel Arch Construction magazine will hold up to 384 or 392 pits, in the vertical single-layer or horizontal palletized multiple stacking configurations, respectively.

These two configurations represent the limiting cases for the numbers of pits held in a single Modified-Richmond or Steel Arch Construction magazine. In the vertical configuration, individual pit containers may rest on casters rather than on the concrete floor of magazines. This will facilitate inventory operations and worker safety, and accommodate operational needs. In addition, some Steel Arch Construction magazines will be reserved for assembled weapons and component staging activities that have taken place in the past, and will continue in these facilities.

Each pit is clamped in a holding fixture and inserted in a storage container comprised of a carbon or stainless steel drum lined with a nominal three inches of insulating and cushioning material. The pallets for the horizontal multiple stacking configuration are designed to ensure structural integrity and stability. An electric forklift with shielding for radiation protection will be used for storage, retrieval, and inventory operations for the horizontal palletized stacking configuration. The shielded forklift has a passive guidance system (e.g., rail guides, wire guides, etc.,), which prevents the forklift from veering from the aisle, and is equipped with a lateral motion, turret-type fork assembly, which allows palletized pit containers to be stacked and retrieved.

ALTERNATIVES: The Environmental Assessment considers the alternatives of No Action, Combination of the Proposed Action Storage at Pantex with Storage at Other Department of Energy Sites (Savannah River Site, Los Alamos National Laboratory, and the Hanford Site), Supplement No-Action Alternative Storage Capacity with Storage at Other Department of Energy Sites, and Interim Storage at a Department of Defense Facility. Based on the analysis in the

Environmental Assessment, none of the alternatives would provide sufficient increased interim storage capacity for pits while continuing disassembly operations at the anticipated rate, and none would meet other programmatic objectives, i.e., to provide an approach that is timely and cost effective and utilizes to the maximum extent practicable existing facilities and infrastructures.

ENVIRONMENTAL IMPACTS: Routine Operating Conditions: Under normal operating conditions, the storage of up to 12,000 pits would result in only minor releases of air pollutants associated with equipment engines and a minor increase in particulates (dust) associated with forklift operations in moving security blocks and pit containers to the magazines. There would be no impact to water resources, flood plains, wetlands, cultural resources, or other site features. No new facilities are required to increase storage capacity. Consequently, there would be no environmental impact due to the need for construction or significant modification of facilities.

The primary impact of routine operations is occupational radiation exposure to workers involved in placement of pits into storage and periodic inspections and inventories of pits stored on an interim basis. Increasing the number of pits from 6,000 to 12,000 will increase the estimated cumulative personnel exposure by approximately 14 percent (from 67.8 person-rem per year as reflected in Appendix F of the Environmental Assessment to approximately 80.4 person-rem per year). For all operations at the Pantex Plant, worker radiation doses are maintained below the annually established Pantex operating limit of 1 rem per year. This limit is well below the federally mandated limit of 5 rem per year. Limiting the number of pits stored at Pantex on an interim basis to a maximum of 12,000 pits would reduce the cumulative Personnel Exposure (person-rem/yr) estimated to occur from the proposed action in Appendix F of the Environmental Assessment from 92.4 person-rem per year to 80.4 person-rem per year. The reduction would result from reducing the total number of magazines inventoried on an annual basis from 40 magazines per year to 24 magazines per year. The handling procedures and rate of fill of the magazines described in the Environmental Assessment remain unchanged. Individual exposures would be maintained well within Federal and Department guidelines. Emphasis will be placed on ensuring that doses to workers will be minimized through implementation of "As Low As Reasonably Achievable" practices.

Additionally, the level of penetrating radiation expected to result from storage of up to 12,000 pits would result in no measurable effect on exposure to an individual occupying a position for an entire year at the nearest Pantex site boundary. Such a level would be indistinguishable from natural background radiation. No adverse health effects would be expected among the general public as a result of routine operations from this action.

<u>Abnormal Events/Accidents:</u> The Department of Energy analyzed a series of potential accidents in the Environmental Assessment. By using conservative assumptions (i.e., those that tend to overestimate potential impacts), the Department of Energy attempted to bound all reasonably foreseeable adverse impacts. The Department of Energy analyzed impacts from abnormal events having a probability of occurrence of greater than one in a million (1×10^{-6}).

Potential accident-initiating events considered in the Safety Analysis Report of the Zone 4 magazines were reviewed for potential impact. Included were earthquakes, external explosions, forklift accidents, missiles, tornados, and aircraft crash. The potential for consequences for an abnormal event/accident range from negligible to marginal. No consequences to the public or the environment would be anticipated. The workers in the immediate vicinity of the accident site could receive a marginal radiation dose. An analysis performed of the likelihood of an aircraft crash into a Modified-Richmond or Steel Arch Construction magazine in Zone 4 indicated an annual probability of less than 1×10^{-6} per year.

Because the Ogallala Aquifer is the primary water source for most of the Texas Panhandle, and in response to the expressed interest of State and local officials and the public regarding possible contamination of the aquifer, the Department of Energy performed additional analyses on potential impacts to the aquifer. The analyses describe the potential for aquifer contamination should plutonium be released to the environment within an 80-km radius of the Pantex Plant. No accident or routine operating condition with a probability greater than 1×10^{-6} was identified that could result in a plutonium release having an impact on the Ogallala Aquifer. In the unlikely event of an accident that resulted in a release of plutonium, it is expected that the majority of the radioactivity (90 percent) deposited on the soil surface would remain in that top layer of soil. Because plutonium is relatively immobile in soils similar to those found at and near the Pantex site, no effects to the Ogallala Aquifer would be expected.

DETERMINATION: Based upon the analyses in the Environmental Assessment, and after careful consideration of comments received, the Department of Energy has determined that the storage of no more than 12,000 pits at Pantex does not constitute a major Federal action significantly affecting the quality of the human environment. Therefore, an Environmental Impact Statement is not required and the Department issues this Finding of No Significant Impact.

Any new Finding of No Significant Impact, if that should prove necessary, that relies on the Environmental Assessment for Interim Storage of Plutonium Components at the Pantex Plant will be issued only after consultation with State and affected stakeholders regarding DOE's views of the need for a revised Finding of No Significant Impact and after a public meeting in Amarillo to consider the proposed Finding of No Significant Impact. If a new Finding of No Significant Impact is issued, it will respond to comments received during the consultation and public meeting process.

Issued at Washington, DC, this January 19, 1994.

Tara O'Toole

Tara O'Toole, M.D., M.P.H.
Assistant Secretary
Environment, Safety and Health

INSTRUCTION SHEET
DEPARTMENT OF ENERGY RESPONSE TO COMMENTS FROM THE STATE OF TEXAS

Use the following three-step process to locate your comments and the Department's response:

Step 1 To find the document number assigned to the individual letters, use Table ES-1 in the Executive Summary of the Department of Energy's Response to Comments from the State of Texas (Volume I).

> **Example**: The letter received from Governor Ann Richards has been assigned the document number 1001.

The letters are located in Volume II - Letters Received from the State of Texas. The dividers correspond to the document number assigned to each letter.

Step 2 To locate individual comments extracted from the letters, refer to the letters in Volume II. In the right hand margin of the letters, individual comments were assigned two numbers. The first number is the document number and the second number is the comment number for that particular letter.

> **Example**: On the second page of Governor Ann Richards' letter (document #1001), the first sentence of the second paragraph has the number 1001/1 in the right hand margin. The number indicates that the first sentence is comment #1 for this letter.

Step 3 To find the assigned response to a specific comment, use the index in Appendix K of the Department of Energy's Response to Comments from the State of Texas (Volume I). The index lists numerically all of the comments extracted from the letters by document and comment number.

> **Example**: For Governor Ann Richards' letter (document #1001), there are three comments listed. The following information is provided for comment #1 of document #1001 (1001/1):
>
> Document #: 1001   Comment #:1   Response #: E.1

To locate the corresponding page for the response, use the Table of Contents for the Department of Energy's Response to Comments from the State of Texas (Volume I).

> **Example**: In the Table of Contents for Volume I, Response E.1 to document/comment number 1001/1 is located under Section E, Ogallala Aquifer. The response starts on page E-1 of the Department of Energy's Response to Comments from the State of Texas (Volume I).

If you have any difficulty in locating comments or responses, please call 1-800-832-0890. When you hear the recording, press 0 for the Department of Energy operator and ask to be connected to either Tracey Leslie at extension 3-5543 or Lisbeth Walker at extension 3-3504. If both are unavailable, please leave a message with a phone number and someone will return your call as soon as possible.

DOE/EA-0812

ENVIRONMENTAL ASSESSMENT FOR INTERIM STORAGE OF PLUTONIUM COMPONENTS AT PANTEX

AND

DEPARTMENT OF ENERGY RESPONSE TO COMMENTS ON THE PRE-APPROVAL ENVIRONMENTAL ASSESSMENT AND THE REVISED PRE-APPROVAL ENVIRONMENTAL ASSESSMENT AND PUBLIC MEETING

VOLUME I

JANUARY 1994

U.S. Department of Energy
Albuquerque Operations Office
Amarillo Area Office
Pantex Plant
P.O. Box 30030

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The primary mission of the Department of Energy Pantex Plant is the assembly and disassembly of nuclear weapons. Historically, weapons were returned to the Pantex Plant from the Department of Defense, disassembled, and the plutonium components (pits) were temporarily held (staged) at the Pantex Plant until they were recycled to make new weapons. The Department is now proposing to expand the capability to hold pits at Pantex and to store them there on an interim basis pending implementation of decisions on long-term storage and disposition.

This Environmental Assessment evaluates the environmental impacts of additional interim storage of pits at the Pantex Plant in Amarillo, Texas. Two factors combine to create the need for increased interim storage of pits. First, pits are no longer being shipped to the Rocky Flats Plant from Pantex to be recycled. This function was temporarily halted at the Rocky Flats Plant in 1989 to make improvements in the operations and facilities. In January 1992, pit recycle operations were suspended indefinitely. Subsequently, the Department has decided to no longer maintain a nuclear component production capability at Rocky Flats Plant.

Second, decisions to reduce the size of the nuclear weapons stockpile have accelerated the accumulation of pits. These pits need to be stored on an interim basis until decisions can be implemented on the long-term storage of plutonium required for national security purposes and on the disposition of surplus plutonium. Long-term storage is being considered in the Nuclear Weapons Complex Reconfiguration Programmatic Environmental Impact Statement, currently in preparation. The Programmatic Environmental Impact Statement will analyze environmental impacts, costs and technical considerations of the various alternatives. In addition, the Department will prepare a new site-wide Environmental Impact Statement for the Pantex site to update the information and analysis contained in the 1983 Pantex Site statement. This Environmental Impact Statement will examine all aspects of current and foreseeable operations at the Pantex Plant. This will include all dismantlement and storage-related issues at the Pantex Plant.

In regard to the disposition of plutonium, on September 27, 1993, President Clinton established an interagency task force to determine the disposition of plutonium surplus to national defense requirements. This task force is being led by the National Security Council and the Office of Science and Technology Policy. The Department is committed to prepare an EIS to underpin its implementation of actions it proposes to take in conjunction with the task force recommendations on the disposition of surplus plutonium.

The proposed action analyzed in this Environmental Assessment is to provide additional storage beyond the present pit storage capacity (6,800 pits) for up to 20,000 pits for an interim time period. The number of pits that could be held within each of the 18 Modified-Richmond magazines (western portion of Zone 4) would increase from approximately 370 to a maximum of 440. In addition, each of the existing 42 Steel Arch Construction magazines, also located in the western portion of Zone 4, could be used to hold up to 392 pits. The increase in storage capacity for each Modified-Richmond magazine involves utilizing a multiple stacking configuration of the pits within the magazine. Steel Arch Construction magazines have not been used previously for holding pits, and the multiple stacking configuration has not been used previously in Steel Arch Construction or Modified-Richmond magazines. Eighteen Modified-Richmond and 42 Steel Arch Construction magazines (in either multiple- or single-layer storage configuration) could be used for pit storage. However, some of these will continue to be used for assembled weapon and component staging activities. The practice of segregating weapons from components will continue. Pits stored on an interim basis will be segregated from other stored weapon components.

The proposed action is immediately available, would not require new facility construction or demolition of existing structures, and would result in negligible additional generation or management of wastes. Environmental impacts of the proposed action from routine operations would be limited to radiation exposure of workers which would be controlled, as currently is done, with procedures and personnel monitoring to ensure that the Department of Energy's "As Low As Reasonably Achievable" objectives are achieved and the current worker dose limits maintained. Therefore, no adverse health effects among workers would be expected. There would be no measurable increase in direct radiation above natural background radiation at the Pantex Plant boundary. The potential for plutonium release from various types of accidents and abnormal events (including aircraft crashes) was examined. The analysis concluded that the initiating events were so improbable that they are not credible. Additionally, it was determined from the analysis of potential accidents that no significant plutonium release would occur.

A number of alternatives to increased interim pit storage at the Pantex Plant were considered. These included interim storage at other Department of Energy facilities (the Los Alamos National Laboratory, the Savannah River Site, and the Hanford Plant) and Department of Defense sites as well as a No-Action Alternative. None of the alternatives (alone or in combination) has been shown to meet the programmatic objective to provide sufficient increased interim storage capacity while continuing disassembly operations at the anticipated rate.

The No-Action Alternative does not meet the weapon disassembly goals in support of weapons reduction initiatives and would negatively affect ongoing efforts by the Department of Defense to streamline its operations and to meet its commitments to receive and store munitions and equipment currently outside the continental United States. The benefits of totally dismantling the weapon, eliminating the potential for accidental or unauthorized detonation and reducing the number of highly attractive terrorist targets, would also not be realized.

For each of the other alternatives there would be additional costs, transportation requirements, potential requirements for facility modifications (for pit storage, support structures or security enhancements), and additional time would be required to establish the infrastructure in order to implement interim storage at an alternative site. Impacts of the Proposed Action were found to be limited to worker exposures to radiation. No environmental benefit would be gained in packaging and shipping some or all of the pits to any other location for interim storage purposes and there would be increased worker exposure due to the additional handling that would be required.

The Department of Energy provided a Pre-Approval copy of the Environmental Assessment to the State of Texas in Texas in December 1992. Subsequently, the State provided the Pre-Approval Environmental Assessment to interested and affected members of the public. State and public comments were submitted to the Department for consideration during February and March, 1993. In response to these comments, the Department reviewed and revised the Environmental Assessment, adding a Comment Response Document (See Volume I, Section II, Response to Comments on the Pre-Approval Environmental Assessment Received From the State of Texas). The revised Pre-Approval Environmental Assessment was issued on November 11, 1993.

The Department then held a public meeting on December 6, 1993 in Amarillo, Texas to review the revised Environmental Assessment and Comment Response Document. Following the public meeting, the Department accepted written comments beginning December 6, 1993 and concluding December 20, 1993. The Environmental Assessment was expanded to include the Department's response to the comments received during the two-week period (See Volume I, Section III, Response to Comments on the Revised Pre-Approval Environmental Assessment and Public Meeting).

1.0 INTRODUCTION AND BACKGROUND

1.0 INTRODUCTION AND BACKGROUND

In three recent nuclear weapons policy declarations (September 27, 1991, January 28, 1992, and June 16, 1992), the United States' initiated efforts to reduce its nuclear weapons arsenal. These reductions, made possible by the end of the Cold War and the associated changes in United States national security needs, were defined and directed through joint Department of Energy/ Department of Defense actions. The Nuclear Weapons Stockpile Memoranda and corresponding Planning and Production Documents direct the retirement of, and establish retirement rates for, weapons held in the custody of the Department of Defense. The Department of Energy establishes a schedule for the return and dismantlement of weapons in support of these retirement rates. The outcome of the three policy declarations is the commitment to reduce the nuclear weapons stockpile from more than 20,000 warheads to fewer than 10,000 warheads before the end of the century. To meet this stockpile reduction initiative, the Department of Energy has established a goal of maintaining a disassembly rate of 2,000 weapons per year for the near-term. This level of activity at the Pantex Plant for weapons disassembly would be similar to that experienced in the past for all assembly/disassembly operations.

Historically, the Department of Energy's national security mission has included the assembly and disassembly of nuclear weapons. A nuclear weapon is comprised of a physics package, containing special nuclear material (i.e., plutonium or highly enriched uranium) and other materials and components. Most nuclear weapon physics packages contain a primary assembly that consists of a detonator system and a ball-shaped composite of either high explosive or insensitive high explosive surrounding a component called a pit. The pit is comprised of a hermetically sealed metallic outer shell and an inner shell of solid plutonium metal.

The primary mission of the Pantex Plant is the assembly and disassembly[1] of nuclear weapons. The Pantex Plant has conducted these activities in a safe and responsible fashion for more than 40 years. Newly assembled weapons are transported and transferred to the Department of Defense for deployment. Retired weapons are returned to the Pantex Plant for disassembly. The pits from the disassembled weapons were typically staged[2] at the Pantex Plant.

Until 1989, Pantex Plant activities were closely coupled to the operations at the Rocky Flats Plant near Denver, Colorado. Two of the Rocky Flats Plant's primary missions were: 1) manufacture of pits which were eventually transported to the Pantex Plant for final assembly into nuclear weapons, and 2) receipt of pits from the Pantex Plant from disassembled weapons for recovery, reprocessing, and fabrication of the special nuclear material into new pits.

In December 1989, plutonium processing and pit fabrication operations at the Rocky Flats Plant were curtailed by the Department of Energy pending resolution of safety and environmental issues. The Pantex Plant continued to disassemble weapons, but shipments of pits from dismantled weapons between the Pantex Plant and Rocky Flats Plant were suspended. The pits from those weapons were staged in Zone 4 for later shipment to the Rocky Flats Plant. The Department of Energy had anticipated that shipments of pits to the Rocky Flats Plant would be

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[1] Over 50,000 nuclear weapons have been dismantled within the nuclear weapons complex in the last 40 years, and over 30,000 of those at the Pantex Plant.

[2] Staging is the temporary holding of materials (weapons or components) as they await a next step (i.e., disassembly or transport off-site). There has been no set time limit historically for staging since movement of materials, for transport or disassembly, has been dependent on scheduling, conditions of the potential receiving facilities and resource availability.

reinitiated when processing activities in support of new weapons programs were resumed. Efforts to restart plutonium processing operations continued until January 1992 when they were terminated by the Department of Energy because of reduced requirements for nuclear weapons production in support of the national defense. Consequently, pits from weapons disassembled at the Pantex Plant have been placed in interim storage in Zone 4.

The activities necessary to carry out the Pantex assembly and disassembly mission (including staging of pits) were analyzed in the Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983). The Department of Energy has prepared this Environmental Assessment to focus on the proposed activities necessary to accommodate the interim storage of the pits from the weapons disassembled as a result of the arms reduction commitments discussed above. The Department also will prepare a new site-wide environmental impact statement to update the 1983 document.

2.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

2.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

The proposed action is to provide interim storage of pits removed from nuclear weapons in response to recent nuclear weapons reduction initiatives[3]. The proposed action is required to enable these reductions, and it also maintains the benefits that accrue from dismantling weapons, which is to eliminate the potential for accidental or unauthorized detonation. Further, it reduces the number of highly attractive terrorist targets, and it permits more cost-effective operations for the Department of Defense.

The proposed action analyzed in this document has evolved as a result of recent developments in the areas of national security and foreign policy. As originally envisioned, the proposed action was to provide additional storage for up to 20,000 pits at Pantex for a period of approximately six to ten years. The anticipated duration of the interim storage was based on the December 1994 expected completion of the Department's Reconfiguration Programmatic EIS, allowing sufficient time to implement the decision regarding the future nuclear weapons complex that would be made on the basis of that Programmatic Environmental Impact Statement. It was expected that one of the elements of the future weapons complex would be a new long-term storage facility, to be constructed within the six to ten year time frame.

President Clinton, on September 27, 1993 established an interagency task force to determine the disposition of plutonium surplus to national defense requirements. This task force is being led by the National Security Council and the Office of Science and Technology Policy with the participation of the Arms Control and Disarmament Agency, the Central Intelligence Agency, the Office of Management and Budget, and the Departments of State, Defense and Energy. The public and certain foreign nations will also be invited to participate in the task force. The results and implementation of its recommendations are likely to have significant impact on both the number of pits requiring long-term storage, and the duration of any storage period. It is likely that a substantial majority of the pits proposed to be stored at Pantex, which are surplus to the nation's defense needs, will be affected by decisions resulting from the work of the task force. Because the task force was so recently chartered, however, it is impossible to now predict the timing of its recommendations or their implementation.

In addition to its participation in this task force, the Department is conducting or will shortly commence the following National Environmental Policy Act reviews which also will address the storage of plutonium:

First, as noted above, the Reconfiguration Programmatic Environmental Impact Statement is examining the alternatives for the long-term storage of all Department of Energy owned plutonium. The alternatives being considered for long-term storage include "no-action," which, if selected in the Record of Decision on that Environmental Impact Statement, would continue the storage of the pits at Pantex in the existing facilities. Another alternative being considered is to upgrade the existing facilities. If this alternative is selected in the Record of Decision, upgrades to the existing storage facilities, including Pantex, would occur following a likely additional project specific review under the National Environmental Policy Act. The final alternative under consideration is the siting

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[3] President Bush's remarks to the Nation from the Oval Office on September 27, 1991: "I am therefore directing that the United States eliminate its entire worldwide inventory of ground-launched short-range, that is, theater nuclear weapons. We will bring home and destroy all of our nuclear artillery shells and short-range ballistic missile warheads."

"Many of these land and sea-based warheads will be dismantled and destroyed. Those remaining will be secured in central areas where they would be available if necessary in a future crisis."

and construction of a new consolidated long-term storage facility which, if selected in the Record of Decision, would result in the pits stored at Pantex being moved to that facility, at 1 of 5 candidate sites. The Record of Decision is expected to be issued in 1995. It should be noted that the Pantex site is among five sites under consideration for the location of a new long-term storage facility.

Second, the Department is commencing the preparation of a new site-wide Environmental Impact Statement for the Pantex site. This Environmental Impact Statement will examine all aspects of current and foreseeable activities and operations of the Pantex Plant, including all dismantlement and storage-related issues. This Environmental Impact Statement will include analysis of measures to further mitigate the impacts of Pantex operations. While the scope of the Environmental Impact Statement cannot be defined precisely until the public scoping process has been completed, the Department of Energy expects that alternatives to the continued storage of pits at Pantex will be considered. This review will take 2-3 years to complete. The public will be invited to help both scope the appropriate review and provide comments on the draft Environmental Impact Statement when completed.

Third, the Department is committed to include in an Environmental Impact Statement appropriate major federal actions it proposes to take in conjunction with the task force on the disposition of surplus plutonium. This will help ensure meaningful public involvement in the examination of alternative means of disposition.

The resolution of all these uncertainties and the preparation of these documents will require time, making it less likely to site and construct a new long-term storage facility on the schedule previously indicated and which would have led to storage relief at Pantex in six to ten years. Because of the national security and foreign policy considerations previously described, which highlights the importance of the continued disassembly of nuclear weapons and the consequent interim storage of the fissile material they contain, the Department cannot wait for these longer-term programmatic decisions. If the proposed action is not adopted, shipment of nuclear weapons to Pantex for dismantlement will likely cease in the first quarter of 1994 and actual dismantlement will cease shortly thereafter, given the current disassembly rate.

Accordingly, the Department is proposing to provide storage for up to 20,000 pits in the Pantex facility on an interim basis until the longer-term decisions on storage/disposition are made and implemented. The Department is now contemplating that the new site-wide Environmental Impact Statement for the Pantex site will consider the environmental impacts for a period of 5-10 years associated with continued operation of the Pantex Facility, including storage. The long-term decisions regarding the storage/disposition of plutonium will be made following the completion of the Reconfiguration Programmatic Environmental Impact Statement now scheduled for late 1994, and the work of the task force on plutonium disposition. These decisions will be made on the basis of the various activities and analyses described above.

The proposed action is consistent with storage activities currently conducted at the Pantex Plant site, but will result in:

1. An increase in pit storage capacity, from 6,800[4] to a maximum of 20,000;

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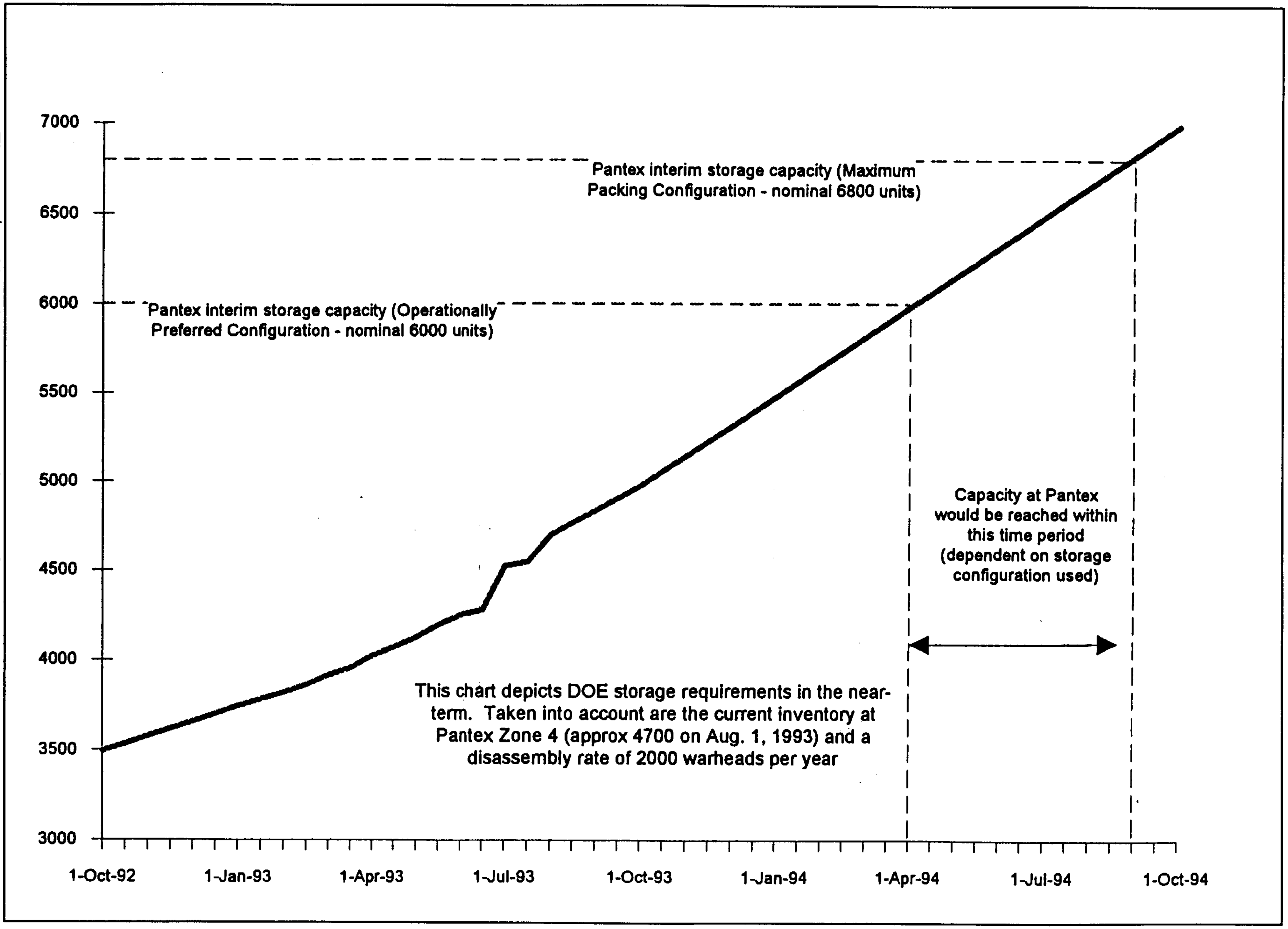
[4] The 6,800 value is based on the maximum packing configuration in Modified-Richmond magazines. This configuration is not currently the operationally preferred configuration, but serves to provide the most conservative bounding parameters for the safety and environmental analyses.

2. A reallocation of the number and type of magazines to be employed for interim storage; and

3. A change in the historical staging/storage configuration to allow increased operational flexibility and efficiency (multiple stacking);

Unless interim storage capacity is increased in the near-term, the Department of Energy will likely be forced to cease disassembly activities in the first quarter of 1994, given the current dissassembly rate. (Figure 2.1).

Figure 2.1 Near-Term Projected Storage Capacity Requirements



3.0 PROPOSED ACTION

3.0 PROPOSED ACTION

The proposed action is to provide interim storage for up to 20,000 pits in the Pantex facility until decisions can be implemented on the long-term storage of plutonium required for national security purposes and on the disposition of surplus plutonium. These decisions will be made on the basis of the various activities and analyses described in Section 2.0.

Implementation of the proposed action requires an increase in the interim storage capacity of the Pantex Plant. This increase in capacity would involve an increase in both the number of storage magazines allocated for storing pits and the number of pits stored within each magazine. Currently, up to 6,800 pits could be held in 18 Modified-Richmond magazines located in the western portion of Zone 4 (Figures 3.1 and 3.5). However, to facilitate measures to reduce worker exposures to radiation during safeguards and security activities, an alternative storage configuration (Figure 3.2) is being employed. This storage configuration permits storage of a nominal 6,000 pits.

Under the proposed action, the number of pits held within each of the 18 Modified-Richmond magazines would increase from 378 pits to a maximum of 440. This is accomplished by using a horizontal palletized multiple stacking configuration. In addition, each of the existing 42 Steel Arch Construction magazines also located in the western portion of Zone 4 could be used to hold up to 384[5] or 392 pits, using the single-layer vertical or horizontal palletized multiple stacking configurations respectively. Steel Arch Construction magazines have not been used previously for holding pits, and the horizontal palletized multiple stacking configuration has not been utilized previously in either Modified-Richmond or Steel Arch Construction magazines. (See Table 3-1.) Although designation of 18 Modified-Richmond and 42 Steel Arch Construction magazines for storage (in either multiple or single-layer storage configuration) would provide for more than 20,000 storage spaces, this designation allows for operational flexibility and facilitates security and safeguards by not specifying specific magazines. Furthermore, some Steel Arch Construction magazines would be reserved for assembled weapon and component staging activities that have historically taken place, and will continue to take place, in these facilities. The practice of segregating weapons from components would continue, and interim stored pits would be segregated from other staged weapon components.

The Department of Energy Orders and procedures for ensuring safe and secure storage of the pits would continue to be followed rigorously. The majority of the pits in Zone 4 will continue to be packaged in AL-R8 containers (RFE-8801, 1988), but other approved containers such as Type B containers may be used. Type B containers are certified for off-site transportation of pits under the Department of Energy performance criteria adopted from Title 10 Code of Federal Regulations Part 71 whereas the AL-R8 container is not. While both container types adequately meet the design safety requirements necessary for interim storage of plutonium components, pits packaged in the AL-R8 container would have to be repackaged into a certified shipping container for shipment off-site. The AL-R8 container utilizes the pit structure for containment whereas a Type B certified shipping container has two independent seals for containment. The AL-R8 container is constructed of 18-gauge carbon steel, and the container is internally lined with Celotex® fiberboard to provide impact and thermal protection wherein the pit is suspended within the fiberboard using a steel clamping device. The outer containment of a Type B shipping container is 16-gauge stainless steel and the inner containment drum (within which the pit is

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[5] The Steel Arch Construction magazine operational limit for pits stored in the vertical single-layer configuration. Actual maximum packed capacity of 406 pits/Steel Arch Construction magazine will not be considered for use.

located) is constructed of 12-gauge stainless steel. Celotex® packaging material is used between the inner and outer containment drums and also around the pit inside the inner containment drum.

Table 3-1 - Pit Storage Capacity

	No-Action Alternative		Proposed Action*		
Magazine Type	(vertical single-layer configuration)		(vertical single-layer configuration)		(horizontal palletized multiple stacking configuration)
	Operationally preferred	"bounding" configuration	Operationally preferred	"bounding" configuration	
Modified-Richmond	336 (Figure 3-2)	378 (Figure 3-5)	336 (Figure 3-2)	378 (Figure 3-5)	440 (Figure 3-3)
Steel Arch Construction	Not in use for pit staging or storage		384 (not shown)	406 (Figure 3-6) (will not be considered for use)	392 (Figure 3-4)

* No-Action storage configurations may also be used during interim storage activity (either during transition to horizontal palletized multiple stacking configuration or as necessary) since the No-Action configurations are bounded within the current Safety Analysis Report analyses.

In either type of magazine, the pit, in its approved container, would be stored in one of two configurations: multiple stacking of containers placed horizontally on pallets (Figures 3.3 and 3.4), and/or a single layer of containers placed vertically on the floor (Figures 3.5 and 3.6). The pallets for the multiple stacking configuration have been designed to ensure structural integrity and stability. Final Safety Analysis Report, Pantex Plant Zone 4 Magazines (Issue D, April 1993) concluded that the multiple stacking configuration would be stable in a maximum credible earthquake scenario. These two configurations represent the bounding cases for the numbers of pits that would be held in a single Modified-Richmond or Steel Arch Construction magazine. Variations and/or a combination of these arrangements may be used. Individual pit containers could rest on casters rather than on the concrete floor of magazines, and aisles may also be used. This would facilitate inventory operations, ensure worker safety, and accommodate operational needs.

An electric forklift with shielding for radiation protection would be used for storage, retrieval, and inventory operations for palletized stacking configurations or individual container handling. The shielded forklift will have a passive guidance system (e.g., rail guides, wire guides, etc.) for the palletized stacking configuration that will prevent the forklift from veering from the aisle. The forklift will be equipped with a lateral motion, turret-type fork assembly that allows palletized pit containers to be stacked and retrieved without having the forklift itself turn. The shielded forklift system is an example of the emphasis at the Pantex Plant to reduce and then maintain worker radiation exposure. Efforts are currently under way to develop Automated Guided Vehicles that could be used both to place pits in magazines and to assist in taking inventories using barcode readers. The use of Automated Guided Vehicles could further reduce worker exposure to external radiation associated with pit interim storage and inventory activities. Only the shielded forklift operator will be inside the magazine during the operations. Shielding on the forklift should provide a dose reduction factor of at least 20 over current inventory methods.

Implementation of the proposed action would not involve new facility construction, demolition, additional generation or management of wastes, uncontained plutonium handling or processing, long-term or permanent storage, or disposal of plutonium components at the Pantex Plant.

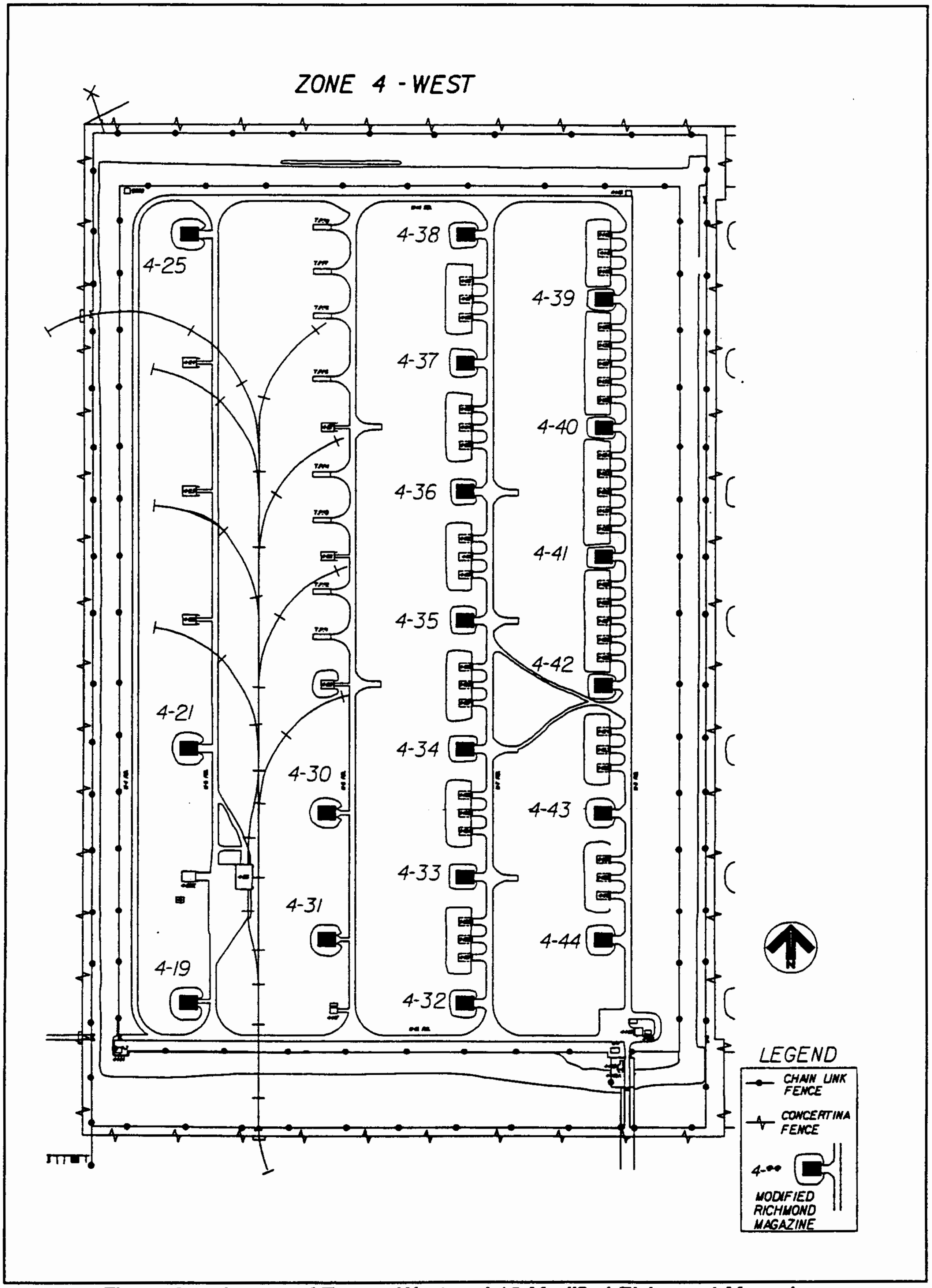


Figure 3.1 - Layout of Zone 4 West and 18 Modified-Richmond Magazines

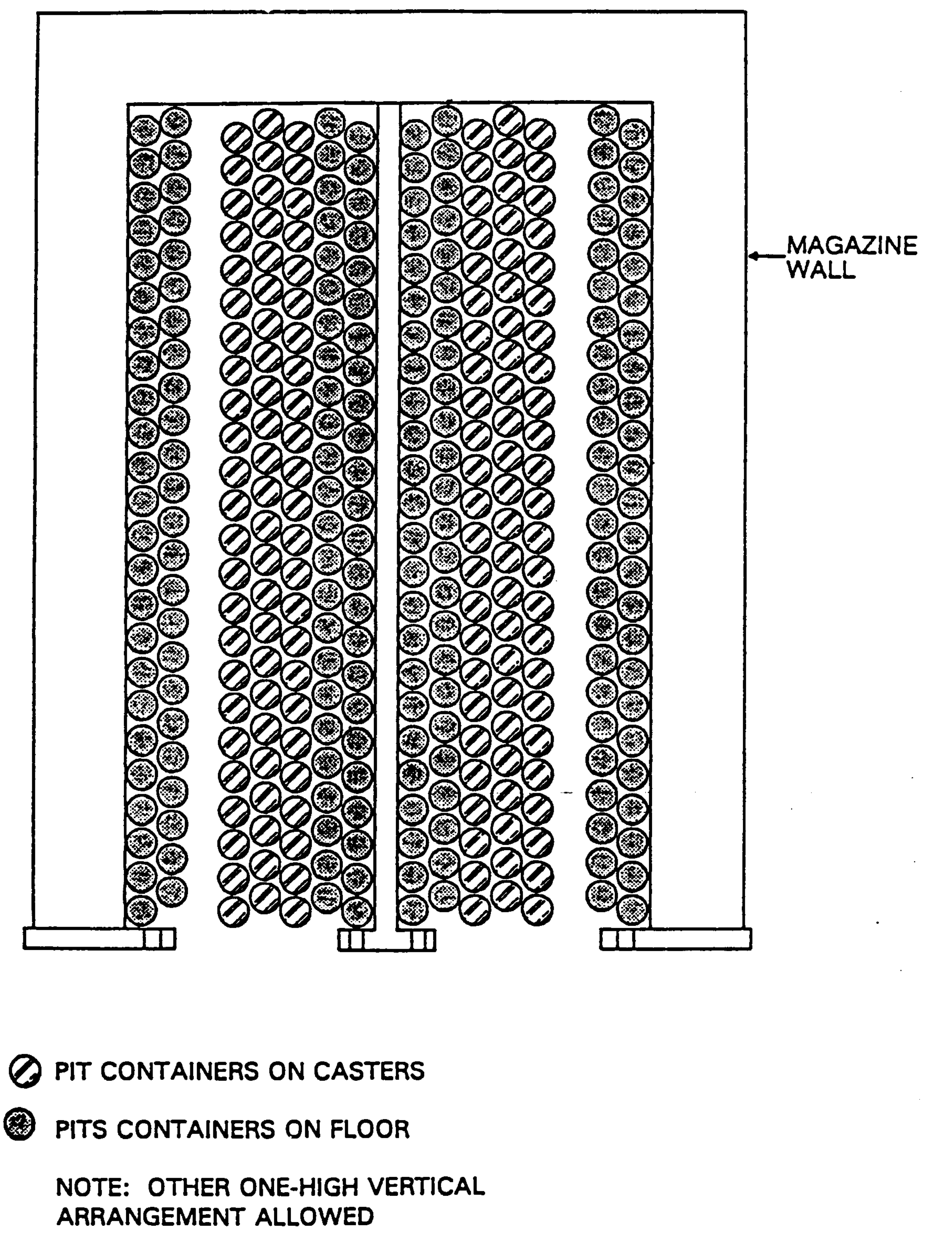


Figure 3.2 - Modified-Richmond Magazine Vertical Single-Layer Configuration (Operationally Preferred)

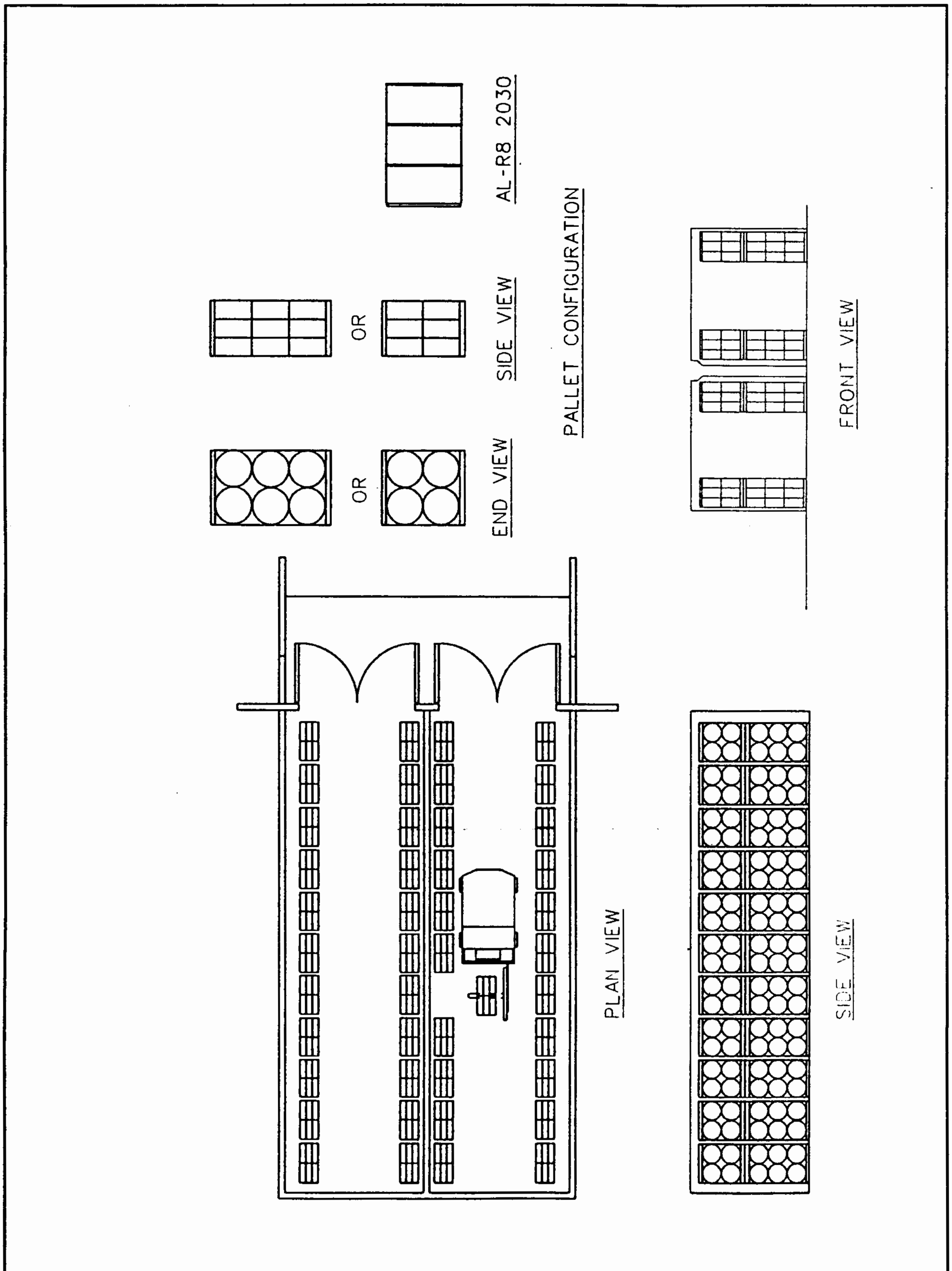


Figure 3.3 - Modified-Richmond Magazine Proposed Horizontal Palletized Multiple Stacking Configuration

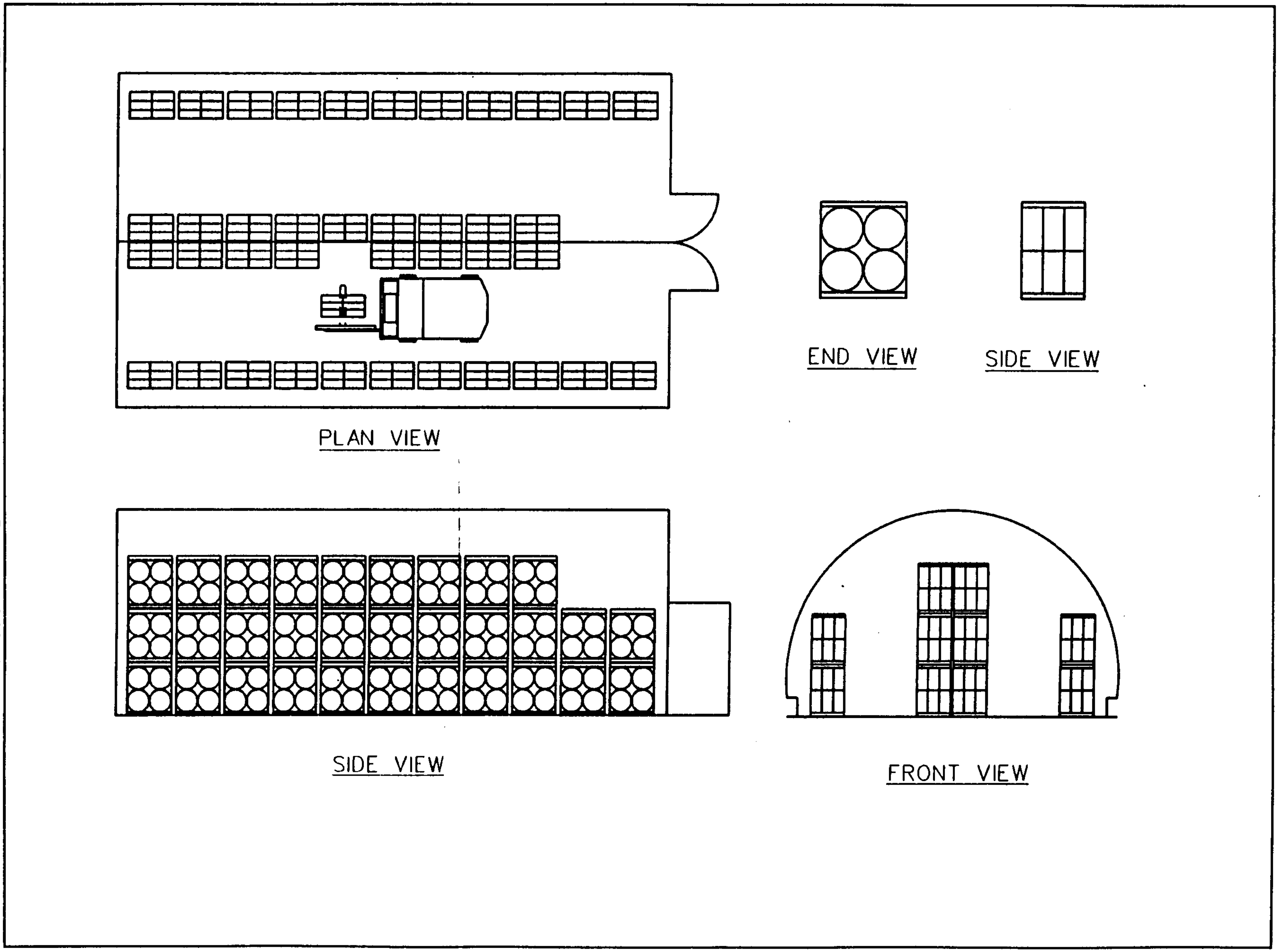


Figure 3.4 - Steel Arch Construction Magazine Proposed Horizontal Palletized Multiple Stacking Configuration

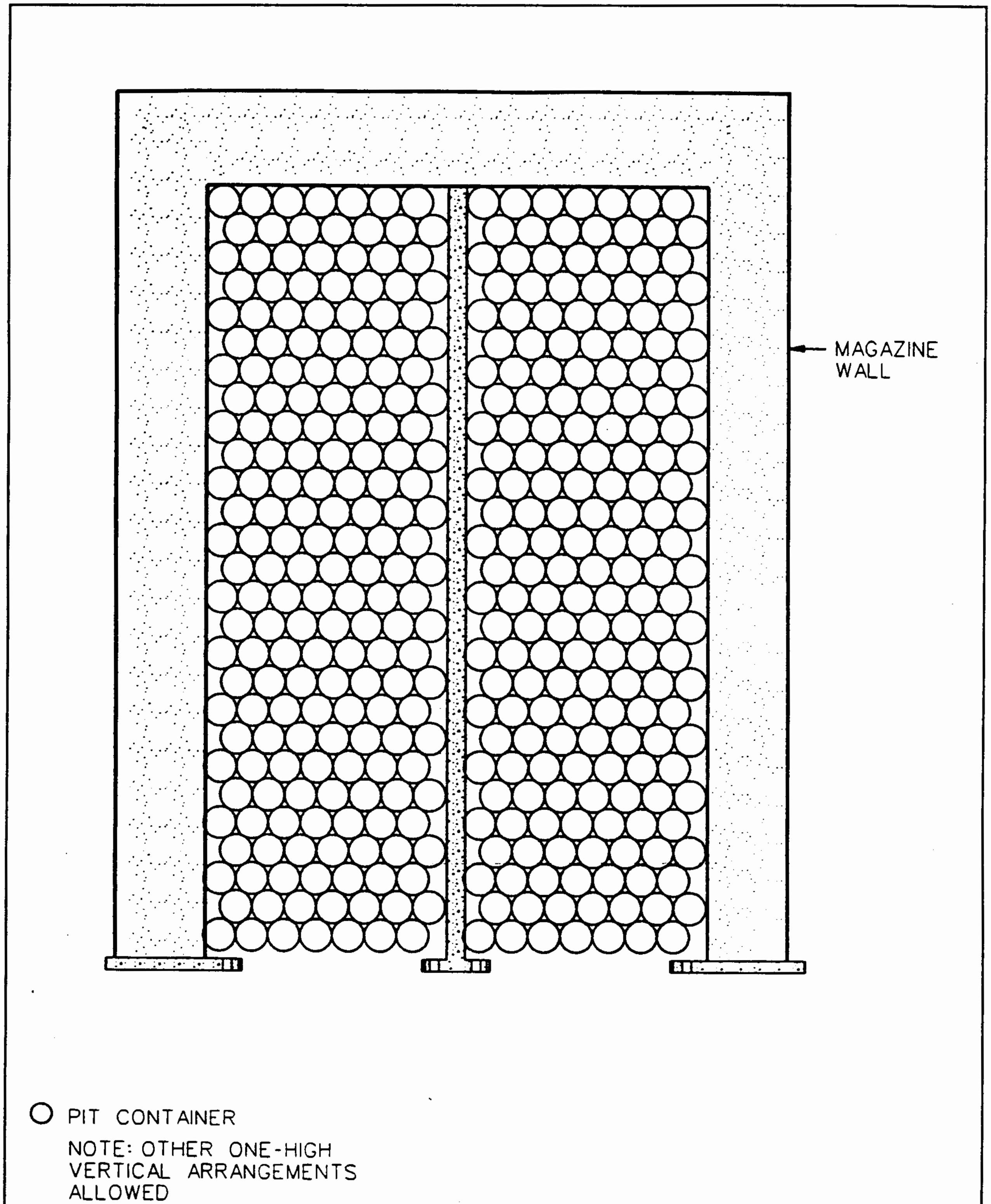


Figure 3.5 - Modified-Richmond Magazine Vertical Single-Layer Configuration (Bounding) (All Containers on Casters)

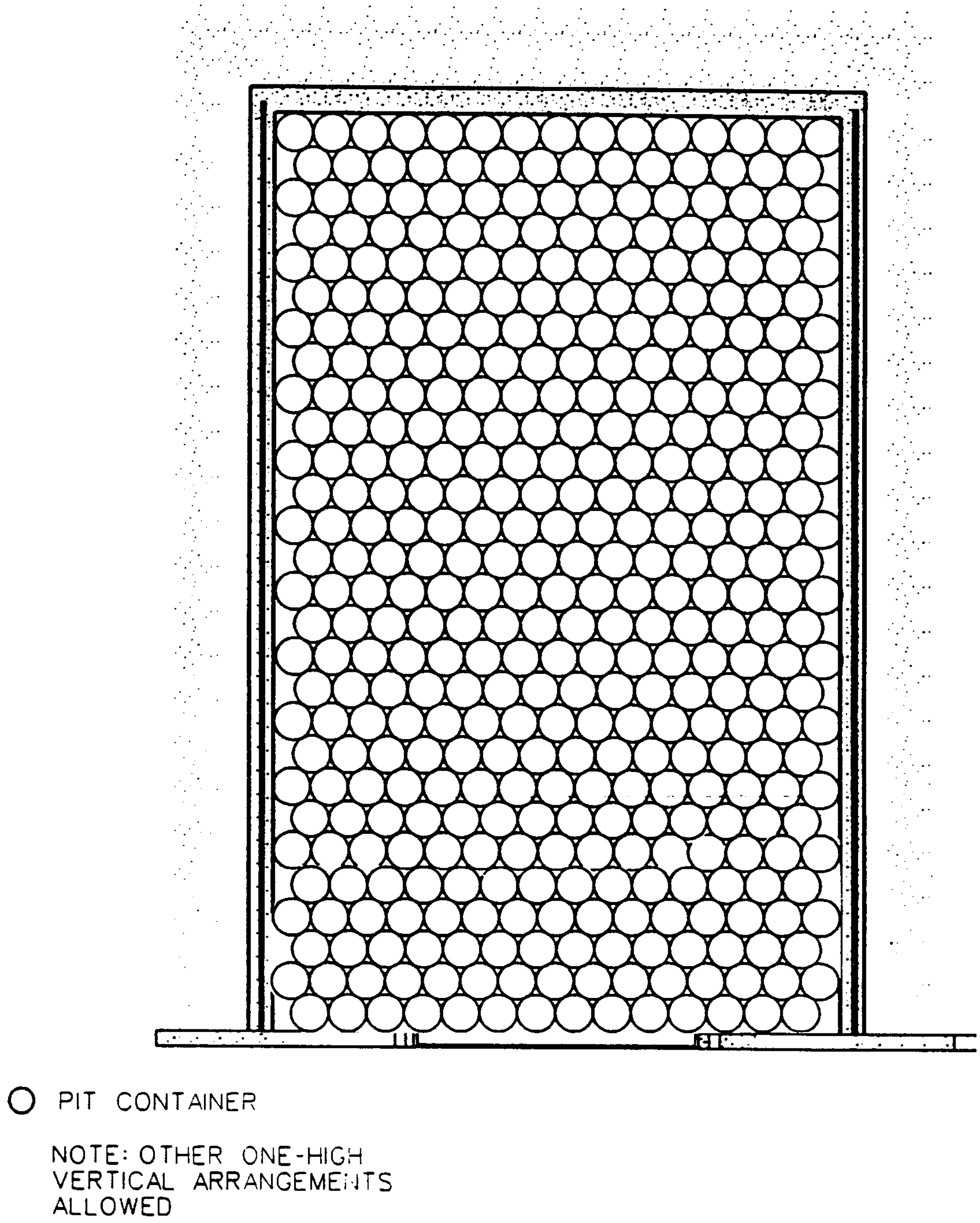


Figure 3.6 - Steel Arch Construction Magazine Vertical Single-Layer Configuration (Bounding) (All Containers on Casters)

4.0 ALTERNATIVES TO THE PROPOSED ACTION

4.0 ALTERNATIVES TO THE PROPOSED ACTION

Alternatives to the Proposed Action are described in the following subsections. None of the alternatives have been shown to meet the programmatic goal of providing sufficient increased interim storage capacity for pits while continuing disassembly operations at the anticipated rate. Also none would meet the other programmatic objective; namely, an approach that is timely, cost-effective, and utilizes to the maximum extent practicable existing facilities and infrastructure taking into account protection of the environment along with worker and public's health and safety. These alternatives include consideration of Department of Defense installations and assessing availability of storage facilities at Department of Energy facilities such as the Los Alamos National Laboratory, the Savannah River Site, and the Hanford Plant. The No-Action Alternative does not meet the weapons disassembly goals in support of weapons reduction initiatives. For the other alternatives, in each case there were additional costs, transportation requirements, and facility modifications or infrastructure requirements that precluded the alternatives availability to meet the programmatic goal. The only potential environmental impacts associated with implementation of the proposed action are worker exposures. There is no environmental benefit while radiation exposures could increase as a result of packaging and shipping some or all of the pits to any other location for interim storage purposes. Table 4-1 compares the proposed action to the alternatives described below.

4.1 No-Action

The No-Action Alternative would preserve the present practice of receiving and disassembling weapons and the interim storage of plutonium components in the 18 Modified-Richmond magazines located in Zone 4. Only configurations involving a single layer of vertical containers would be utilized. These configurations are bounded by the maximum packing arrangement discussed in Section 3 and illustrated in Figure 3.5. The capacity of this alternative would provide interim storage for 6,800[6] pits. Actual best management practice to facilitate required safeguards and security activities and reduce worker exposure to radiation could dictate use of other storage configurations that would provide less pit storage capacity. One such configuration is shown in Figure 3.2 and allows for interim storage of a nominal 6,000 pits. Once capacity is reached, dismantlement activities at Pantex would cease. In order for weapon dismantlement to resume, additional pit storage facilities would have to be identified, approved, and made operational. In addition, the weapons already in Department of Energy custody at the Pantex Plant would remain staged in Zone 4, and weapons in Department of Defense custody would remain at Department of Defense facilities. This particular result, deferring dismantlement and holding weapons in Department of Defense facilities, is not as sound as continued dismantlement, principally, because it maintains the potential for accidental or unauthorized detonations; and it does not reduce the number of highly attractive terrorist targets. Additionally, deferring dismantlement and holding weapons in Department of Defense facilities forecloses opportunities for streamlining Department of Defense operations. The Army and the Navy would be forced to maintain nuclear weapons storage capacity currently planned for alternative uses or scheduled to be closed. In the case of the Army, nuclear weapons storage capacity slated to be used for the storage of conventional munitions and equipment returning from Europe and the Persian Gulf would be required to be maintained for nuclear weapons storage. This change in plans would cost the Army approximately $28 million per year beginning in July 1995, the date beyond which Army nuclear

[6] The 6,800 value is based on the maximum packing configuration. This configuration is not currently the operationally preferred configuration, but serves to provide the most conservative bounding parameters for the safety and environmental analyses.

depot operations was not planned. For the Navy, holding weapons in lieu of dismantlement will mean postponement of the closure of a weapons storage facility currently slated for September, 1994 at a cost of $21 million per year. Also deferring dismantlement and holding weapons in Department of Defense facilities will affect current planning regarding actions to be taken to meet START I and START II objectives. Specifically, Air Force Material Command would have to exercise an existing Memorandum of Agreement with Air Combat Command to convert an existing weapons storage area into a weapons storage depot. This conversion can be done at small cost. The only significant cost to the Air Force, which cannot be quantified at this time, would be the cost of relocating the munitions currently stored in this facility.

The START accords, while not yet ratified, represent the direction the past and present United States leadership wishes to take with regards to arms control. This intent has been further codified with the January 19, 1993 issuance of a Nuclear Weapons Stockpile Plan. In this Plan, only those stockpile levels which support the intent of the START accords were approved. A new stockpile plan is currently in the final stages of development. This Plan is slated for submission for the President's approval late 1993. This Plan also complies with the stockpile levels specified by the START accords.

4.2 Combination of Proposed Action Storage at Pantex with Storage at Other Department of Energy Sites

Potential pit storage capability has been identified at three Department of Energy sites: the Savannah River Site, the Los Alamos National Laboratory, and the Hanford Plant. The Rocky Flats Plant was not considered because there is no additional storage space for pits. Because sufficient pit storage capacity at these three sites would not provide the needed capacity in a timely manner, this alternative would require utilizing the proposed storage configuration and facilities for near-term needs at the Pantex Plant. The Department of Energy would need to further evaluate use of existing or potential pit storage capacity at these other Department of Energy sites. If such evaluation demonstrated that decentralized interim pit storage would provide additional environmental and programmatic benefit, actions to provide funding, modify facilities (if required), conduct safety evaluations, etc., would have to be completed before shipment of pits to the other Department of Energy site(s).

The following is a brief description of relevant features of the Savannah River Site, the Los Alamos National Laboratory, and the Hanford Plant:

> The Savannah River Site, located near Aiken, South Carolina, has five vaults that have the capacity to store plutonium. The 235-F and 247-F vaults and the Plutonium Storage Facility are able to store pits in AL-R8 storage containers. They could accommodate about 1,100 AL-R8 pit storage containers. The 247-F vault is expected to become available later in Fiscal Year 1993 or early Fiscal Year 1994. The Plutonium Storage Facility is expected to become operational in Fiscal Year 1995. Currently, two vaults (309 and 410) are used to store in-process plutonium in cans and five-gallon canisters. The 309 and 410 vaults do not have the drum storage capability to store pits. While some of these facilities may be suitable for pit storage, the Savannah River Site has various quantities of plutonium compounds within its own processing facilities that will be stored in the aforementioned vaults.
>
> The Los Alamos National Laboratory is located in Los Alamos, New Mexico. Pits have been stored at TA-41 and TA-55. TA-55 is at approximately 90 percent capacity and over committed for Los Alamos National Laboratory's stated pit storage needs. The total

storage capacity can accommodate approximately 60 pits. The facility at TA-41 is inactive because it does not meet current Department of Energy requirements for environment, safety and health, security, and conduct of operations. Furthermore, Los Alamos National Laboratory's programmatic requirements did not justify the costs required to make needed changes to maintain TA-41. A third facility, the Nuclear Materials Storage Facility which is under construction, is not operational. If funding is provided by the Department of Energy, this facility could be operational in 1997 and with current planned design modifications could provide storage for up to 200 pits.

The Hanford Plant is located in south-central Washington State, near the city of Richland. The primary mission at the Hanford Plant is environmental restoration. Several studies have considered pit storage capabilities for the Hanford Plant. Special Nuclear Material is stored in vaults and vault-type rooms located within the Plutonium Finishing Plant. Many of the storage positions located in these areas are not suitable for pit storage because they are configured to accept smaller storage containers. Facility enhancements to maximize pit storage within the Plutonium Finishing Plant were estimated to cost approximately $7 million. These modifications would allow suitable storage of approximately 3,000 pits, some in their shipping containers and others in storage containers. Additional storage space is available within the Fuel and Materials Examination Facility. Construction of this facility was completed in 1984 and was intended to support the Liquid Metal Fast Breeder Reactor Program. However, it has not yet been involved in any hot-cell operations or any plutonium processing operations. The Fuel and Materials Examination Facility consists of six levels, comprised of process cells, rooms, and one Special Nuclear Material vault. The vault, one process cell, and four other rooms have been evaluated for pit storage. It is estimated that more than 7,000 pits could be stored if appropriate modifications were made to these areas. Facility modifications include plugging cell penetrations, moving doors, installing vault doors, and electronic equipment. These modifications were estimated in 1989 to cost approximately $20 million. The nuclear weapons complex mission at the Hanford Plant was terminated by the Department of Energy in 1989. The site was transitioned to the Office of Environmental Restoration and Waste Management and dedicated to environmental restoration activities. Given the termination of the defense mission and the commitment of Department of Energy to clean up of the site, the reintroduction of a Defense Programs mission would not be reasonable or appropriate.

The Rocky Flats Plant is not included in this alternative because there is no additional storage capacity for pits received from other sites. The Rocky Flats Plant currently stores pits that were awaiting reprocessing when operations were curtailed. The Rocky Flats Plant is consolidating all pits and other Special Nuclear Material from Buildings 991 and 996 tunnel (Corridor C) and other plant locations to vault-type storage in Building 371. This action is necessary due to facility aging, the structural uncertainties of Buildings 991 and 996, and a desire to reduce the safeguards and security requirements for other portions of the plant where Special Nuclear Material is currently stored. Special Nuclear Material would be consolidated for interim storage pending the implementation of the Record of Decision of the Nuclear Weapons Complex Reconfiguration Programmatic Environmental Impact Statement. Capacity limits in Building 371 would be reached when all Special Nuclear Material at the Rocky Flats Plant has been consolidated.

In summary, this alternative to the proposed action considers the possibility of combining the storage capacity at Pantex with storage capacity at other Department of Energy sites in the near-term. Additional requirements for environmental, safety, and pre-operational documentation, staffing, and training would delay making these facilities available in the near-term.

In addition, the following would have to be considered:

a) The nuclear weapons complex is undergoing numerous changes to include environmental restoration and consolidation of its nuclear material to facilitate restoration and to enhance safeguards and security. The complex has limited storage capacity, and each site's capability to store material (pits and Special Nuclear Material in various other forms) must be maximized. There are many ongoing programs under which the storage capability at the above sites is currently being assessed. Consolidation of material and subsequent inventory reduction at the Rocky Flats Plant, reduction of the inventory at Lawrence Livermore National Laboratory, and clean out of processing canyons at the Savannah River Site are a few that vie for the existing or potential storage capacity at the Savannah River Site, the Los Alamos National Laboratory, and the Hanford Plant. Cleanup of most sites will increase the amount of material to be stored. Efficient use of resources would require evaluation of competing storage requirements for other plutonium material at the candidate site as well as from other sites before a decision can be made to ship pits for interim storage. For example, uniqueness of facilities makes it inappropriate to send other Special Nuclear Material forms (e.g., plutonium oxide) to Pantex for storage where currently only pits can be stored safely. Likewise, storing pits at a facility designed to accommodate other Special Nuclear Material forms would be prudent only if the benefits derived justify such use.

b) Interim storage of pits would be subject to subsequent Department of Energy complex-wide evaluations regarding long-term storage or disposition of plutonium surplus to national security needs. These evaluations are being pursued in the ongoing Nuclear Weapons Complex Reconfiguration Programmatic Environmental Impact Statement activities, implementation actions derived from the task force on the disposition of surplus plutonium, and the new site-wide Environmental Impact Statement for the Pantex site.

c) On the basis of the analyses presented in this Environmental Assessment, the environmental impacts of the proposed action were determined to be limited principally to radiation exposure of workers. This suggests that no environmental benefit would be derived by storing pits at up to four separate facilities (the Pantex Plant, the Savannah River Site, the Los Alamos National Laboratory, and the Hanford Plant). Decentralization of storage could effect a net increase in the expected radiological worker exposure over the proposed action by reducing the efficiency afforded in a large scale interim storage operation versus several smaller scale storage operations. Additional personnel exposure would be expected if the pits were packaged in containers (Type B) certified[7] for shipment and then repackaged for storage in the more readily available and more inexpensive AL-R8 containers, which are suitable for storage but not certified for shipping. The exposure from the repackaging operation is estimated to range from 0.014 to

[7] The Type B container is certified for off-site transportation of pits under the Department of Energy performance criteria adopted from Nuclear Regulatory Commission criteria found in Title 10 Code of Federal Regulations Part 71 whereas the AL-R8 containers is not so certified.

0.051 person-rem per container for robotic and manual repackaging[8] respectively. Therefore, total dose to repackage 2,000 pit containers, a year's work of dismantlement, would range from 28 to 102 person-rem total cumulative dose. This additional dose could be avoided if pits were stored in the Type B shipping container. A sufficient inventory of Type B containers should be able to be procured/purchased and available for use as storage containers in 1995.

4.3 Supplement No-Action Alternative Storage Capacity with Storage at Other Department of Energy Sites

This alternative is to supplement the No-Action Alternative at Pantex with storage at the Savannah River Site, the Los Alamos National Laboratory, and the Hanford Plant. The existing capacity at the Pantex Plant would be reached between during the first quarter 1994. Assuming that a total of approximately 1,100 pits could be stored at the Savannah River Site in the near-term, capacity at the Pantex Plant and the Savannah River Site would be approximately 7,100 to 7,900. This would result in a storage deficit of approximately one year, assuming disassembly rates that met stockpile reduction initiatives (see Figure 4.1). Disassembly would have to cease until other interim or a permanent storage facility could be made available. Because of the reasons stated in Section 4.2 above, and because these facilities must be available even earlier for this alternative, it cannot be assured that this alternative could meet the need for near-term interim storage.

4.4 Interim Storage at a Department of Defense Facility

As an alternative to the Proposed Action, interim storage of pits at a Department of Defense facility was assessed. Candidate sites were identified and then the analysis focused on potential impacts, timing, and resource requirements. Department of Energy staff has been working with the staff of the Department of Defense/Department of Energy Nuclear Weapons Council to consider the feasibility and practicality of interim storage at a Department of Defense facility. The potential for retention of weapons by Department of Defense, instead of dismantlement and the required storage of pits, is discussed as part of the No Action Alternative.

Background

The Department of Defense is in the process of restructuring its forces to reflect troop reductions and base closures. Some Department of Defense bases are being configured to accommodate only conventional forces and their weapons, which are being moved from overseas bases and United States facilities designated for closure. The requirement for additional continental United States storage capacity at Department of Defense sites is further complicated by consolidation of active nuclear weapon storage and the backlog of retired weapons. Several factors were considered for identifying potential candidate interim storage sites at Department of Defense facilities. To be considered as a candidate for an alternative interim storage site for pits, a Department of Defense site must:

[8] Repackaging dose rate based on a higher dose rate pit and lead apron shielding.

1) have existing storage facilities that meet all Department of Energy Special Nuclear Material storage requirements with minimal modification[9]; and

2) offer potential for transfer to or sharing of the site with Department of Energy. (If the site is to be shared, the Department of Defense mission should be compatible with the Department of Energy's mission for interim storage of pits.)

A preliminary candidate list of potentially available Department of Defense storage facilities was prepared by the Department of Defense. As a matter of Department of Defense policy, the presence of nuclear weapons at specific sites cannot be confirmed or denied for security reasons. Therefore, a discussion of specific Department of Defense sites is not presented in this document. The facilities fall into the following categories:

- active Department of Defense nuclear weapons storage facilities[10];
- inactive (currently or in the near future) Department of Defense nuclear weapons storage facilities; and
- inactive (currently or in the near future) conventional weapon storage facilities[11].

The following information provides an overview of potential environmental and operational impacts, the time required for implementation, and resource and cost requirements for interim storage of pits at a Department of Defense facility. These requirements would be dependent on the facility category.

Environmental and Operational Impacts

Environmental impacts from use of any Department of Defense facility for interim storage are similar to those identified for the Proposed Action. However, additional personnel radiation exposure would be expected if the pits were packaged in containers certified[9] (Type B) for shipment and then repackaged for storage in the more readily available and more inexpensive AL-R8 containers, which are suitable for storage but not certified for shipping. The exposure from the repackaging operation is estimated to range from 0.014 to 0.051 person-rem per container for robotic and manual repackaging[10] respectively. Therefore, total dose to repackage 2,000 pit containers, a year's worth of dismantlement, would range from 28 to 102 person-rem total cumulative dose. This additional dose could be avoided if pits were stored in the Type B shipping container. A sufficient inventory of Type B containers should be able to be procured/purchased and available for use as storage containers in 1995.

9 It is not practical to consider Department of Defense sites that do not have existing munitions storage facilities capable of being modified and upgraded to meet Department of Energy storage requirements for Special Nuclear Materials, because of the time needed to construct those facilities, the additional environmental impacts, and the extra cost compared to that needed to modify existing facilities.

10 Only one facility has been identified in the Department of Defense draft candidate list.

11 Active conventional weapons storage facilities are not reasonable, because the Department of Defense mission would not be compatible with Department of Energy's mission.

There is potential for some added environmental impacts at the candidate Department of Defense sites for construction or facility modification that could be required to support safety, security and operational requirements. The magnitude of these impacts would depend on the extent of the modification or construction required. For example, impacts from the construction of high security fencing, guard towers, and barriers would be expected if an inactive conventional weapons storage facilities were to be selected. Alternatively, minimal impacts would be expected from the utilization of the existing facilities at an active nuclear weapons storage facility.

Transportation of the pits to a Department of Defense facility would result in minor added energy costs and some added, although minimal, risk inherent in the transportation of Special Nuclear Material. Pit containers must be transported by Safe-Secure Trailer. Using an authorized convoy configuration, 45 trips would be required per year to transport 2,000 pits annually from Pantex to an alternative interim storage site.

Timing

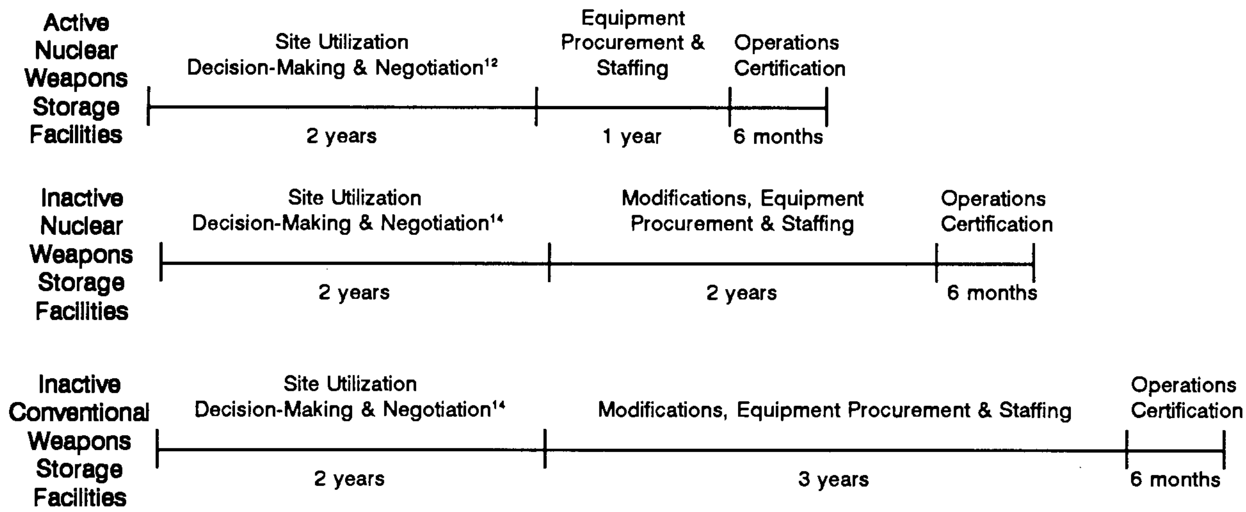
Any proposal to use a portion of a site's capacity for interim storage of pits would require negotiation of site-sharing or transfer agreements for space and support accommodations consistent with the Department of Defense mission and requirements for the facility. Since restructuring of Department of Defense forces and base closures could take several years, not all the candidate sites would be immediately available. In addition, planning (including National Environmental Policy Act requirements) and identification of necessary modifications and acquisition of appropriate resources would have to be completed, which would require additional time. Before any Department of Defense site could receive any pits, at a minimum the following would need to be accomplished:

1) completed facility modifications (if required) for security (i.e., security fencing, vehicle barriers, guard towers, intrusion detection devices), support facilities (for shipping/receiving, repackaging, or surveillance inspection), or operations (i.e., shielded forklift, pit surveillance instrumentation);

2) acquisition of a trained and qualified staff to conduct interim storage operations; and

3) a validated readiness posture that would include safety analysis reports, operations procedures, training and qualification program.

An optimistic estimate of the timing required to set up interim storage at a Department of Defense facility is illustrated in the following timeline.



<u>Resource Requirements and Cost</u>

Resources and costs associated with use of the three Department of Defense site categories (i.e., active nuclear weapons storage facility, inactive nuclear weapons storage facilities, and inactive conventional weapons storage facilities) were estimated. Use of such Department of Defense site categories provides a basis for the assumptions used to estimate modification and operational requirements necessary to permit interim pit storage. Table 4-2 provides a breakdown of estimated costs (recurring as well as one-time) for implementing interim storage at a Department of Defense facility.

Environmental impacts (radiation dose) and costs related to using a Department of Defense site would be minimized by using storage facilities at an active nuclear weapons storage facilities and storing the pits in the Type B shipping containers. This option could result in an estimated additional expenditure of $7.5 million per year to conduct interim storage operations at a Department of Defense site instead of at Pantex, slightly less than if AL-R8 storage containers are used. These reduced impacts and costs would be somewhat offset by the $36 million[13] needed to purchase the extra Type B containers to accommodate all of the pits during the period of interim storage. Additionally, a one-time cost of approximately one million dollars for equipment necessary for monitoring, surveillance and calibration would be required. The one time costs do not include the administrative costs associated with preparing the necessary environmental, safety analysis and operational procedures documentation nor the cost of training qualified staff.

In summary, implementation of this alternative instead of interim storage at Pantex:

- offers no environmental benefit;
- is not as timely; and
- would cost more.

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[12] Negotiations with Department of Defense regarding site utilization would involve formulation of appropriate Memorandum of Understanding/Memorandum of Agreement. Decision-making regarding site utilization includes National Environmental Policy Act analysis and preliminary safety analysis considerations. Because the National Environmental Policy Act analyses would have to be a jointly sponsored by Department of Energy and Department of Defense, the time required to coordinate completion of the analyses could be more lengthy.

[13] Lower bound of $4 million assumes procurement of 2000 Type B Model HE-400A shipping containers (at $2,000 each), which would be used for transporting pits to interim or long-term storage. The upper bound of $40 million assumes all 20,000 pits require Type B shipping containers for interim or long-term storage.

Table 4-1 - Comparison of Proposed and Alternative Actions

	Section	Site for Storage/ Potential Pit Capacity	Capacity (meets goals)	Specific Facilities	Stacking Configuration	Comments
Proposed Action	3.0	Pantex Plant up to 20,000	Yes	- 18 Modified-Richmond - up to 42 Steel Arch Construction	Multiple-Layer and/or Single-Layer	
No-Action	4.1	Pantex Plant *6,000-6,800	No	- 18 Modified-Richmond	Single-Layer	Does not meet President's dismantlement objectives
Combination of Proposed Action Storage at Pantex with Storage at other Department of Energy Sites	4.2	Pantex Plant up to 20,000 Depending on Availability of: Savannah River 1,100 Hanford (Potential) 10,000+ Los Alamos (Potential) 200	Yes	- 18 Modified-Richmond - up to 42 Steel Arch Construction - Savannah River Site - Hanford - Los Alamos National Laboratory	Proposed Action configuration at Pantex and configuration at other sites TBD	• Resolution of programmatic & institutional issues required. • Requirement for environmental, safety, pre-operational documentation, & for modifications could delay availability in the near-term
Supplement No-Action Alternative Storage with Storage at other Department of Energy sites	4.3	Pantex Plant *6,000-6,800 Savannah River 1,100 Hanford (Potential) 10,000+ Los Alamos (Potential) 200	No	- 18 Modified-Richmond - Savannah River Site - Hanford - Los Alamos National Laboratory	No-Action Alternative configuration at Pantex and configuration at other sites TBD	Does not meet President's weapons reduction initiatives
Interim Storage at a Department of Defense Facility	4.4	Department of Defense Facilities	No	None Currently Available	Not Applicable	No acceptable Department of Defense facility is currently available for use as an interim storage facility

* 6,800 is the maximum magazine capacity value used to provide bounding parameters for the safety and environmental analyses. The actual maximum magazine capacity could be less based on a best management practice decision to use an alternate (less dense) storage configuration (nominal 6,000).

Table 4-2 - Resource/Facility/Equipment Requirements and Estimated Costs (in millions) for Interim Storage at a Department of Defense Site.

	Active Nuclear Weapons Storage Facilities		Inactive Nuclear Weapons Storage Facilities		Inactive Conventional Weapons Storage Facilities	
	AL-R8 Storage Container	Type B Shipping Container	AL-R8 Storage Container	Type B Shipping Container	AL-R8 Storage Container	Type B Shipping Container
RECURRING COSTS						
Transportation	2.4	2.4	2.4	2.4	2.4	2.4
Receiving & Packaging Operations	0.1	0	0.1	0	0.1	0
Operations	4.1	4.1	5.4	5.4	5.4	5.4
Management/Administration	1.0	1.0	1.0	1.0	1.0	1.0
TOTAL ANNUAL OPERATING COST	7.60	7.50	8.90	8.80	8.90	8.80
ONE-TIME COSTS						
Modification	0.0	0.0	3.3	3.3	16.5	16.5
Additional Type B Containers	4.0	40.0	4.0	40.0	4.0	40.0
Equipment	1.0	1.0	1.0	1.0	1.0	1.0
ONE-TIME "SET-UP" COSTS (not including maintenance)	5.00	41.00	8.3	44.3	21.5	57.5

Assumptions:

General:
- Dismantlement rate -- 2,000 weapons per year
- 6,800 pits will remain at Pantex -- the current authorized capacity

Modifications:
- No modifications needed for storage magazines
- Modifications at inactive nuclear weapons storage facilities and Coventional Weapons Storage Facilities to upgrade receiving and pit handling area (for repackaging and pit/container surveillance program)
- Active nuclear weapons storage facilities need no security upgrades and assumes that security personnel provided by Department of Defense
- Inactive nuclear weapons storage facilities needs refurbished or upgraded security systems
- Type B Shipping Containers (model HE-400A) costed at $2,000 each
- Inactive conventional weapons storage facilities needs completely new security system (fencing and upgrades)

Transportation:
- 45 pits moved per Safe-Secure Trailer convoy trip; to move 2,000 pits requires 45 trips; cost per 1,000 mile trip calculated at $54/mile

Operations:
- 100 persons needed to operate facility (includes security, materials handling, inventory, materials control/accountability, surveillance testing, environment, safety, and health personnel, other support) -- for Active Nuclear Weapons Storage Facility, assumes security personnel provide by Department of Defense
- Receiving/Packaging Operations assumes 3 persons needed
- Equipment to be procured includes:
  2 shielded forklifts, gamma spectrometer, radiation inspection/monitoring, equipment calibration

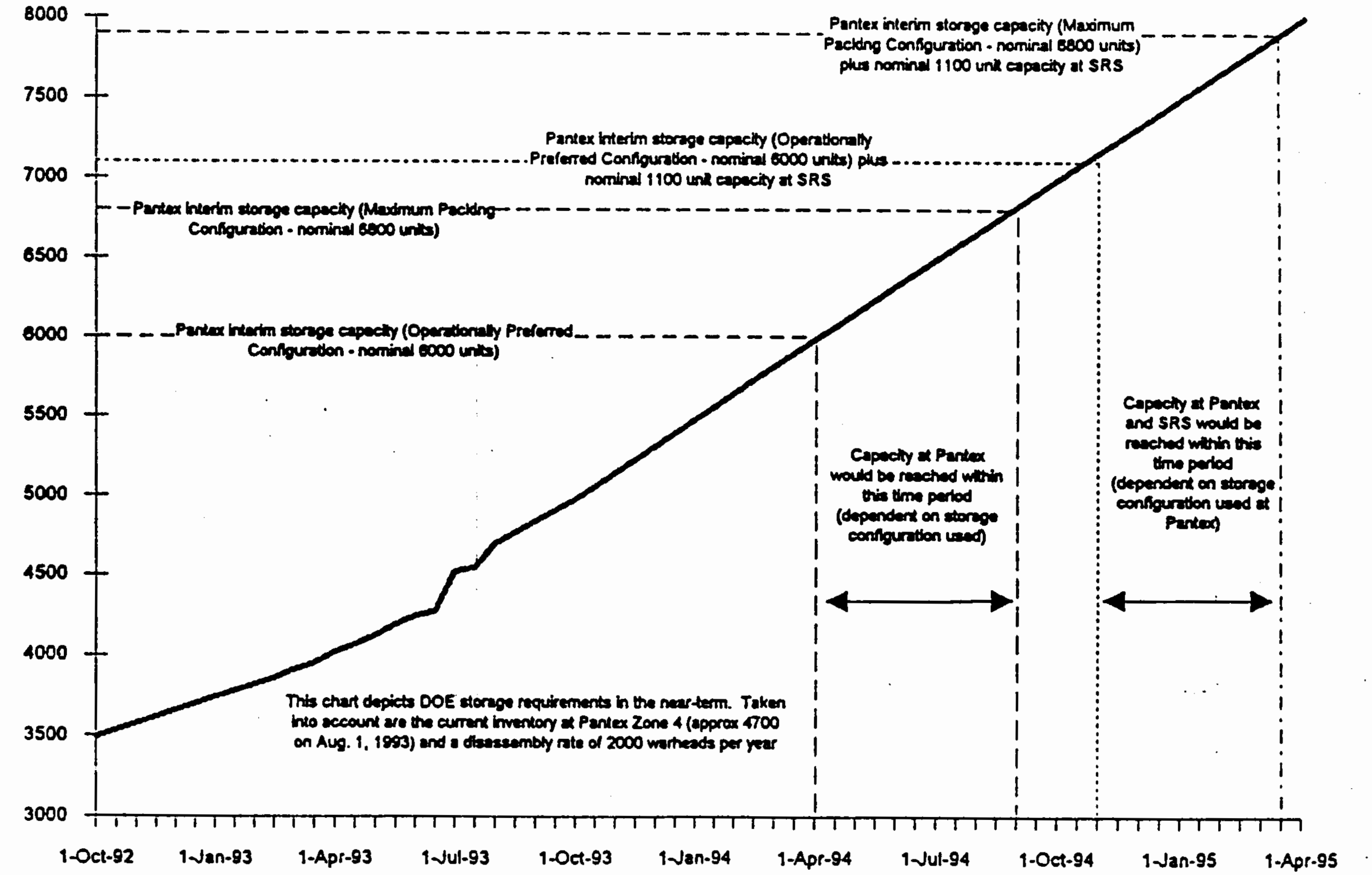


Figure 4.1 - Near-Term Projected Storage Capacity Requirements

5.0 EXISTING ENVIRONMENT

5.0 EXISTING ENVIRONMENT

The proposed action would involve use of existing facilities and no new construction would be required. Consequently, the description of the existing environment is focused on those aspects of the environment which potentially may be affected by the proposed action. Additional information on the Pantex Plant and its existing environment may be found in the Final Environmental Impact Statement, Pantex Plant Site (Department of Energy, 1983) and in the Pantex Plant Site Environmental Report for Calendar Year 1990 (Mason & Hanger-Silas Mason Co., Inc., 1991).

5.1 Environment

The Pantex Plant is located in Carson County, about 17 miles northeast of Amarillo, Texas, and central to the panhandle of Texas (Figures 5.1 and 5.2). There are 18 Modified-Richmond magazines located in the western portion of Zone 4 of the Pantex Plant (Figure 3.1) that are used for holding assembled weapons and other components. Assembled weapons and pits are not co-located in the same magazine. Each of the Modified-Richmond magazines consists of an earth covered, concrete box-like structure (Figures 5.3 and 5.4). To access these facilities, a forklift/tractor is used to remove the concrete security blocks in front of each door. These blocks are in place whenever a magazine is not being accessed. The 42 Steel Arch Construction magazines located in the western portion of Zone 4 (Figure 5.5) are used for staging assembled weapons and some components. Currently, no pits are stored in any of the Steel Arch Construction magazines. Each of the Steel Arch Construction magazines consists of an earth covered, steel-arch structure (Figures 5.6 and 5.7). Access to these facilities also requires a forklift/tractor to remove concrete security blocks in front of each door. The only utility system that serves either the Modified-Richmond or the Steel Arch Construction magazines is electricity for security-related purposes. Natural ventilation for both types of magazines is provided through a steel pipe in the ceiling of each magazine and small vents in the front wall on either side of the magazine doors.

The Pantex Plant is situated in an area that has a semi-arid continental climate. Prevailing wind direction is from the south-southwest with an average wind speed of 14 mph with occasional gusts of up to 70 mph. (Figure 5.8). The Plant site is in compliance with all applicable air emission standards. The plant lies within Zone 1 on the Seismic Risk Map. This means that a Zone 1 earthquake may cause some minor damage (e.g., broken windows, falling plaster, disturbance of tall objects).

The nearest major surface water source is the Canadian River, approximately 14 miles north of the site. The Canadian River flows eastward into Lake Meredith, approximately 25 miles north of the plant (Mason & Hanger-Silas Mason Co., Inc. 1991). There are several playas (natural land depressions) on the Plant site which affect local drainage. Surface runoff flows across the flat terrain into these playas during periods of rainfall and forms ephemeral lakes that dissipate through infiltration into the ground or through evaporation enhanced by low humidity. Playas 1, 2, and 3 (Figure 5.9) are on Department of Energy-owned property and Playas 4 and 5 are on property leased by Department of Energy from Texas Tech University. Under unusual flooding conditions, storm water runoff from the extreme northeastern section of the Pantex Plant has the potential to flow off-site towards a playa north of the site. However, the northeastern section is mechanically pumped to an on-site playa to retain and control potential off-site runoff. The United States Army Corps of Engineers has determined that playas at the Pantex Plant site are "jurisdictional wetlands" under Section 404 of the Clean Water Act and subject to the provisions of the Act. There are no areas on the Pantex Plant site within a 100 year or 500 year floodplain.

There are two principal water-bearing units beneath the Pantex Plant site and adjacent areas; the Ogallala Aquifer and the Dockum Group Aquifer. The unsaturated zone from the ground surface to the Ogallala Aquifer consists of up to 460 feet of sediments. A perched water zone occurs discontinuously above the main zone of saturation approximately in the middle of the Ogallala Formation. The city of Amarillo, Texas, has a municipal well field located approximately 1 mile northeast of the Pantex Plant's well field. Both well fields access the Ogallala. Water from the Ogallala Aquifer is mixed with water from Lake Meredith and used for municipal and industrial supplies in the area. Water chemistry in the Ogallala Aquifer and in the unsaturated zone beneath playas is generally quite good, typically a mixed-cation/bicarbonate water with 200-500 mg/L total dissolved solids and a pH of about 7.5. The Dockum Group Aquifer lies under the Ogallala Formation and is believed to be semi-confined with respect to the overlying Ogallala Aquifer. The Dockum Group Aquifer, which has generally poor water quality, supplies domestic and livestock wells south and southeast of the Pantex Plant.

5.2 Radiological Environment

Radiation at the Pantex Plant consists of both natural background radiation and radiation from plant operations. Personnel exposure to radiation at the Pantex Plant is maintained in accordance with the principles of As Low As Reasonably Achievable. The annual whole body dose limit mandated by Federal regulations (52 Federal Register 2822, January 27, 1987) and enforced by the Department of Energy is 5 rem. Time, distance and shielding are key elements in the As Low As Reasonably Achievable program used to reduce radiation exposure. A personnel dosimetry program measures radiation exposure and plant management uses the data to ensure limits are not exceeded.

Collective worker dose from penetrating radiation for all Pantex workers has varied over the years. For instance, from January 1982 to December 1986, the annual collective dose averaged 115 person-rem. More recently, from January 1987 to December 1991, the annual collective dose averaged 28 person-rem, a marked improvement.

Naturally occurring radiation contributes to an average individual dose of approximately 300 mrem/yr (National Council on Radiation Protection, 1987). Operations associated with the Pantex Plant account for an average individual radiation worker dose of approximately 70 mrem/yr additional dose. The maximum radiation dose to any Pantex Plant radiation worker was 0.53 rem in 1991 (Martin, J., 1992), well below the Pantex Plant administrative operating limit of 1 rem/yr (established annually), and substantially below the Federal limit of 5 rem/yr for occupational workers. The average radiation exposure for all other workers was less than 10 mrem per person for calendar year 1991. The postulated dose to the maximally exposed off-site individual at the fence line in 1990 was 0.16 mrem (Mason & Hanger-Silas Mason Co., Inc., 1991). Such a dose is considered insignificant and no health effects are expected.

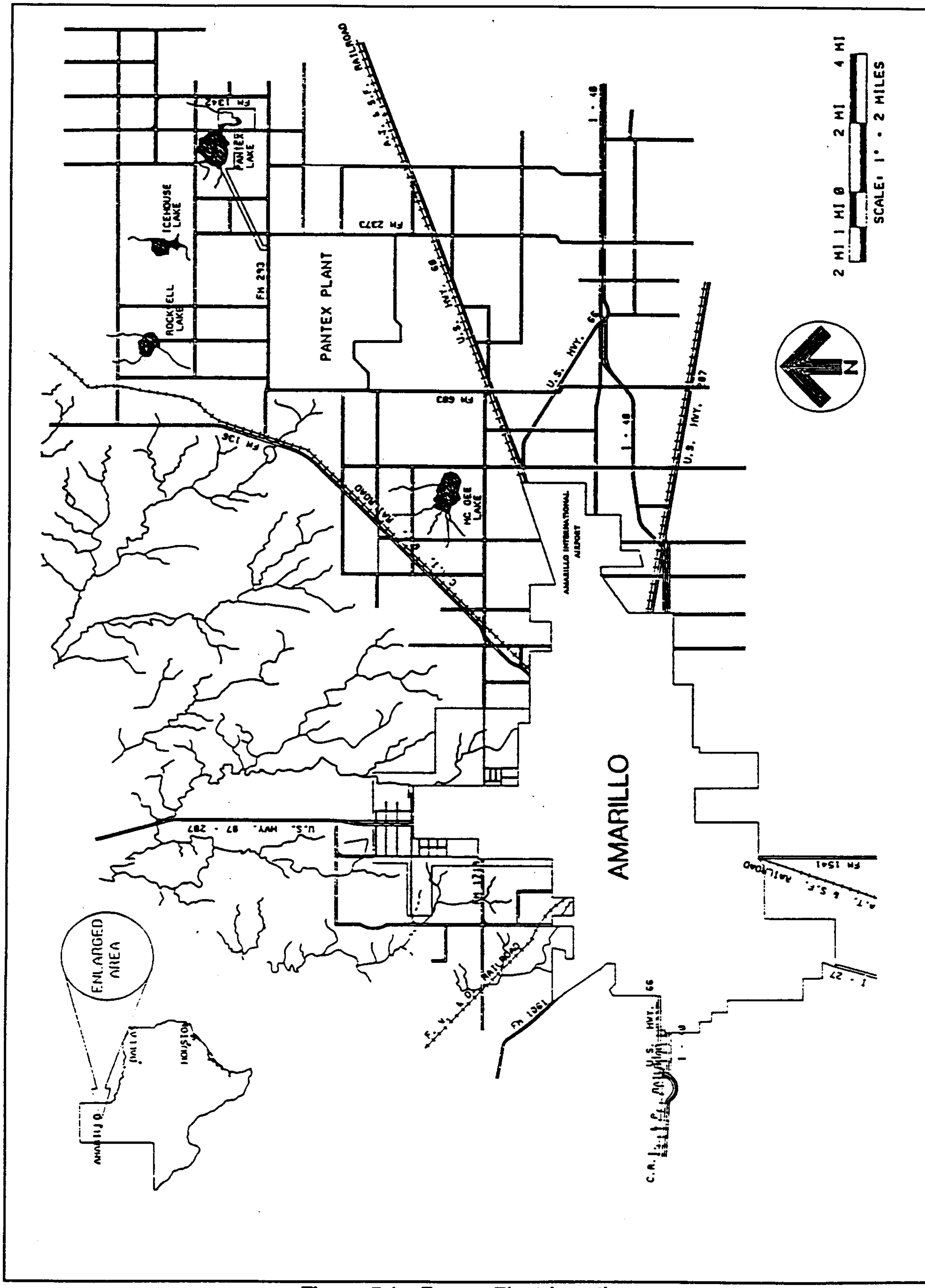


Figure 5.1 - Pantex Plant Location

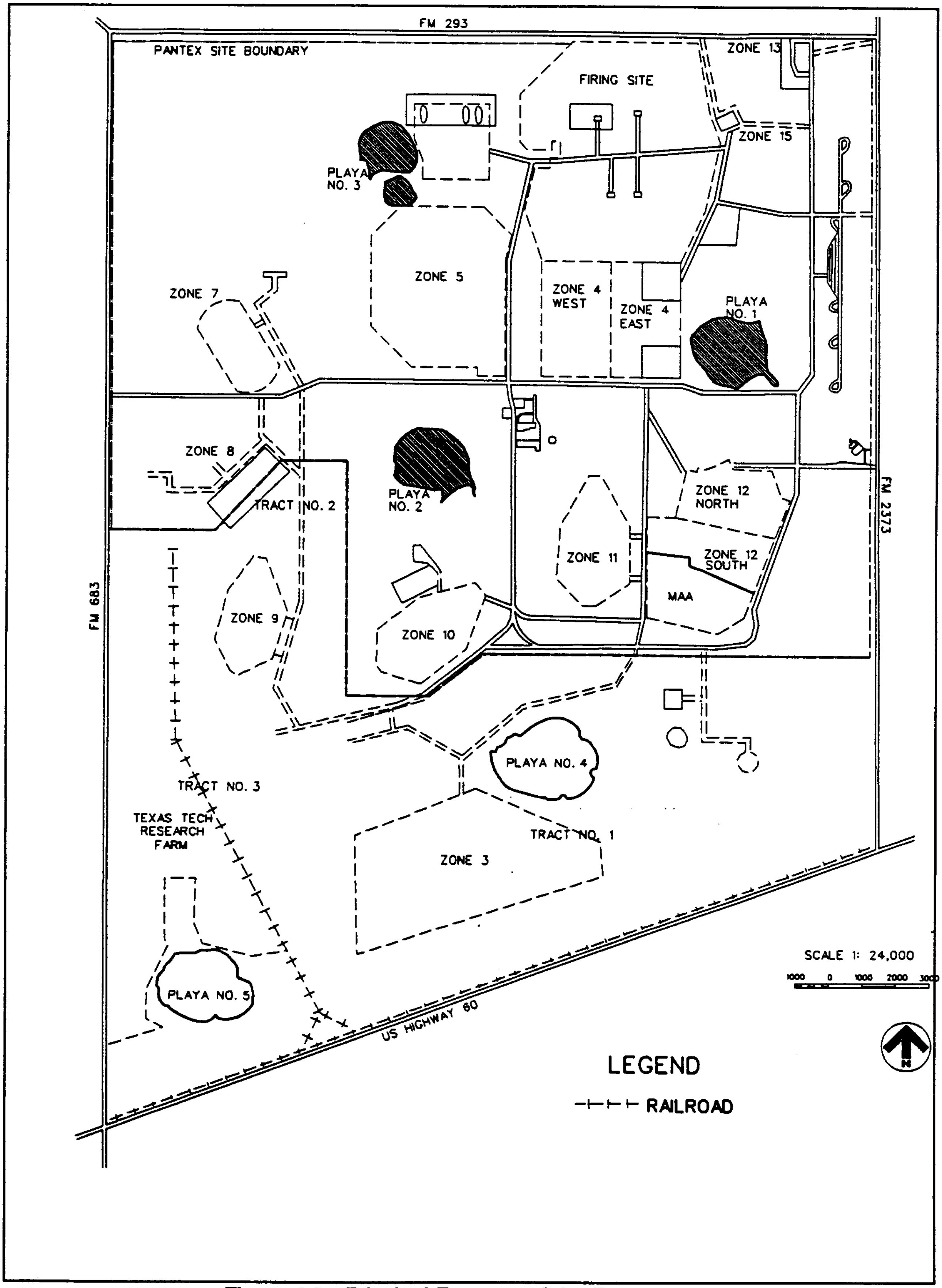


Figure 5.2 - Principal Features of the Pantex Plant

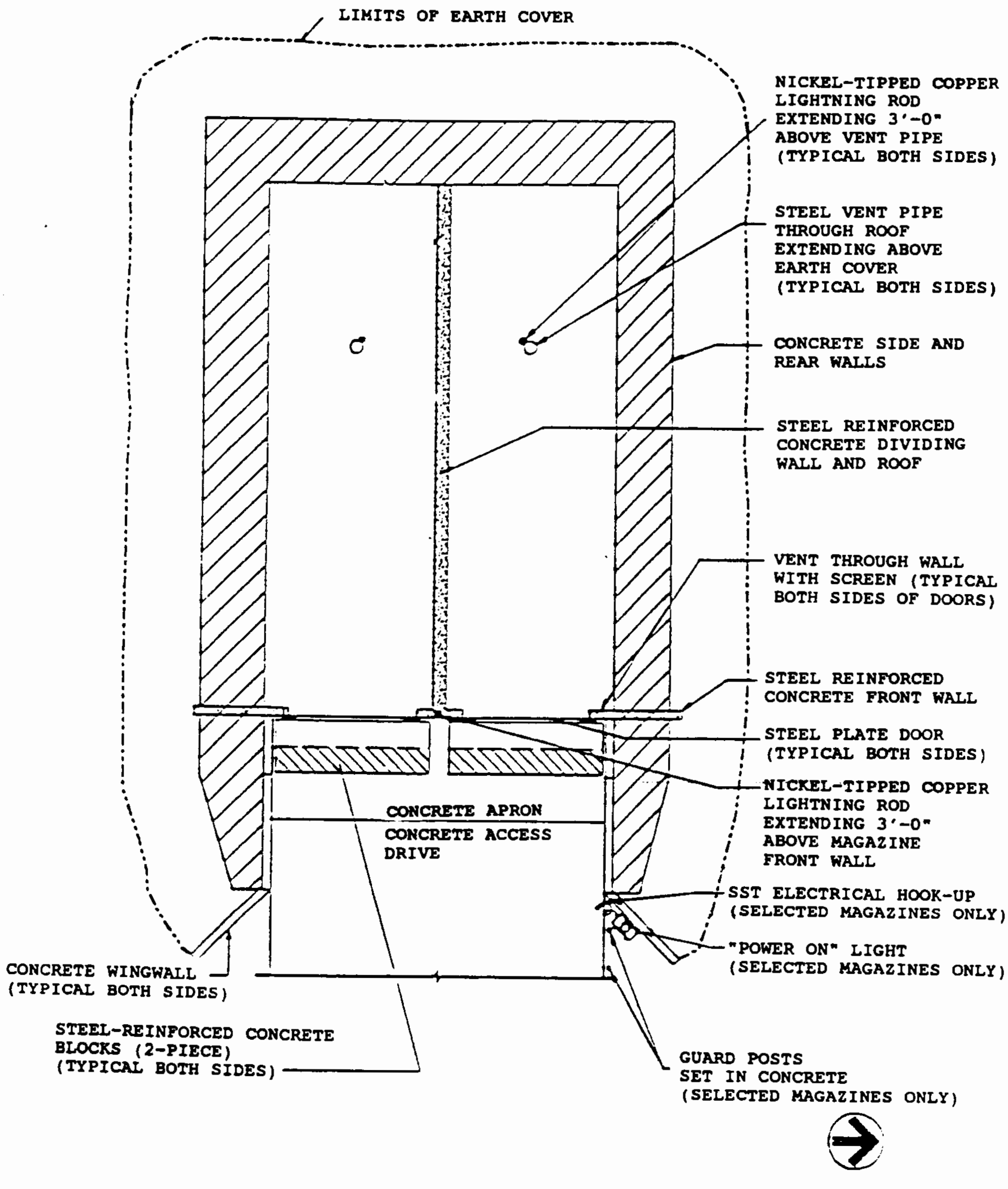


Figure 5.3 - Modified-Richmond Magazine Layout (Top View)

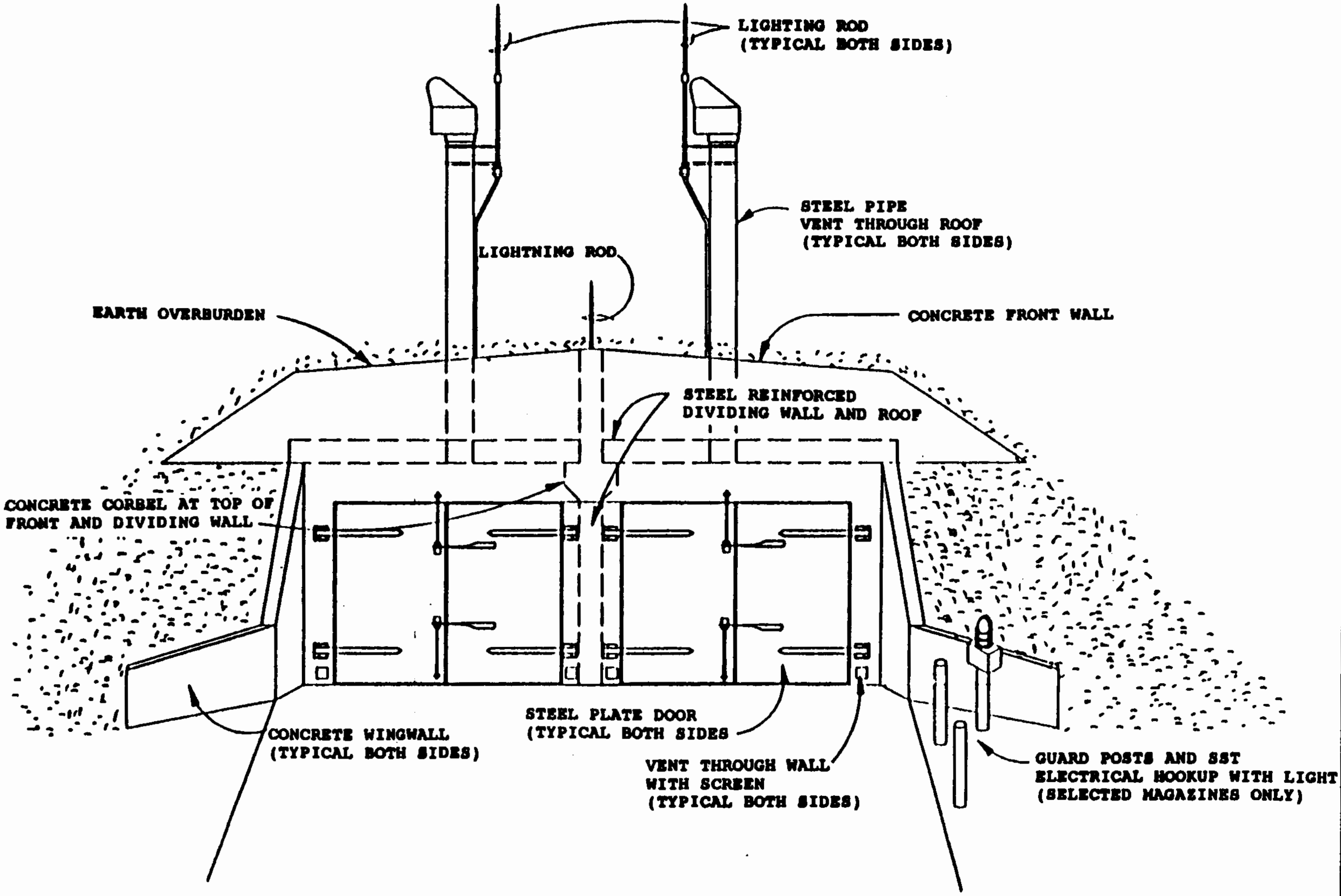


Figure 5.4 - Modified-Richmond Magazine Layout (Front View)
(Security Blocks Omitted for Clarity)

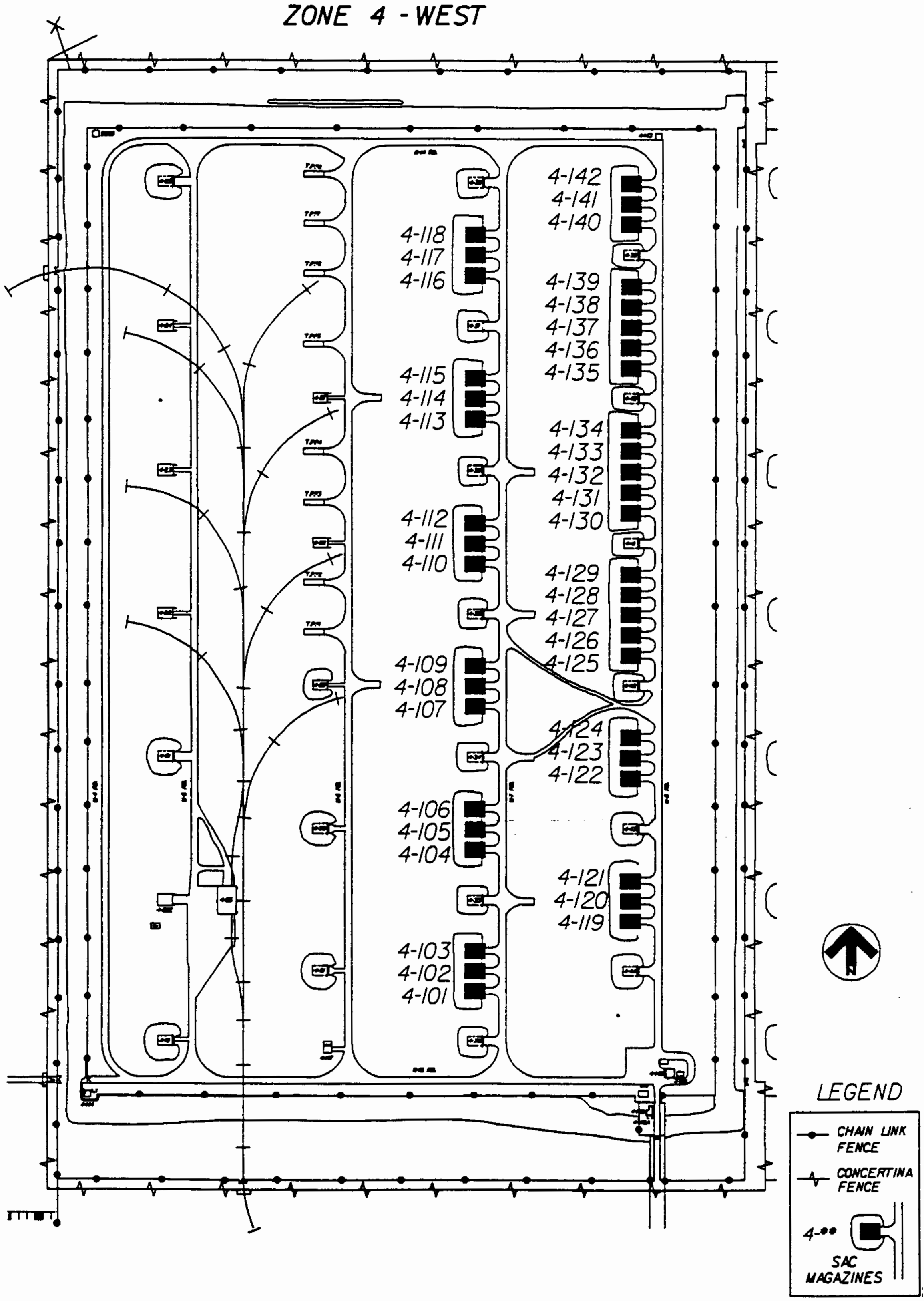


Figure 5.5 - Layout of Zone 4 West and 42 Steel Arch Construction Magazines

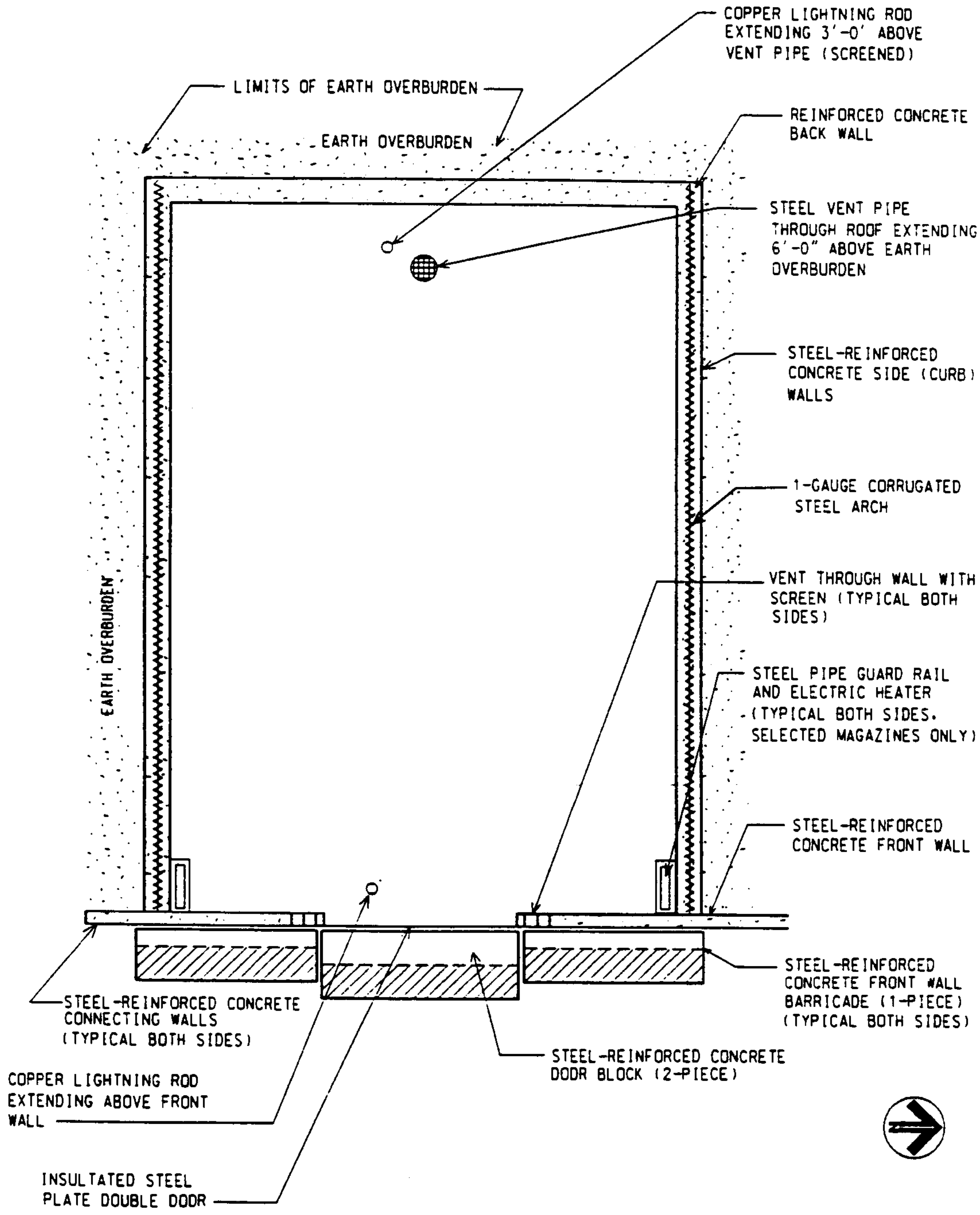


Figure 5.6 - Steel Arch Construction Magazine Layout (Top View)

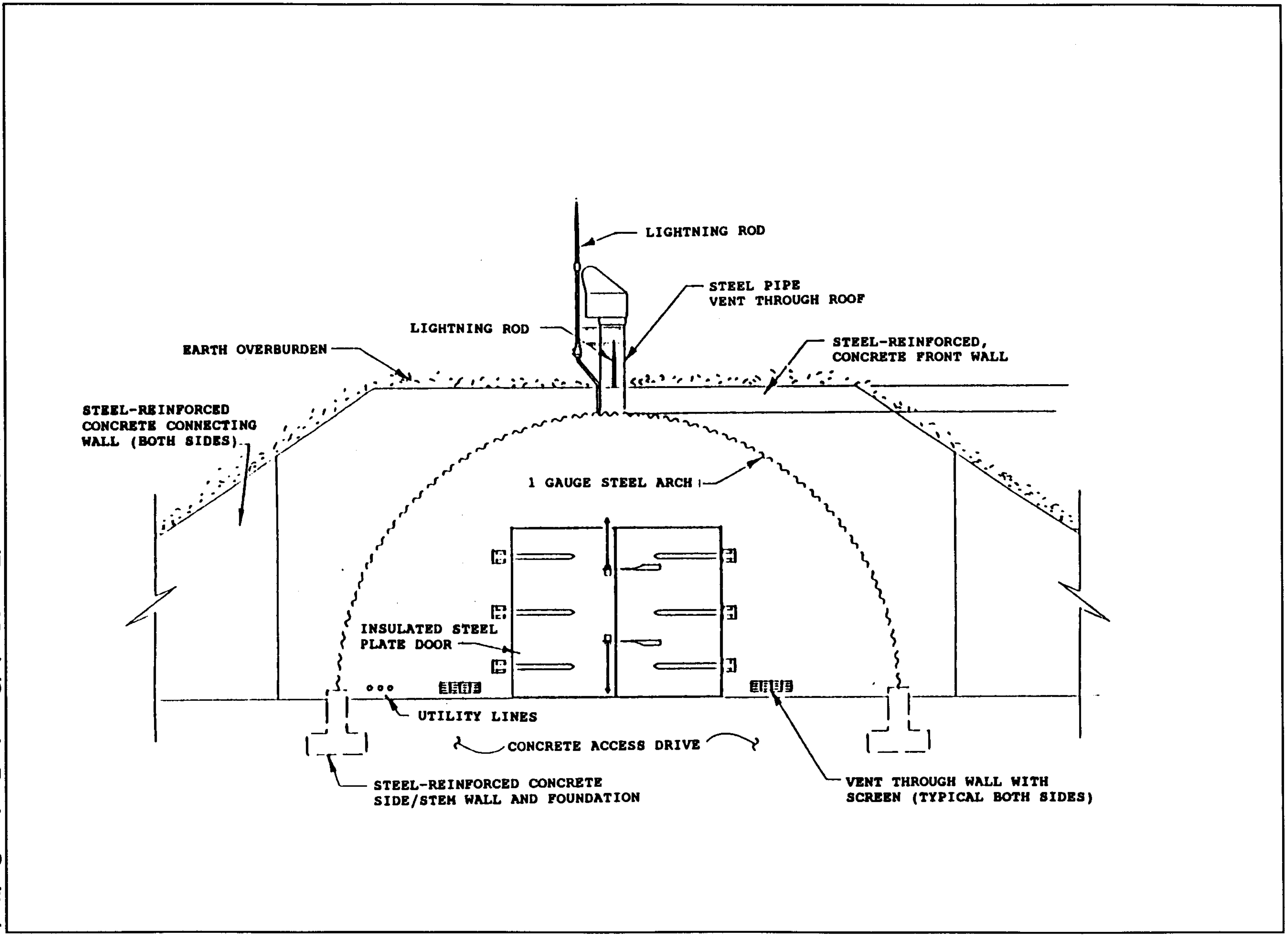
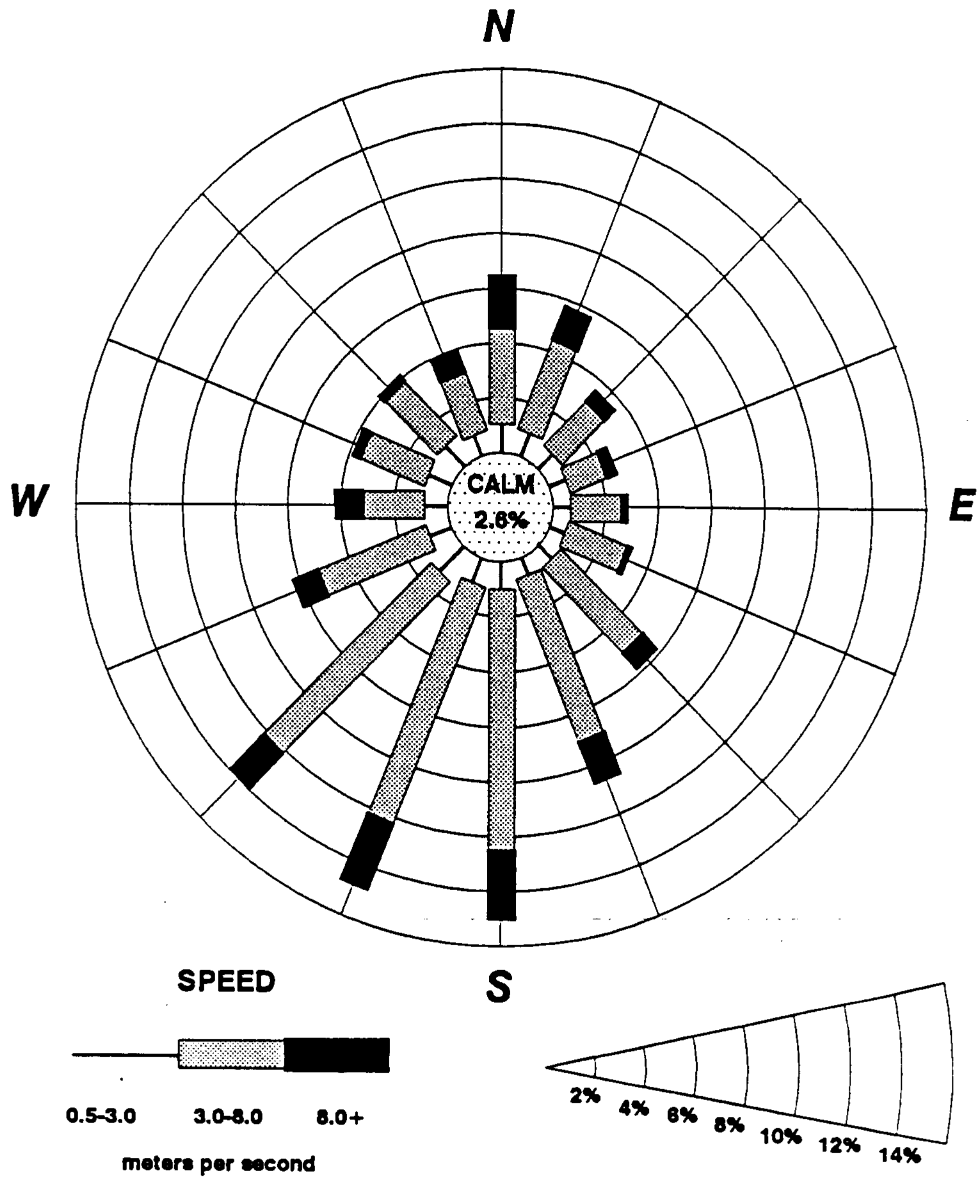


Figure 5.7 - Steel Arch Construction Magazine Layout (Front View) (Security Barriers Omitted for Clarity)



(Derived from data provided by the National Weather Service Station, Amarillo, TX 1955-1964,
Source: Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983) Pg 3-3)

Figure 5.8 - Average Annual Wind Rose for Pantex Area

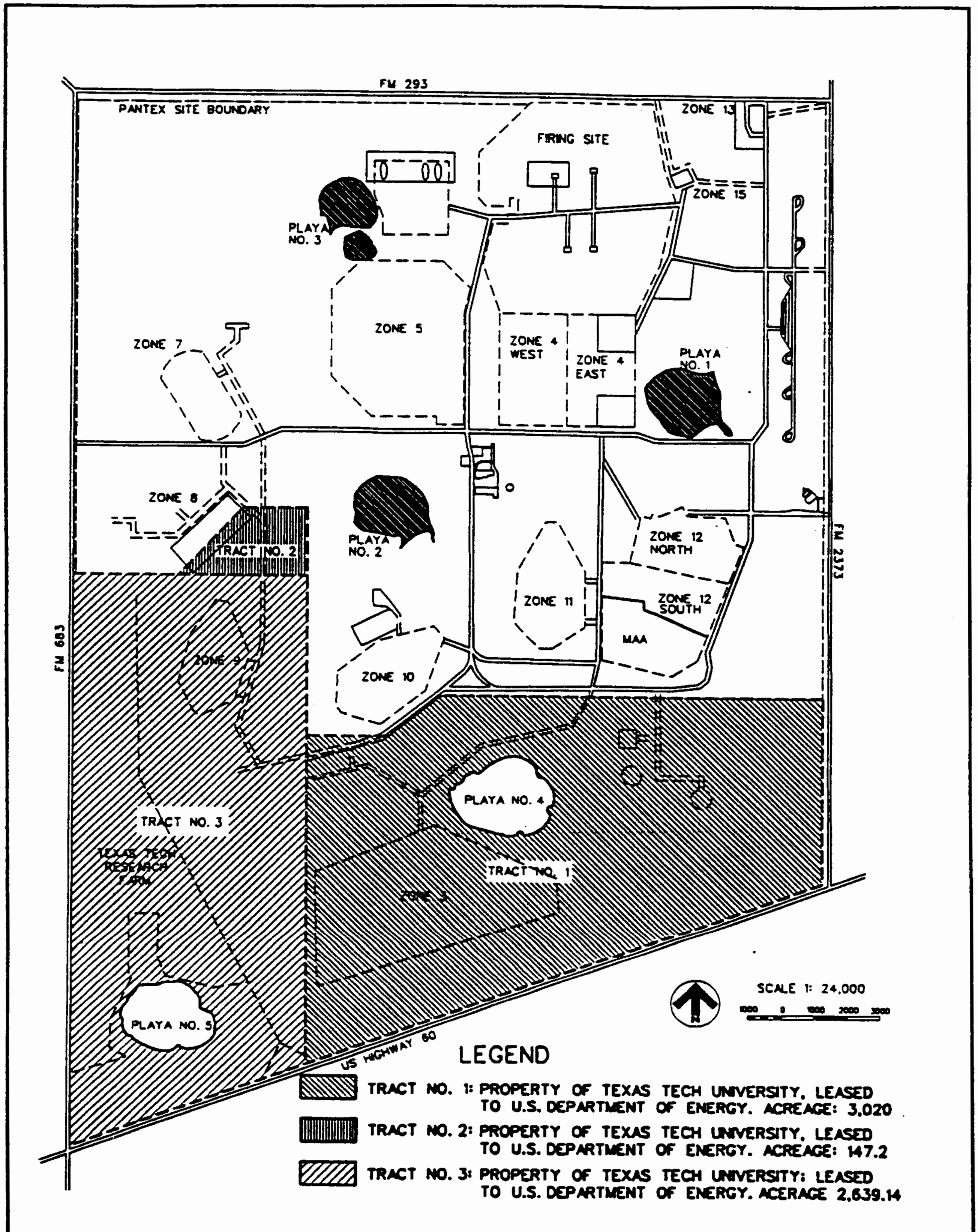


Figure 5.9 - Land Utilization Map - Pantex Plant Layout

6.0 ENVIRONMENTAL IMPACTS

6.0 ENVIRONMENTAL IMPACTS

6.1 Routine Operating Conditions

Potential environmental impacts associated with the Proposed Action and the No-Action Alternative during routine operations are discussed in the following subsections.

Because the proposed action would not require any construction activities and because any facility modification would be inside existing facilities, impacts to the natural environment would be minimal. Under normal operating conditions, there would be minor releases of air pollutants associated with equipment engines and a minor increase in particulate (dust) associated with operation of forklifts used to move the security blocks and transport the pits to the magazines. There would be no impact to water resources, flood plains, wetlands, cultural resources or other site features. Routine operations of the No-Action Alternative are similar to those for the proposed action, differing only in the quantity of materials held and number of magazines authorized for pit storage. The horizontal palletized multiple stacking configuration allows the use of a forklift to lift and manipulate a group of containers in a way that facilitates and speeds inspections. In the vertical configuration, the drums must be individually handled for the inspection process. This difference in how the drums must be handled for inspection activities accounts for the difference in inspection time between the No Action Alternative and the Proposed Action configurations.

6.1.1 Radiological Impacts

The pit is comprised of a hermetically sealed metallic outer shell and an inner shell of solid plutonium metal. Each pit is clamped in a holding fixture and inserted in a storage container comprised of a carbon or stainless steel drum lined with a nominal three inches of insulating and cushioning material. No radiological releases are associated with routine staging/ interim storage operations for either the Proposed Action or the No-Action Alternative.

6.1.1.1 Radiological Exposure to Workers Associated with the Proposed Action

Radiological impacts of routine operations would consist principally of radiation exposure (neutron and gamma) to workers involved in placement of pits into storage and periodic inspections and inventories of pits stored on an interim basis. Periodic inspections and inventories are planned every 18 months, based upon permanent variance to the prior requirement for a bimonthly physical inventory for each Modified-Richmond or Steel Arch Construction interim storage magazine. Workers are required to wear protective clothing (e.g., lead aprons), as directed by the Radiation Safety Department at Pantex, when handling containerized pits or when entering magazines.

Appendix F provides a detailed analysis for cumulative worker doses attributed to the proposed interim storage activities. A high level of conservatism is used through dose rates and durations of exposures; in addition, no credit is currently taken for personnel shielding, i.e., lead aprons, remote inventorying equipment, or other equipment shielding used or planned for future use. Specific assumptions used are tabulated in Table 6-1.

The predicted cumulative worker doses are dependent on the amount of americium in a plutonium pit, which varies with the age of a pit. Americium, the decay product of a plutonium isotope found in weapons grade plutonium, reaches its maximum content in a pit in approximately 73 years. After this time, the americium content decreases through radioactive decay. During decay, americium emits alpha and gamma radiation. The gamma radiation produced by the

Table 6-1 - Assumptions Used to Calculate Radiological Exposure to Workers Associated with the Proposed Action

Inventory Process:	
Vertical Single-Layer Configuration	Two people, 70 minutes for each side of a Modified-Richmond magazine. Also assumes 140 minutes per Steel Arch Construction magazine. Inventory of per each magazine once every 18 months (40 magazines/yr).
Horizontal Palletized Multiple Stacking Configuration	Two people, 45 minutes for each side of a Modified-Richmond, and 1 person 90 minutes for each Steel Arch Construction magazine. Inventory of each magazine once every 18 months (40 magazines/yr).
Corrosion Inspections:	100 percent container corrosion inspection for each magazine every 18 months (vertical single-layer configuration only). Assume 1 minute per container for surveillance operations, 2 workers (100 percent inspection).
Miscellaneous Operations:	One Steel Arch Construction magazine and one Modified-Richmond magazine opened every workday for 2 hours with 2 workers.
Magazine Capacities:	For the vertical single-layer configuration, 384 containers is the operational maximum for Steel Arch Construction magazines and is used for both magazine types in the calculations. For horizontal palletized stacking configuration, the maximum capacity is 440 containers in Modified-Richmond and 392 containers for Steel Arch Construction magazines.
Radiation Dose Rates:	525 mrem/hr for the vertical single-layer configuration inventory process. 250 mrem/hr for the horizontal palletized stacking configuration inventory process. 60 mrem/hr for corrosion inspection activities. 30 mrem/hr for miscellaneous operations.

decay of americium is more energetic than the radiation produced by the plutonium present in fully aged pits (greater than 45 years from manufacture). The resultant expected increase in radiation field has been included in calculations presented in Appendix F. The exposure rates in the magazines will be at the highest levels when the americium reaches equilibrium with the plutonium, in approximately 45 years. However, personnel exposure will be mitigated through the use of the shielded forklift, the self shielding attributed to the proposed horizontal storage and use of personnel protective equipment such as lead aprons. A more detailed discussion of the effects of americium is found in the Final Safety Analysis Report for Pantex Plant Zone 4 Magazines.

The annual collective dose attributed to the bounding case where use of the single-layer vertical configuration is used, is projected to be from 100 to 200 person-rem. This range of exposure is related to maintaining 60 magazines containing a total of up to 20,000 pits. The annual collective dose attributed to the bounding case where use of the horizontal palletized multiple stacking configuration is used, is projected to be from 50 to 100 person-rem.

In addition to individuals taking personal precautions such as the mandatory use of lead aprons, shielded forklifts and Automated Guided Vehicles (in the future) would be used both to place pits in magazines and to assist in taking inventories using barcode readers. The use of such vehicles would further reduce worker exposure to external radiation associated with pit storage and inventory activities. The typical individual worker radiation doses would be maintained below the established Pantex annual administrative operating limit (1 rem/yr for 1992). Using a Latent Cancer Fatality Rate of 4 to 5 fatal cancers per 10,000 person-rem, a 1 rem exposure results in about 0.08 percent increased risk. The natural incidence of fatal cancer in the total population is about 20 percent.

6.1.1.2 Radiological Impacts Associated with the No-Action Alternative

A high level of conservatism is used as detailed in Appendix F. Specific assumptions used to calculate the annual collective dose for the No-Action Alternative are tabulated in Table 6-2.

Table 6-2 - Assumptions Used to Calculate Radiological Exposure to Workers Associated with the No-Action Alternative

Inventory Process: Vertical Single-Layer Configuration	Two people, 70 minutes for each side of a Modified-Richmond magazine. Inventory 2 sides each month. Frequency is in accordance with current operations.
Corrosion Inspections:	100 percent container corrosion inspection for each Modified-Richmond magazine every 18 months. Assume 1 minute per container for surveillance operations, 2 workers (100% inspection of 12 magazines/yr).
Miscellaneous Operations:	One Modified-Richmond opened every workday for 2 hours with 2 workers. Loading, unloading, use of forklifts, continuous close exposure is limited.
Magazine Capacities:	For the vertical single-layer configuration 384 containers is used in the calculations.
Radiation Dose Rates:	525 mrem/hr for the vertical single-layer configuration inventory process. 60 mrem/hr for corrosion inspection activities. 30 mrem/hr for miscellaneous operations.

The annual collective dose attributed to the bounding case where the use of single-layer vertical configuration is projected to be from 50 to 100 person-rem. This range of exposure is related to maintaining 18 Modified-Richmond magazines in the maximum packing configuration containing up to 6,800 pits and is considered to be conservative; for perspective, current dosimetry records for both 1991 and 1992 indicate that the collective dose rate for personnel associated with all Zone 4 operations is less than 10 person-rem per year. Lower individual and collective worker dose rates would be expected from differing numbers of pits (i.e., use of preferred storage configurations) in Zone 4 in comparison to the proposed action.

The typical individual worker radiation doses would be maintained below the established Pantex annual administrative operating limit (1 rem/yr for 1992). Using a Latent Cancer Fatality Rate of 4 to 5 fatal cancers per 10,000 person-rem, a 1 rem exposure results in about 0.08 percent increased risk. The natural incidence of fatal cancer in the total population is about 20 percent. Under the No-Action Alternative, the transportation of weapons for dismantlement would diminish or cease entirely, eliminating the corresponding potential exposure as documented in the Final Environmental Impact Statement for the Pantex Plant.

6.1.2 Radiological Exposure to Public

For either the Proposed Action or the No-Action Alternative, the expected level of penetrating radiation would result in no measurable effect or exposure to an individual occupying a position for an entire year at the nearest Pantex site boundary. Such a level would be indistinguishable from natural background radiation. No adverse health effects would be expected among the general public as a result of normal operations from this action.

6.1.3 Cumulative Impacts for the Proposed Action

The only potential impact of the proposed action would be increased worker radiation exposure. For all operations at the Pantex Plant, worker radiation doses are maintained below the annually established Pantex administrative operating limit (1 rem/yr for 1992). This limit is significantly below the Department of Energy mandated limit of 5 rem/yr. The Pantex personnel dosimetry program measures radiation exposure, and plant management uses the data to ensure limits are not exceeded. Although the annual collective worker dose may increase, the Federal individual worker exposure limit would not be exceeded by the proposed action.

6.2 Abnormal Events/Accidents Associated with the Proposed Action

A series of potential accident initiating events were analyzed for operations in Zone 4 (Department of Energy, 1992). Impacts from abnormal events having a probability greater than one in a million (1×10^{-6}), occurring as a result of implementing the proposed action, are presented in this section (Department of Energy, 1988). The definitions of various events including an incredible event are based upon a deliberate process of comparison between events having various societal risks. Ultimately the definition of an incredible event is based upon the expectation that the event has a sufficiently small likelihood of occurrence such that it need not be further assessed. In particular, it need not be further assessed relative to other societal risks.

All events that are quantified are typically stated in efficiency terms of annual probability of occurrence. It is the standard practice for consistency, efficiency and because it provides a standard timeframe from which judgements on the acceptability of risks originating from different events.

Facilities included in the analysis were the Modified-Richmond and Steel Arch Construction magazines. Results of these accidents are summarized in Tables 6-3, 6-4A, and 6-4B.

Detailed discussions are provided in the appendices as follows:

Screening of Potential Accident-Initiating Events	Appendix A
Blast Calculations	Appendix B
Structural Analysis	Appendix C
Forklift Operational Analysis	Appendix D
Aircraft Hazard Analysis	Appendix E

6.2.1 Screening of Potential Accident Initiating Events

A list of potential accident-initiating events was prepared and a qualitative assessment made to eliminate from further consideration any event that posed little or no hazard to the magazines or their contents. This list and a brief statement of findings from the assessment are provided in Appendix A. Events that required a more structured assessment were those initiated by earthquakes, external explosions, missiles, tornados, forklift accident and aircraft crash.

6.2.2 Potential Blast Hazards

An analysis was made of the effects that blasts from explosions occurring in nearby facilities might have on the interim storage facilities or their contents. This analysis is described in Appendix B. Department of Energy determined that missiles could be generated by a high explosive blast that could reach the magazines. The consequences, as described in Appendix C, were such that the magazines and their contents would not be affected.

6.2.3 Structural Analysis

An analysis (summarized at Appendix C) was made of the effect earthquakes would have on the magazines, and Department of Energy concluded that no significant effect would occur. An analysis was also made of the effect of tornados and missiles propelled by tornados or explosions on the magazines. It was determined that no significant effect would occur.

6.2.4 Forklift Operational Accident

In this analysis (see Appendix D), the single boom on a specially designed forklift, traveling at 5 mph, strikes and punctures an AL-R8 container. The boom then crushes the pit within the container and packing material, expelling plutonium dust. Essentially, all of the 20 mg of available plutonium dust becomes airborne within the AL-R8 container; however, calculations, using conservative assumptions, show that only 0.57 mg of the plutonium actually escapes to the outside air.

The total activity released by 45-year old weapons grade plutonium, which maximizes resultant activity levels, in the above accident is calculated to be 92 μCi. Assuming that the plutonium is dispersed uniformly and instantaneously, a worker present would receive 0.02 μCi. This is equivalent to the 50-year committed effective dose equivalent (Committed Effective Dose Equivalent) for lungs of 24 rem, and the 50-year Committed Effective Dose Equivalent whole body dose of 6.6 rem. There would be no immediate or long-term health effect to the worker as a result of an accident of this type. Workers in the immediate vicinity of the accident site could receive a marginal radiation dose; negligible consequences to the public or the environment are anticipated.

6.2.5 Aircraft Hazard Analysis

Appendix E, "Aircraft Hazard Analysis," presents a quantitative analysis of the likelihood of any class (e.g., air carrier, military) of aircraft striking a Modified-Richmond or Steel Arch Construction magazine. The results of the analysis (summarized by aircraft class) are as follows:

Aircraft Class	Crash Probability/Year
Air Carrier	2.78×10^{-8}
Military Aviation	2.50×10^{-7}
General Aviation	1.52×10^{-6}
Aerial Application	5.42×10^{-8}
TOTAL	1.86×10^{-6}

The analysis indicates that the likelihood of any class of aircraft impacting into any of the 60 Zone 4 magazines (regardless of the magnitude of that impact) is approximately 1.9×10^{-6} per year. The overall estimated probability of impact is greater than one in a million (1×10^{-6}) per year. However, it must be observed that this estimate is dominated by the results for general aviation in that approximately 82 percent of the total probability comes from that source. This arises from the fact that general aviation clearly dominates the air traffic in the Amarillo area. As indicated in the Safety Analysis Report for Zone 4, 62 percent of the total traffic count is general aviation. Given this situation, and the fact that these single-engine aircraft are lightweight and fly at low speeds compared to the air carriers and military aircraft, the vulnerability of the magazines in Zone 4 to impacts from general aviation aircraft was examined.

Analysis (detailed in Appendix C) indicates that light aircraft (i.e., single-engine aircraft) moving at typical speeds will not penetrate or collapse a Zone 4 magazine structure. This analysis is summarized in Appendix E. Therefore, it is considered reasonable to exclude single-engine aircraft from further consideration in the accident analysis and to focus attention on those aircraft that have some potential for penetration or destruction impact. When the probability calculation was reworked to reflect only aircraft crashes capable of damaging a Zone 4 magazine structure, the overall estimate of the probability of an aircraft crash dropped below 1 x 10^{-6} per year. The results by aircraft class are as follows:

Aircraft Class	Crash Probability/Year
Air Carrier	2.78 x 10^{-8}
Military Aviation	2.50 x 10^{-7}
General Aviation	3.31 x 10^{-7}
Aerial Application	5.42 x 10^{-8}
TOTAL	6.63 x 10^{-7}

The above approach is considered conservative and, on the basis of the analysis in Appendix E, an aircraft crash into a Zone 4 magazine sufficient to cause damage and potential release of radioactive material is considered beyond extremely unlikely. The consequence of this accident is bounded by the analyses conducted in the Final Environmental Impact Statement for the Pantex Plant.

Table 6-3 - Summary of Accident Analysis Results - Modified-Richmond and Steel Arch Construction Magazines

Accident Scenario	Annual Probability[1]	Effect on General Public[2]	Effect on Environment[2]	Effect on Plant Workers[2]	Dollar Loss [2]	Program Interruption[2]	Risk Level[3]
Aircraft Crash[4] (General Aviation, Single Engine)	Extremely Unlikely (1.2E-6)	Negligible (no effect)	Negligible (no effect)	Negligible (no effect)	Marginal - (minor cracking of concrete)	Negligible (no effect)	IV-C
Design Basis[4] Earthquakes (0.10g)	Unlikely (1.0E-3)	Negligible (no effect)	Negligible (no effect)	Negligible (no effect)	Marginal - (minor cracking or spalling of concrete)	Negligible (no effect)	IV-B
Maximum Credible[4] Earthquakes (0.33g)	Extremely Unlikely (1.5E-5)	Negligible (no effect)	Negligible (no effect)	Negligible (no effect)	Marginal - (minor cracking or spalling of concrete)	Negligible (no effect)	IV-C
External Explosion[5] (5.2psi overpressure; Zone 4 East magazines)	Unlikely (1.7E-4)	Negligible (no effect)	Negligible (no effect)	Marginal - (personnel near Zone 4 MAA magazines slightly injured)	Negligible - (no dollar loss)	Negligible (no effect)	III-B
External Fires[5] (diesel fuel fire)	Likely (2.5E-2)	Negligible (no effect)	Negligible (no effect)	Negligible (no effect)	Marginal - (minor damage to doors and concrete front wall, loss of forklift)	Negligible (no effect)	IV-A
Missiles[5] (Explosion-Generated - 40 lbs., 778 ft/sec)	Extremely Unlikely (1.6E-6)	Negligible (no effect)	Negligible (no effect)	Critical - (personnel near Zone 4 MAA magazines severely injured)	Marginal - (minor damage to security barrier)	Negligible (no effect)	II-C
Missiles[4] (Tornado- Driven)	Extremely Unlikely (2.0E-5)	Negligible (no effect)	Negligible (no effect)	Negligible (no effect)	Negligible - (slight damage to security barrier)	Negligible (no effect)	IV-C
Design Basis[4] Tornados (150 mph)	Extremely Unlikely (2.0E-5)	Negligible (no effect)	Negligible (no effect)	Negligible (no effect)	Marginal - (minor cracking or spalling of concrete)	Negligible (no effect)	IV-C
Maximum[4] Credible Tornados (220 mph)	Extremely Unlikely (1.0E-6)	Negligible (no effect)	Negligible (no effect)	Negligible (no effect)	Marginal - (minor cracking or spalling of concrete)	Negligible (no effect)	IV-C
Operational Accident[5] - (forklift puncture of pit container)	Likely (>1.0E-2)	Negligible (no effect)	Negligible (no effect)	Marginal - (whole body 50 year CEDE <7 rem)	Marginal - (from decontamination proceedings)	Negligible (no effect)	III-A

NOTES:

1. Probability estimates are based on quantitative analysis or the qualitative description provided in the Zone 4 Safety Analysis Report.
2. Consequence estimates are based on quantitative analysis and the qualitative description provided in the Zone 4 Safety Analysis Report.
3. Risk is defined as the combination of the annual probability and the worst of the effects the event could produce on the general public, the plant workers, or the environment. See Tables 6-4A and 6-4B.
4. Tornado, Earthquake, and Aircraft Crash probabilities are for all Zone 4 magazines.
5. Fire, Explosion, and Operational Accident probabilities are for individual magazines.

Table 6-4A - Qualitative Consequence Categories

Category I - Catastrophic	An accident that may cause deaths, the total loss of the facility or process, severe damage to the environment, extreme dollar loss or a long-term program interruption.
Category II - Critical	An accident that may cause severe injuries or occupational illnesses, major damage to the facility or process, major damage to the environment, large dollar loss, or moderate program interruption.
Category III - Marginal	An accident that may cause minor injuries or occupational illnesses, minor damage to the facility or process, minor damage to the environment, minor dollar loss, or a short-term program interruption.
Category IV - Negligible	An accident that would not result in injuries or occupational illnesses, damage to the facility or process, damage to the environment, dollar loss, or a program interruption.

Table 6-4B - Qualitative Likelihood Categories

Category	Estimated Occurrence Rate (Per Year)	Description
Category A - Likely	$> 1.0 \times 10^{-2}$	The event is likely to occur (possibly several times) during the lifetime of the facility.
Category B - Unlikely	1.0×10^{-2} to 1.0×10^{-4}	The event is unlikely, but may reasonably be expected to occur during the lifetime of the facility.
Category C - Extremely Unlikely	1.0×10^{-4} to 1.0×10^{-6}	The event is extremely unlikely and is not expected to occur during the lifetime of the facility.

7.0 POTENTIAL IMPACTS ON THE OGALLALA AQUIFER

7.0 POTENTIAL IMPACTS ON THE OGALLALA AQUIFER

The Department of Energy could identify no accident or routine operating condition with a probability greater than 1 x 10^{-6} per year that could result in a plutonium release having an impact on the Ogallala Aquifer. However, in response to the expressed interest of the State and public regarding possible contamination of the aquifer, the Department of Energy directed the Los Alamos National Laboratory to perform additional analyses (Turin, et al., 1992). The following summarizes those analyses.

As with all Federal agencies, the Department of Energy would be responsible for cleanup of any contamination. Emergency Response Teams and decontamination crews would remove the plutonium contaminated soil and it would be disposed of, as appropriate, in a repository for radioactive contaminated waste. Plutonium contaminated soil would be removed to levels of plutonium in soil that would not pose a significant threat to public health and safety. The Environmental Protection Agency proposed in 1977 that for residual plutonium, 0.2 $\mu Ci/m^2$ in the top centimeter of soil would result in dose rates less than the guidance recommendations for acceptably low risks from alpha radiation exposure - about 1 millirad per year to lung tissue. This value was proposed by the Environmental Protection Agency, but never officially adopted. The Final Environmental Impact Statement for the Pantex Plant (Department of Energy, 1983) also used this value for the top centimeter of soil as the level to which soil would be decontaminated in the event of a release. The Environmental Impact Statement also references a study (Elder, 1982) that provides an example of ground dispersion from an accident. Analysis has shown that the maximum calculated area that is expected to be contaminated to a level above the proposed Environmental Protection Agency guideline due to an accident in Zone 4 is 75 km^2. See memorandum from Sandia National Laboratory, dated April 30, 1993 from Y.T. Lin, N.R. Grandjean, R.E. Smith to D.R. Rosson (Department of Energy/Albuquerque) titled "Plutonium Dispersal Deposition Area Estimates of a Hypothetical Aircraft Crash Into Pantex Zone 4, (included in the Environmental Assessment Comment Response, Appendix I).

The Department of Energy's previous experience with cleanup of nuclear test sites indicates that a cleanup to the 0.2 $\mu Ci/m^2$ level is achievable. 1) See Palomares Summary Report. Field Command, Defense Nuclear Agency, Technology and Analysis Directorate, Kirtland Air Force Base. 2) Thule. United States Air Force Nuclear Safety, AFRP 122, January/February/March 1970, No. 1, Volume 65 (Part 2), Special Edition: "Project Crested Ice". 3) Johnston Island. Thermo Analytical (Attention: Nels Johnson/5635 Jefferson Street, N.E., Albuquerque, New Mexico 87109), Soil Clean of Technologies.

If required, surface soil cleanup may be both expensive and time-consuming. However, a delay on the order of a few years would not significantly change the Environmental Assessment's analyses concerning the potential effects of a plutonium dispersal accident on the Ogallala Aquifer. Although there is uncertainty concerning the long-term rate of plutonium transport, soil scientists generally agree that it is relatively immobile and that it will not migrate beyond remedial depths within the few years that could be needed to complete a cleanup.

The Los Alamos National Laboratory analysis describes the potential for aquifer contamination should plutonium be released to the environment within an 80 km radius of the Pantex Plant (Elder, 1986). The following assumptions were used in preparing the groundwater impact analysis:

- Surface soils would be decontaminated to levels no greater than 0.2 $\mu Ci/m^2$ following the hypothetical accident. (Previous experience indicates this level is achievable.)

- Surface transport processes may increase soil concentrations ten-fold, to 2.0 $\mu Ci/m^2$, before infiltration takes place.

- Recharge to the Ogallala Aquifer is focused at playa lake beds. Playa lake recharge rates are approximately 3 cm/year, ten times the High Plains average.

- The Ogallala Aquifer water table may be encountered as shallow as 50 feet beneath the land surface within the study area (located south of Pantex, directly opposite predominant wind directions).

- The entire unsaturated zone exhibits a plutonium sorption coefficient of 100 mL/g, approximating the sorption of clean Ogallala sand.

With these conservative assumptions in place, two analyses were performed. A non-dispersive piston-flow model indicated that significant plutonium levels might be encountered in a 50-foot deep aquifer after approximately 76,000 years (at depths of 200 and 400 feet, plutonium travel times are 305,000 and 610,000 years, respectively). A second, more realistic analysis incorporating dispersion showed that even with unrealistically low dispersivity values, peak plutonium concentrations in the 50-foot aquifer would never exceed the most restrictive drinking water dose limits. With more realistic dispersivity values, or deeper water tables more typical of the study area (i.e., approximately 400 feet directly beneath the Pantex Facility), peak plutonium concentrations in the aquifer would be orders of magnitude below dose limits. Neither analysis showed significant impacts to deeper aquifers.

Additional complicating factors have also been analyzed. These include colloidal plutonium transport, preferential flow, the effects of perched aquifers, opportunities for short-circuit flow through abandoned wells or other conduits, and the fate of daughter products. Although it is difficult to quantify these factors accurately, they are expected to have little if any negative impact on the Ogallala Aquifer. Colloidal transport is perhaps the most uncertain process in this category, but a field experiment at a nearby location suggests that colloidal transport will not enhance radionuclide transport enough to significantly affect groundwater quality in the Ogallala Aquifer.

Sorption, preferential flow, and plutonium remediation technology references are listed in Section 9.0 of this Environmental Assessment. Most of the sorption and preferential flow references are also cited in Turin et al., 1992. References for plutonium remediation technologies regarding soil and aquifer material cleanup were provided on Page 7-1 of this Environmental Assessment. Although there is very little in open literature concerning plutonium remediation for water, the references provided in Section 9.0 of this Environmental Assessment may be helpful.

The conclusion of these analyses is that the hypothetical plutonium dispersal accident does not pose a significant threat to the Ogallala Aquifer.

8.0 EXTERNAL AGENCY AND STAKEHOLDER INVOLVEMENT

8.0 EXTERNAL AGENCY AND STAKEHOLDER INVOLVEMENT

Agencies contacted during preparation of this Environmental Assessment:

- Nuclear Weapons Council (Joint Department of Energy/Department of Defense Independent Organization Chartered by Congress)
- Department of Defense - Defense Nuclear Agency
- Department of State
- Federal Aviation Administration

State and local governments, agencies, local citizens, private interest groups, and providing comments on this Environmental Assessment:

State of Texas:

- Ann W. Richards, Governor
- Bob Bullock, Lt. Governor
- Senator Teel Bivins (District 31), The Senate of The State of Texas
- Dan Morales, Attorney General, Office of the Attorney General
- Boyd Deaver, Texas Water Commission
- Joseph A. Martillotti, Texas Department of Health, Bureau of Radiation Control
- Alison A. Miller, Texas Air Control Board
- Tom Millwee, Chief, Texas Department of Public Safety, Division of Emergency Management
- Thomas A. Griffy, University of Texas at Austin, Department of Physics
- Auburn L. Mitchell, University of Texas at Austin, Texas Bureau of Economic Geology

Carson & Randall Counties and City of Amarillo:

- Jay R. Roselius, County Judge, Carson County
- Walt Kelley, City of Amarillo/Counties of Potter and Randall, Emergency Management

Other Government Agencies:

- C. Ross Schulke, United States Department of Transportation, Federal Aviation Administration
- Benito J. Garcia, Chief, State of New Mexico, Environmental Department

Local Citizens:

- 48 signatures/form letter

- Betty E. Barnard
- Louise Daniel
- Portia Dees
- Boyd M. Foster, President Arrowhead Mills
- Margie K. Hazlett
- William and Mary Klingensmith
- Bishop Leroy T. Matthiesen Diocese of Amarillo
- Jeri & Jim Osborne & Family
- Judy Osborne
- Dana O. Porter
- Karen Son
- Norbert Schlegal
- Tamara Snodgrass

Private Interest Groups:

- Operation Commonsense (W.H. O'Brien)
- Panhandle Area Neighbors and Landowners (PANAL) (Addis Charless, Jr.)
- Panhandle Area Neighbors and Landowners (PANAL) (Doris & Phillip Smith)
- Panhandle 2000 (Jerome W. Johnson)
- Save Texas Agriculture and Resources (STAR) (Beverly Gattis)
- Serious Texans Against Nuclear Dumping (STAND) of Amarillo, Inc. (Beverly Gattis)
- Texas Corn Growers Association (Carl L. King, President)
- The Peace Farm (Mavis Belisle, Director)
- The Texas Nuclear Waste Task Force (Tonya Kleuskens, Chairman)
- Hanford Education Action League (HEAL) (James Thomas)
- Institute for Energy & Environmental Research (Arjun Makhijani, Ph.D.) Military Production Network (Beverly Gattis)
- Nukewatch (Sam Day, Director)
- Physicians For Social Responsibility (Lawrence D. Egbert, MD)

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9.0 REFERENCES

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APPENDIX A - SCREENING OF POTENTIAL ACCIDENT-INITIATING EVENTS

APPENDIX A

SCREENING OF POTENTIAL ACCIDENT-INITIATING EVENTS

This appendix presents the potential accident-initiating events that were considered in the safety analysis of the Zone 4 magazines. From this list of events, a qualitative assessment was performed to eliminate from further consideration any of the events that posed little or no hazard to the magazines or their contents.

Potential accident-initiating events were identified by reviewing several prior risk and safety studies. The prior studies that were examined included environmental impact and safety analyses performed for the Pantex Plant (References 1, 2, and 3), Department of Energy-sponsored current guidelines for performing hazards assessments (References 4, 5, and 6), recent safety and risk analyses of another Department of Energy facility (References 7 and 8), and the recommended list of initiating events used to evaluate commercial nuclear power plant risks (Reference 9). In addition, an attempt was made to identify any other potential external initiating events unique to the Pantex Plant that had not been considered in previous studies.

Table A-1 presents the events that were considered for the Zone 4 magazines. The Status column in this table indicates how each event was categorized in the screening process. The four criteria used in the screening process are as follows:

1. The event is impossible or highly improbable due to the size or location of the facility; the characteristics of the regional geography, topography, or hydrography; and the nature of the materials handled or the operations performed in the magazines.

2. The event produces stresses that are similar or obviously less severe than other events under consideration.

3. The event would not result in any potential for adverse consequences on the interim storage facilities.

4. The event could not be eliminated from consideration by screening; some level of quantitative analysis is required.

Many of the events listed in Table A-1 were eliminated from further consideration by using this screening process. However, six events were not eliminated as follows: (1) earthquakes, (2) external explosions, (3) forklift accidents, (4) missiles, (5) tornados, and (6) aircraft crash. Discussions of these events are provided in Appendix B, C, D, and E of this Environmental Assessment. All of the events considered in this assessment, along with brief descriptions of their screening rationale, are listed in Table A-1.

Aircraft Impacts

Detailed analysis in Appendix E, Aircraft Hazard Analysis, has determined an aircraft impact with a Zone 4 magazine, resulting in a radioactive release, as an incredible event (Reference 15).

Avalanches/Landslides

Due to the flat terrain around the Pantex Plant, avalanches and landslides are not credible events.

Table A-1 - Potential Accident-Initiating Events

Event	Status[a]
Avalanches/Landslides	1
Coastal Erosion	1
Criticality Events	1[1]
Internal Explosions	1
Internal Fires	1[2]
Internal Floods	1
Meteor Strikes	1
Seiche	1
Tsunami	1
Volcanic Activity	1
Industrial or Military Facility Accident	1, 2
Forest/Grass Fires	2
Hail	2
Ice	2
Snow	2
Straight Winds	2
Transportation Accidents	2
Pipeline Accidents	2, 3
Structural Interactions	2, 3
Chemical/Toxic Gas Releases	3
Corrosion	3
Drought	3
External Fires	3[3]
External Floods	3
Fog	3
Frost	3
Lightning Strikes	3
Loss of Off-Site Power	3
Low Lake or River Water Level	3
River Diversions	3
Sandstorms/Dust Storms	3
Temperature Extremes	3
Aircraft Impacts	4
Earthquakes	4
External Explosions	4
Forklift Accident	4
Tornados	4
Missiles	4

[a] Status Key

1 - Not possible or plausible at this site or facility.
2 - Less severe than other potential events.
3 - No potential for adverse consequences.
4 - Quantitative analysis required.

NOTES:

[1] Criticality analysis performed in the Zone 4 Safety Analysis Report identified this event to be incredible.

[2] Internal Fire analysis performed in the Zone 4 Safety Analysis Report for pit storage indicates that the absence of combustibles would preclude a sustained fire having environmental impacts.

[3] External Fire analysis performed in the Zone 4 Safety Analysis Report concluded there would be no impacts to magazines or contents.

Chemical/Toxic Gas Releases

Release of toxic gas would not result in any hazard to the contents of the magazines. Evacuation may be required in such an event, but abandoning operations results in no hazard to the magazine contents.

Coastal Erosion

The Pantex Plant is not subject to coastal erosion.

Corrosion

The interim storage to be provided for plutonium pits includes containment of the plutonium in a corrosion-resistant metal shell which in turn is surrounded by a positioning material (Celotex®), sealed within either a carbon steel or stainless steel drum, which is stored in a metal or concrete magazine. Other than periodic inventories, there are no other activities occurring in the interim storage area magazines.

Under normal circumstances, it would be expected that no corrosive media other than moisture resulting from changes in relative humidity would come in contact with the interior surfaces of the magazines, let alone the pit storage containers. In the absence of a highly corrosive media, there is no mechanism to cause corrosion that would lead to the degradation of the pit containers. It should be noted that minor rusting of the carbon steel drum is expected, but in no way impacts containment of Special Nuclear Material or the ability of the AL-R8 to serve as a suitable storage container. In the event that an unexpected corrosive media was determined to have entered a magazine, it would be removed promptly. The Sandia National Laboratories Stockpile Evaluation Department has defined a pit storage container (AL-R8) sampling and inspection plan to verify the integrity of the pit container during interim storage. In this plan, ten to twenty containers per year would be selected for 100 percent visual inspection of all individual piece parts. In addition, visual inspection for rust/corrosion, inspection of the insulation, weld integrities and all plastic parts will be conducted. Formal evaluation of all data will be used to detect potential systematic problems. This sampling technique is similar to that used for stockpile evaluation of weapons in the stockpile.

Criticality

No operational event was identified which could result in a criticality event.

Drought

Droughts are possible at the site, but there is no potential for adverse effects to the magazines or their contents.

Earthquakes

Seismic events could not be eliminated from consideration. The likelihood and effects of this event on the magazines and their contents are considered in detail in Appendix C.

External Explosions

Blast pressures and fragments caused by accidental explosions in adjacent structures could not be eliminated from consideration in this screening assessment. The effects of this event on the magazines are considered in more detail in Appendices B and C.

External Fires

The only credible external fires would be those from grass fires and from fires involving diesel-powered vehicles that may be close to the entrance of the magazines. Because of the absence of uncontained combustibles in the magazines, no impacts to magazine contents would result from external fires.

External Floods

Localized flooding (ponding) is possible near some magazines, but the general inundation of the magazines is considered incredible due to the elevation of Zone 4 (Reference 10). Even if ponding occurred due to rainfall, neither the magazines nor their contents would be damaged.

Fog

Fog presents no hazard to the magazines.

Forest/Grass Fires

Because the Pantex Plant is located in an area of grassy plains, forest fires are not a concern. The area containing the magazines is separated from other areas by gravel, which should preclude a range (grass) fire from impacting the storage area.

Forklift Accident

A forklift operational accident could not be eliminated from consideration. The likelihood and effects of this event on the magazines, their contents, and the environment are considered in Appendix D.

Frost

Frost presents no hazard to the magazines or their contents.

Hail

Hail is not a concern because of the structural characteristics of the magazines. Furthermore, any potential effects of hail on the magazines (i.e., roof collapse) are subsumed in the consideration of earthquakes and tornados.

Ice

Ice loading is not a concern because of the structural characteristics of the magazines. Furthermore, any potential effects of ice loading on the magazines (i.e., roof collapse) are subsumed in the consideration of earthquakes and tornados.

Internal Explosions

Because of the absence of high explosives inside the magazines, internal explosions were eliminated from consideration in this screening assessment.

Internal Fires

Because of the absence of uncontained combustibles in the magazines, internal fires were eliminated from consideration in this screening assessment.

Internal Floods

There are no water or fire protection sprinkler lines inside or immediately outside the magazines. Therefore, internal floods were not considered credible events.

Industrial or Military Facility Accidents

Because of the large restricted area around Zone 4 and the remote location of the Pantex Plant, no industrial or military facility accidents are credible.

Lightning Strikes

Because of the lightning protection system installed throughout each magazine, the protected nature of pits inside the earthen magazines and the built-in design features of weapon assemblies to withstand lightning strikes, this event is not considered a credible threat to the magazines or their contents.

Loss of Off-Site Power

The only electrical loads associated with the magazines are for security-related purposes exterior to the magazines. Complete loss of electrical power to the magazines would have no safety-related consequences.

Low Lake or River Water Level

This hazard is considered only if off-site water sources are required for safety-related cooling purposes. No such cooling requirements exist for the operations conducted in the magazines.

Meteor Strike

Previous analyses of the likelihood of a meteor strike on a structure the size of a large process building indicated that this event is incredible (Reference 11). Furthermore, the United States Nuclear Regulatory Commission has excluded meteor strikes as a credible threat to nuclear power plants (Reference 12).

Missiles

Missiles generated as a result of tornados or external explosions could not be eliminated from consideration. The design basis missiles that the magazines are required to withstand are listed in Appendix B. The effects of these events on the magazines are considered in more detail in Appendix C. No rotating machinery is located within Zone 4 that has the potential to generate missiles with the potential to adversely affect the magazines or their contents.

Operational Accidents (Forklift)

Operational accidents generated by component failure or operator error could not be eliminated from consideration. The most limiting operational accident, the puncture of a pit container by a forklift, is analyzed in Appendix D.

Pipeline Accidents

The only pipelines containing high pressure or explosive materials in or near the Zone 4 magazines are: (1) a 2-1/2-inch steam line that had previously supplied heaters within magazines 4-19 and 4-21, (2) a 1-inch (30 psig) underground natural gas line that previously supplied magazine 20E (this line passes approximately 100 feet west of magazine 4-19), and (3) a 2-inch (50 psig), north-south underground natural gas line that passes approximately 700 feet east of magazines 4-39 through 4-44 and 4-119 through 4-142 (Reference 15). Rupture of the steam line is not considered to be a significant threat because the branch lines previously entering magazines 4-19 and 4-21 have been removed, and the upstream lines could not cause damage to the magazines. Natural gas pipeline failures are not considered a credible threat because of the lighter-than-air nature of the gas and the lack of a collection point.

River Diversions

This potential hazard is only relevant for facilities that depend on near-site rivers for safety-related cooling purposes. Therefore, it is not relevant to the magazines.

Sandstorms/Dust Storms

Because of the sealed nature of the magazines, sandstorms and duststorms would not represent a hazard to the structures or their contents.

Seiche

Seiches are not a concern for the magazines because no large shallow bodies of water are located near the Pantex Plant.

Snow

Snow loading is not a concern because of the structural characteristics of the magazines. Furthermore, any potential effects of snow loading on the magazines (i.e., roof collapse) are subsumed in the consideration of earthquakes and tornados.

Straight Winds

Straight winds present less of a hazard to the magazines than tornados (Reference 14). Any effect of straight winds is subsumed in the consideration of tornados.

Structural Interactions

No off-gas stacks, tall buildings, or other structures exist in the immediate vicinity of the magazines. Therefore, the potential for interactions with these adjacent structures is not credible.

Temperature Extremes

All weapon assemblies and weapon components can withstand all anticipated temperature extremes without adverse safety implications.

Tornados

Tornados could not be eliminated from consideration. The likelihood and effects of this event on the magazines are considered in more detail in Appendix C.

Transportation Accidents

Several vehicles may be near the magazines, including Safe, Secure Trailer's, diesel powered forklifts, electric forklifts and various transport and security vehicles. Only electric forklifts are allowed inside the magazines, Therefore, transportation accidents that could occur are subsumed in the consideration of Chemical/Toxic Gas Releases, External Explosions, and Missiles. Transportation accidents inside the magazines involving the inadvertent puncture of a weapon component container or the collision into a weapon assembly are considered operational accidents and are assessed qualitatively in Appendix D.

Tsunamis

Due to the inland location of the site, tsunamis are not relevant to the Pantex Plant.

Volcanic Activity

No potential for volcanic activity exists at or near the Pantex Plant.

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APPENDIX B - BLAST CALCULATIONS

APPENDIX B

BLAST CALCULATIONS

This appendix presents the basic data used to assess the potential blast hazards associated with the Zone 4 magazines. The blast pressures produced by adjacent explosions and their resultant effect on the Modified-Richmond and Steel Arch Construction magazines are examined. The effects of the blast pressure produced by an adjacent explosion on specific human organs are considered as part of these blast calculations. Quantity-distance calculations are presented to identify the safe and actual distances between Zone 4 structures. Finally, the maximum credible explosion-generated missile that could affect a Zone 4 magazine is defined and described. All calculations have been conducted by one analyst and were verified by a second analyst as a quality assurance measure.

B.1 ADJACENT EXPLOSION PRESSURE EFFECTS

The methods outlined in References 1 and 2 were used to determine the side-on overpressures, normally reflected pressures, and specific impulses resulting from potential explosions in structures adjacent to the Steel Arch Construction and Modified-Richmond magazines. The parameters that are required to estimate the blast characteristics of adjacent explosions are: (1) the distance from the explosion (R); (2) the Trinitrotoluene-equivalent weight of material involved in the explosion (W); and, (3) the correction factor for the elevation of the Pantex Plant. The distance (R) from a potential explosion to a Steel Arch Construction or Modified-Richmond magazine is taken directly from plant drawings. The Trinitrotoluene-equivalent weight of high explosive that could be involved in the event is taken from Reference 3. Finally, the correction factor that accounts for the elevation of the Pantex Plant is calculated using the following atmospheric pressures:

P_o = atmospheric pressure at sea level = 14.695 pounds per square inch (psi)
P = atmospheric pressure at Pantex Plant elevation (3500 feet) = 12.929 psi

Tables B-1 through B-6 illustrate the data and calculations required for estimating the side-on overpressures (P_s), side-on specific impulses (I_s), normally reflected pressures (P_r), and normally reflected specific impulses (I_r) on Modified-Richmond magazines from hypothetical explosions in adjacent structures, and the distances associated with the organ damage threshold pressures. The information for the Steel Arch Construction magazines is included only in Tables B-3 and B-4. The Modified-Richmond calculations were done first for every conceivable donor building. This analysis showed that the cases in Tables B-3 and B-4 were the limiting cases for any Zone 4 magazine. Thus, only the cases in Tables B-3 and B-4 were applied to the Steel Arch Construction magazines.

Side-on overpressures were modeled as emanating from either: (1) a partially confined explosion occurring in a 3-walled structure, or (2) an unconfined hemispherical explosive charge detonated at-grade. Side-on overpressures for a forward blast in a Steel Arch Construction magazine were calculated from Figure 4-63 of Reference 2. P_r, I_s, and I_r were estimated from Figure 4.5 or Figure 4.6 of Reference 1 using the appropriate values of P_s. The ratio of side-on overpressures to dynamic pressures used in the calculation of human organ threshold distance are from Figure 4-66 of Reference 2.

Table B-1 - Blast Calculations for Adjacent Explosion in M-13 Road Magazines (Zone 4 East)

Corrected Side-on Overpressure $P_s(P/P_a)$ (psi)**	Corrected Scaled Distance $Z(P/P_a)^{1/3}$	Scaled Distance (Z) $Z = R/W^{1/3}$	Distance (ft) R	Corrected Side-on Specific Impulse $I_s(P/P_a)^{2/3}$ (psi-sec)***	Corrected Reflected Overpressure $P_r(P/P_a)$ (psi)***	Corrected Reflected Impulse $I_r(P/P_a)^{2/3}$ (psi-sec)***
100	2.6	2.7	125	0.76	570.7	2.6
50	3.5	3.6	169	0.61	206.3	2.2
10	7.1	7.4	348	0.31	32.5	0.9
1.0	30.0	31.3	1472	0.08	2.11	0.17
0.58	46.6	48.7	2290****	0.05	1.23	0.10

Table B-1A - Organ Threshold Limits

Threshold Organ Type	Maximum Effect Overpressure (psi) (P_{SO}[1] + P_{DYN}[2])	Distance (ft) R
Eardrum	5	540
Lung	30	277
Lethal	100	167

* M-13 Road Magazines in Zone 4 East could contain material up to 104,000 lb of Trinitrotoluene-equivalent explosives.
** From Reference 2, Figure 4.63 (modeled as a partially confined 3-walled structure).
*** From Reference 1, Figures 4.5 or 4.6.
**** Actual distance to nearest Modified-Richmond magazine.
1 From Reference 1.
2 From Reference 2, Figure 4-66.

Table B-2 - Blast Calculations for Adjacent Explosion in M-12 Road Magazines (Zone 4 East)

Corrected Side-on Overpressure $P_s(P/P_o)$ (psi)**	Corrected Scaled Distance $Z(P/P_o)^{1/3}$	Scaled Distance (Z) $Z = R/W^{1/3}$	Distance (ft) R	Corrected Side-on Specific Impulse $I_s(P/P_o)^{2/3}$ (psi-sec)***	Corrected Reflected Overpressure $P_r(P/P_o)$ (psi)***	Corrected Reflected Impulse $I_r(P/P_o)^{2/3}$ (psi-sec)***
100	2.6	2.7	114	0.69	570.7	2.4
50	3.5	3.6	154	0.56	206.3	1.8
10	7.1	7.4	317	0.28	32.5	0.83
1.0	30.0	31.3	1338	0.07	2.11	0.16
0.67	40.9	42.7	1825****	0.05	1.36	0.11

Table B-2A - Organ Threshold Limits

Threshold Organ Type	Maximum Effect Overpressure (psi) (P_{SO}[1] + P_{DYN}[2])	Distance (ft) R
Eardrum	5	490
Lung	30	252
Lethal	100	152

* M-12 Road Magazines in Zone 4 East could contain material up to 78,000 lb of Trinitrotoluene-equivalent explosives.

** From Reference 2, Figure 4.63 (modeled as a partially confined 3-walled structure).

*** From Reference 1, Figures 4.5 or 4.6.

**** Actual distance to nearest Modified-Richmond magazine.

[1] From Reference 1.

[2] From Reference 2, Figure 4-66.

Table B-3 - Blast Calculations for Adjacent Explosion In M-9 Road Magazines (Zone 4 East)

Corrected Side-on Overpressure $P_s(P/P_o)$ (psi)**	Corrected Scaled Distance $Z(P/P_o)^{1/3}$	Scaled Distance (Z) $Z = R/W^{1/3}$	Distance (ft) R	Corrected Side-on Specific Impulse $I_s(P/P_o)^{2/3}$ (psi-sec)***	Corrected Reflected Overpressure $P_r(P/P_o)$ (psi)***	Corrected Reflected Impulse $I_r(P/P_o)^{2/3}$ (psi-sec)***
100	2.6	2.7	107	0.65	570.7	2.24
50	3.5	3.6	145	0.52	206.3	1.72
10	7.1	7.4	298	0.26	32.5	0.78
1.0	30.0	31.3	1259	0.07	2.11	0.15
4.1	11.4	11.9	480****	0.18	9.8	0.49
5.0	10.4	10.8	435*****	0.19	12.7	0.50

Table B-3A - Organ Threshold Limits

Threshold Organ Type	Maximum Effect Overpressure (psi) (P_{SO}[1] + P_{DYN}[2])	Distance (ft) R
Eardrum	5	462
Lung	30	237
Lethal	100	143

* M-9 Road Magazines in Zone 4 East could contain material up to 65,000 lb of Trinitrotoluene-equivalent explosives.

** From Reference 2, Figure 4.63 (modeled as a partially confined 3-walled structure).

*** From Reference 1, Figures 4.5 or 4.6.

**** Actual distance to nearest Modified-Richmond magazine.

***** Actual distance to nearest Steel Arch Construction magazine.

1 From Reference 1.

2 From Reference 2, Figure 4-66.

Table B-4 - Blast Calculations for Adjacent Explosion in Steel Arch Construction Magazines (5-Plex/Sideward Blast)

Corrected Side-on Overpressure $P_s(P/P_o)$ (psi)**	Corrected Scaled Distance $Z(P/P_o)^{1/3}$	Scaled Distance (Z) $Z = R/W^{1/3}$	Distance (ft) R	Corrected Side-on Specific Impulse $I_s(P/P_o)^{2/3}$ (psi-sec)***	Corrected Reflected Overpressure $P_r(P/P_o)$ (psi)***	Corrected Reflected Impulse $I_r(P/P_o)^{2/3}$ (psi-sec)***
100	2.6	2.7	37	0.22	570.7	0.77
50	3.5	3.6	50	0.19	206.3	0.59
10	7.1	7.4	102	0.09	32.5	0.27
16.7	5.6	5.8	80****	0.11	63.2	0.37
44.4	3.5	3.6	50*****	0.19	201.9	0.55

Table B-4A - Organ Threshold Limits

Threshold Organ Type	Maximum Effect Overpressure (psi) ($P_{SO}{}^1 + P_{DYN}{}^2$)	Distance (ft) R
Eardrum	5	158
Lung	30	81
Lethal	100	49

* Steel Arch Construction magazines could contain material up to 2600 lb of Trinitrotoluene-equivalent explosives.
** From Reference 2, Figure 4.63 (modeled as a partially confined 3-walled structure).
*** From Reference 1, Figures 4.5 or 4.6.
**** Actual distance to nearest Modified-Richmond magazine.
***** Actual distance to nearest Steel Arch Construction magazine.
[1] From Reference 1.
[2] From Reference 2, Figure 4-66.

Table B-5 - Blast Calculations for Adjacent Explosion in Steel Arch Construction Magazines (3- or 5-Plex/Backward Blast)

Corrected Side-on Overpressure $P_s(P/P_o)$ (psi)**	Corrected Scaled Distance $Z(P/P_o)^{1/3}$	Scaled Distance (Z) $Z = R/W^{1/3}$	Distance (ft) R	Corrected Side-on Specific Impulse $I_s(P/P_o)^{2/3}$ (psi-sec)***	Corrected Reflected Overpressure $P_r(P/P_o)$ (psi)***	Corrected Reflected Impulse $I_r(P/P_o)^{2/3}$ (psi-sec)***
100	2.6	2.7	37	0.22	570.7	0.77
50	3.5	3.6	50	0.18	206.3	0.59
10	7.1	7.4	102	0.08	32.5	0.27
1.0	30.0	31.3	430****	0.02	2.15	0.05

Table B-5A - Organ Threshold Limits

Threshold Organ Type	Maximum Effect Overpressure (psi) ($P_{SO}{}^1 + P_{DYN}{}^2$)	Distance (ft) R
Eardrum	5	158
Lung	30	81
Lethal	100	49

* Steel Arch Construction magazines could contain material up to 2600 lb of Trinitrotoluene-equivalent explosives.

** From Reference 2, Figure 4.63 (modeled as a partially confined 3-walled structure).

*** From Reference 1, Figures 4.5 or 4.6.

**** Actual distance to nearest Modified-Richmond magazine.

1 From Reference 1.

2 From Reference 2, Figure 4-66.

Table B-6 - Blast Calculations for Adjacent Explosion in Steel Arch Construction Magazines (3- or 5-Plex/Forward Blast)

Corrected Side-on Overpressure $P_s(P/P_a)$ (psi)**	Corrected Scaled Distance $Z(P/P_a)^{1/3}$	Scaled Distance (Z) $Z = R/W^{1/3}$	Distance (ft) R	Corrected Side-on Specific Impulse $I_s(P/P_a)^{2/3}$ (psi-sec)***	Corrected Reflected Overpressure $P_r(P/P_a)$ (psi)***	Corrected Reflected Impulse $I_r(P/P_a)^{2/3}$ (psi-sec)***
100	4.1	4.3	59	0.15	144.9	0.48
50	5.9	6.1	84	0.11	56.2	0.33
10	11.8	12.3	169	0.06	9.7	0.14
1.0	53.0	55.3	760	0.014	1.2	0.03
2.1	18.1	28.7	430****	0.04	4.6	0.09

Table B-6A - Organ Threshold Limits

Threshold Organ Type	Maximum Effect Overpressure (psi) (P_{SO}[1] + P_{DYN}[2])	Distance (ft) R
Eardrum	5	323
Lung	30	108
Lethal	100	82

* Steel Arch Construction magazines could contain material up to 2600 lb of Trinitrotoluene-equivalent explosives.

** From Reference 2, Figure 4.63 (modeled as a partially confined 3-walled structure).

*** From Reference 1, Figures 4.5 or 4.6.

**** Actual distance to nearest Modified-Richmond magazine.

1 From Reference 1.

2 From Reference 2, Figure 4-66.

B.2 QUANTITY-DISTANCE CALCULATIONS

The limiting quantity-distance for structures in the vicinity of any Modified-Richmond or Steel Arch Construction magazine was examined when the magazines were considered both receiver and donor facilities. When the magazines were considered as receiver facilities, adjacent structures containing high explosives or insensitive high explosives were compared to the siting criteria set forth in Reference 4, Tables 9-5 and 9-10, respectively. High explosives intermagazine limiting quality-distances were determined from the orientation of the adjacent structures to the magazines. Depending on the orientation of these structures, the multiplicative constant (X) used in the standard limiting quality-distance = X • $W^{1/3}$ equation varied. Conservative orientations were used in all cases. For example, the limiting quality-distance for the M-9 Road magazines (Zone 4 East) (65,000 lb Trinitrotoluene-equivalent explosives) from any Modified-Richmond magazine is computed using the equation limiting quality-distance = 2 • $W^{1/3}$ (from Reference 4, Table 9-5). Therefore, the limiting quality-distance for this structure is limiting quality-distance = 2 • $(65{,}000)^{1/3}$ = 80 feet. Insensitive high explosives intermagazine limiting quality-distances were taken directly from Reference 4, Table 9-10.

When the Modified-Richmond or Steel Arch Construction magazines were considered as potential donor facilities (2,600 lb Trinitrotoluene-equivalent explosives), the appropriate high explosives interbuilding limiting quality-distances to adjacent structures were determined using Reference 4, Table 9-3a. For example, the high explosives interbuilding limiting quality-distance to Building 4-26 from the nearest Modified-Richmond magazine (conservatively assumed to be a side blast) is 97 feet. High explosives intermagazine limiting quality-distances were taken directly from Table 9-5, assuming conservative geometries between magazines. (Insensitive high explosives limiting quality-distances were omitted from this analysis because both the Modified-Richmond and the Steel Arch Construction magazines have designs and construction features in accordance with Reference 4 and may contain up to their physical capacity of insensitive high explosives.) Tables B-7 through B-9 present the limiting quality-distances for facilities adjacent to the Modified-Richmond and Steel Arch Construction magazines.

B.3 DEFINITION OF MAXIMUM CREDIBLE EXPLOSION MISSILE

Based on an analysis of the potential for explosions that could occur in Zone 4, the maximum credible explosion that could affect a Modified-Richmond or Steel Arch Construction magazine is an explosion that could occur in a high explosives staging magazine (i.e., a Modified-Richmond magazine) located on M-9 Road on the east side of Zone 4. Because this is the maximum credible explosion that could affect the magazines, it also has the potential to generate the maximum credible explosion missiles. The following discussion defines the mass and velocity of the maximum credible explosion-generated missile that could affect a Modified-Richmond or Steel Arch Construction magazine.

The mass and velocity of the maximum credible missile from an explosion in a Modified-Richmond magazine on Road M-9 were defined using information contained in DOE/TIC-11268 (Reference 1). Reference 1 contains data on fragment characteristics (e.g., mass and range) from several documented explosions. The data are presented in percentile form. Therefore, it is possible to select a 95th percentile projectile such that 95 percent of all fragments would be lower in mass and lower in range than that projectile. Given that the data were available only to the 95th percentile, this percentile was chosen as the statistical cutoff point. From this reference, the 95th percentile fragment mass is 40 lbs and the 95th percentile range is 1485 ft. (That is, there is about a 10 percent chance that a more threatening missile [in terms of either mass or range] could be generated from the explosion of a Modified-Richmond magazine on M-9 Road).

Table B-7 - Explosive Separation (Intermagazine) Distances - Modified-Richmond Magazines as Receiver (Limiting Cases Only)

Adjacent Structure/Vehicle	High Explosives Limit (Trinitrotoluene-Equivalence, lb)*	Required Minimum Separation Distance - High Explosives (ft)**	Insensitive High Explosives Limit (Trinitrotoluene-Equivalence, lb)***	Required Minimum Separation Distance - Insensitive High Explosives (ft)**	Distance From Nearest Modified-Richmond Magazine (ft)
Magazines on M-13 Road (4-71 through 4-75)†	104,000	94	200,000	250	2290 (4-39 through 4-44)
Magazines on M-12 Road (4-65 through 4-70)†	78,000	85	200,000	250	1825 (4-39 through 4-44)
Magazines on M-9 Road (4-45 through 4-51)†	65,000	80	200,000	250	435 (4-39 through 4-44)
Modified-Richmond Magazines‡	2,600	38	200,000	N/A♦	450 (Any except 4-19, 4-21, or 4-25
Steel Arch Construction Magazines‡	2,600	18	N/A♦	N/A♦	80 (4-39 through 4-42)

* Trinitrotoluene-equivalence for high explosives is obtained by multiplying the high explosives limit by 1.3 (Example: for closest Steel Arch Construction magazines; 2,600 lb Trinitrotoluene-equivalence = 1.3 • 2,000 lb high explosives limit).

** From Reference 4, Tables 9-5 and 9-10.

*** Trinitrotoluene-equivalence for insensitive high explosives is obtained by multiplying the insensitive high explosives limit by 1.0 (Example: for closest Modified-Richmond magazines; 200,000 lb Trinitrotoluene-equivalence = 1.0 • 200,0000 lb insensitive high explosives limit).

† Considered non-standard earth-covered magazines (see Reference 4).

‡ Considered standard earth-covered magazines (see Reference 4).

♦ These donor magazines may contain up to their physical capacity of insensitive high explosives, because their construction and siting requirements comply with Reference 4.

Table B-8 - Explosive Separation (Intermagazine) Distances - Steel Arch Construction Magazines as Receiver (Limiting Cases Only)

Adjacent Structure/Vehicle	High Explosives Limit (Trinitrotoluene-Equivalence, lb)*	Required Minimum Separation Distance - High Explosives (ft)**	Insensitive High Explosives Limit (Trinitrotoluene-Equivalence, lb)***	Required Minimum Separation Distance - Insensitive High Explosives (ft)**	Distance From Nearest Steel Arch Construction Magazine (ft)
Magazines on M-9 Road (4-45 through 4-51)†	65,000	80	200,000	250	480 (4-119 through 4-142)
Modified-Richmond Magazines‡	2,600	18	200,000	N/A♦	450 (4-125 through 4-140)
Steel Arch Construction Magazines‡	2,600	18	N/A♦	N/A♦	50 (Any)

* Trinitrotoluene-equivalence for high explosives is obtained by multiplying the high explosives limit by 1.3 (Example: for closest Steel Arch Construction magazines, 2,600 lb Trinitrotoluene-equivalence = 1.3 • 2,000 lb high explosives limit).

** From Reference 4, Tables 9-5 and 9-10.

*** Trinitrotoluene-equivalence for insensitive high explosives is obtained by multiplying the insensitive high explosives limit by 1.0 (Example: for Steel Arch Construction Magazines, 200,000 lb Trinitrotoluene-equivalence = 1.0 • 200,0000 lb insensitive high explosives limit).

† Considered non-standard earth-covered magazines (see Reference 4).

‡ Considered standard earth-covered magazines (see Reference 4).

♦ These donor magazines may contain up to their physical capacity of insensitive high explosive, because their construction and siting requirements comply with Reference 4.

Table B-9 - Explosive Separation (Intraline and Intermagazine) Distances - Steel Arch Construction Magazines as Donors (Limiting Cases Only)

Adjacent Structure/Vehicle	Required Minimum Separation Distance From Nearest Steel Arch Construction Magazine - High Explosives (ft)**	Required Minimum Separation Distance From Nearest Steel Arch Construction Magazine - Insensitive High Explosives (ft)***	Distance From Nearest Steel Arch Construction Magazine (ft)
Steel Arch Construction Magazines†	18	N/A	50 (Any)
Modified-Richmond Magazines†	18	N/A	80 (Any)
Magazines in Zone 4 East‡	55	N/A	480 (4-44 through 4-51)
Building 4-145	250	N/A	550 (4-119)
Building 4-26	97	N/A	700 (4-103 or 4-104)

* Steel Arch Construction magazines have a maximum of 2,600 lb Trinitrotoluene-equivalent of explosives.
** From Reference 4; Tables 9-3a and 9-5.
*** Steel Arch Construction magazines may contain up to their physical capacity of insensitive high explosives, because their construction and siting requirements comply with Reference 4.
† Considered standard earth-covered magazines (see Reference 4).
‡ Considered non-standard-earth covered magazines (see Reference 4).

A reasonable determination of the missile velocity from the range can be performed by recognizing that, given a fixed range, the velocity varies with the takeoff angle of the fragment (i.e., a fragment that travels 1485 feet from the point of the explosion could get there either by going very fast at a takeoff angle near 0° or near 90°, or by traveling less rapidly at a takeoff angle near 45°). If we assume that the takeoff angle of fragments are randomly distributed, then it is possible to determine a 95th percentile velocity in the following manner. If the 40 lb fragment could travel 1485 feet by taking off at any angle between 0° and 90°, then we need only eliminate the 95 percent of the angles in this range associated with the lowest velocities to find a 95th percentile angle. The angles which bound the slowest 95 percent of all velocities are 2.25° and 87.75°, both of which yield the same velocity. Therefore, 95 percent of all of the possible takeoff angles with the lowest velocities lie between 2.25° and 87.75°. The velocity which corresponds to these two angles (i.e., the 95th percentile velocity) is obtained using the standard trajectory equation:

$$R = [V_o^2 \, SIN(2\theta)]/g \qquad \text{(Reference 5)}$$

where:

R = the range of the projectile (ft)
V_o = the takeoff velocity (ft/s)
θ = the takeoff angle (degrees or radians)
g = the acceleration due to gravity (ft/s^2)

Solving this equation for velocity and substituting for known values yields:

$$\begin{aligned} V_o &= [Rg/SIN(2\theta)]^{0.5} \\ &= [1485 \bullet 32/SIN(2 \bullet 2.25°)]^{0.5} \\ &= 778 \text{ ft/s} \end{aligned}$$

Therefore, the result is that we have a 40 lb missile traveling at 778 ft/s with a takeoff angle of 2.25°. Neglecting the effect of air friction, the striking velocity will be the same.

Now it is necessary to see if this projectile can actually strike a Modified-Richmond or Steel Arch Construction magazine, the closest of which is a Steel Arch Construction magazine 425 feet away. The height of a projectile, neglecting air friction, is given by the following formula:

$$y = [TAN(\theta)]x - [g/(2V_o^2COS^2[\theta])]x^2 \qquad \text{(Reference 5)}$$

where:

y = the height of projectile at distance x (ft)
x = the distance of projectile from takeoff point (ft)
g = the acceleration due to gravity (ft/s^2)
V_o = the takeoff velocity of the projectile (ft/s)

Substituting in the known values gives:

$$\begin{aligned} y &= [TAN(2.25°)] \bullet 425 - [32/2 \bullet (778)^2 \bullet COS^2(2.25°)] \bullet 425^2 \\ &= 11.9 \text{ ft} \end{aligned}$$

Therefore, the projectile will be no more than 11.9 feet off the ground when it has traveled 425 feet, the distance to the Steel Arch Construction magazine, so it is physically possible for the missile to strike the magazine. The structural analysis of this missile impact is presented in Appendix C, Section C.5. The probability of this missile event sequence is discussed in Section 7.2.8 of the Final Safety Analysis Report, Zone 4 Magazines (Reference 6).

B.4 REFERENCES

1. A Manual for the Prediction of Blast and Fragment Loadings on Structures, DOE/TIC-11268, Revision 2, United States Department of Energy, April 1, 1982.

2. Structures to Resist the Effects of Accidental Explosions, TM-5-1300, NAVFAC P-397, AFM 88-22, Departments of the Army, Navy, and Air Force, United States Government Printing Office, Washington, DC, November 1990.

3. Letter from J.E. Hemphill, Division Manager, Environment, Safety, and Health Division, Mason & Hanger-Silas Mason Co., Inc., to B.L. Gage, Chief of the Environment, Safety, Health, and Emergency Preparedness Branch, United States Department of Energy, Amarillo Area Office, Subject: "Maximum High Explosives Limits Information," March 26, 1990.

4. Ammunition and Explosives Safety Standards, Department of Defense 6055.9-STD, Change 3, United States Department of Defense, January 25, 1991.

5. Physics for Scientists & Engineers, Serway, R.A., Saunders College Publishing, New York, New York, 1983.

6. Final Safety Analysis Report, Pantex Plant Zone 4 Magazines, Issue D, United States Department of Energy, April 1993.

APPENDIX C - STRUCTURAL ANALYSIS SUMMARY

APPENDIX C

STRUCTURAL ANALYSIS SUMMARY

This appendix presents a summary of the structural analysis for the Zone 4 Modified-Richmond and Steel Arch Construction magazines. The response of the structures to Earthquake, Tornados, adjacent explosion pressures, and missiles is evaluated using current Department of Energy natural phenomena design guidelines and appropriate analytical methods. The purpose of this structural analysis was to determine if the magazines could be damaged as a result of the forces produced by these external events. This appendix is a summary of the analysis contained in the for Zone 4 Safety Analysis Report (Reference 1). The magazines are classified as Moderate Hazard facilities, based on a Pantex-specific facility ranking methodology.

C.1 DESCRIPTION OF ZONE 4 MAGAZINES

C.1.1 Modified-Richmond Magazines

The original Richmond magazine sides and back wall are constructed using unreinforced concrete, gravity-type retaining walls. The walls are thick at the base and taper to the top. The magazines were modified by the replacement of the original wood front wall and roof with reinforced concrete components. A reinforced concrete center wall was also added. The center wall is a steel-reinforced concrete wall that divides the structure into two distinct staging areas. This dividing wall extends throughout the entire length and height of a magazine. The interior wall extends below grade into concrete footings. The walls are joined to the footings by male/female notches. The original magazine berms reached the top of the side walls; these berms were enlarged and a layer of soil is placed over the reinforced concrete roof.

The reinforced concrete front wall is attached to the rest of the structure at the center wall. The roof consists of reinforced concrete slabs, which are supported by the side walls, rear wall, and front wall. The slabs are precast in some of the magazines and cast in place for others. Values of compressive concrete strength of 3,000 psi and 40,000 psi for the reinforcing rebar were used.

The entrance to the magazines consists of one set of double doors for each staging or interim storage area. The doors are constructed A-7 steel plate. Each door is supported by two hinges with a center locking mechanism. There are large concrete block barriers placed in front of the doors for security purposes.

C.1.2 Steel Arch Construction Magazines

The main feature of a Steel Arch Construction magazine is a metal arch constructed of corrugated, galvanized steel panels fitted together with bolts. The steel arch is embedded into the front, back, and side walls using anchor bolts and strap anchors that extend into the concrete. Earth overburden is placed over the steel arch. The only penetration in the arch is for a steel ventilation pipe that provides a pathway for natural air circulation through the magazine.

The side (north and south) walls of the magazine are curb-like and are part of the stem wall of the structure. The front (east) wall is constructed of reinforced concrete. This wall extends to the top of the structure and spans the width of the magazine. This wall rests on top of a steel-reinforced concrete stem wall. Extending along the front wall of a magazine are "connecting" walls that intertie the 3- and 5-magazine complexes. These walls, along with the front wall of each individual magazine, form a continuous concrete face for each complex. The connecting walls are tapered in height away from the magazine front wall. The primary function of these walls is to retain the earth overburden placed against the sides of the magazines. The back (west) wall extends to the top of the structure and spans the width of the magazine. The magazine floor is a steel-reinforced concrete slab that rests upon coarse aggregate fill. The slab is also sloped back to front for drainage purposes.

The single entry to the magazine is an insulated, steel double door. The double doors are secured to each other with two locking hasps, and the entire door assembly is secured to the magazine structure with locking bars at the top and bottom of the door opening. Separate key locks are used in each locking hasp. Located in front of and covering the magazine door is a two-piece, steel-reinforced concrete barrier. There are also headwall barriers placed on either side of the door barrier to protect the front wall of some magazines. These headwall barriers remain in place under all normal operating conditions.

C.1.3 Earth Overburden

The earth overburden covering both the Modified-Richmond and Steel Arch Construction magazines consists of a sandy clay. The average dry density of the soil is 110 pcf and the water content is approximately 15 percent. Based on these values, the total weight of the soil is 130 pcf.

C.2 DEFINITION OF DESIGN BASIS AND MAXIMUM CREDIBLE EVENTS

For natural phenomena events (e.g., Earthquakes and Tornados), two levels of magnitude are studied for their effects on the magazines: (1) Design Basis, and (2) Maximum Credible. Design Basis magnitudes are described in Department of Energy-sponsored guidelines (References 2, 3, and 4). Maximum Credible magnitudes are based both on Department of Energy-sponsored guidelines and on a detailed study of the regional and the Pantex Plant geology, seismicity, and meteorology (References 4 and 5). Maximum Credible Events are considered beyond the design basis for this facility. The aircraft crash scenario is based on a light, general aviation aircraft with a weight of 3,500 pounds and an impact velocity of 80 mph. The basis for this selection is provided in Appendix E. The magnitude of other external events (e.g., pressures from adjacent explosions, explosion- and tornado-generated missiles) is either based on the blast analysis summarized in Appendix B or is prescribed in Department of Energy-sponsored guidelines. Only a single magnitude level for these latter external events is studied in this analysis. Table C-1 presents the events that are considered for the structural analysis, their magnitudes, and the basis for their selection.

C.3 EARTHQUAKE ANALYSIS

This section summarizes the response of the magazines to earthquake forces. The structures were assessed for both the design basis earthquake and the maximum credible earthquake, which is beyond the design basis. The design basis earthquake for Moderate Hazard facilities at the Pantex Plant has a maximum horizontal acceleration of 0.10 g and a frequency of occurrence of 1.0×10^{-3} per year. The maximum credible earthquake for the Pantex Plant is defined as having a maximum horizontal acceleration of 0.33 g, with a frequency of occurrence between 1.5×10^{-5} and 1.0×10^{-4} per year (Reference 3). The Design Response Spectrum used for the design basis earthquake was used for the maximum credible earthquake with appropriate scaling.

Table C-1 - Definition of Design Basis and Maximum Credible Events

Event	Design Basis Magnitude	Maximum Credible Magnitude	Basis
Earthquake	0.10 g (98 cm/sec^2)	0.33 g (323 cm/sec^2)	• References 2 and 3 Design Basis Earthquake • Reference 5 Maximum Credible Earthquake
External Blast (M-9 Road Magazine)	N/A	5.7 psi overpressure (equivalent static load)	• Blast Analysis (see Appendix B)
Blast-Generated Missile	N/A	40 lb piece of concrete at 778 ft/s	• Blast Analysis (see Appendix B)
Tornado	150 mph (132 mph fastest mile [straight] wind)	220 mph (200 mph fastest mile [straight] wind)	• References 2 and 3
Tornado-Generated Missile	• 15 lb, 2 inch x 4 inch wooden timber, traveling at 100 mph (horizontal); maximum height 150 ft; 70 mph (vertical) • 75 lb, 3 inch diameter pipe, traveling at 50 mph (horizontal); maximum height 75 ft; 35 mph (vertical)	N/A	• Reference 2
Aircraft Impact	N/A	3,500 lb aircraft impacting at 80 mph	• Appendix E

C.3.1 Static Analysis

The magazines are examined using a conservative static analysis approach. The static analysis was limited to determining the total base shear on the magazines produced by the earthquake and then determining if the shear resistance of the various magazine structural elements can resist the load. No analysis of the magazine contents or subsystems to the earthquake load is presented.

C.3.1.1 Design Basis Earthquake/Maximum Credible Earthquake - Modified-Richmond Magazine Earthquake Summary

The magazine structure resists earthquakes by transferring the resulting lateral loads through the connection between the roof and the wall and through the walls to the base slab. The sidewalls also serve to resist the active earth pressures developed in the overburden as a result of the earthquake. The lateral loads resulting from the horizontal acceleration of the roof are resisted by the shear strength of the grout between the roof and walls.

Based on a 16-inch wide grout pad, the grout strength from the design basis earthquake is 1,100 pounds per square foot or 8 psi. Grouts and mortars are typically capable of developing shear stresses of approximately 50 psi. Thus, the resulting factor of safety is about 6. This analysis is extremely conservative in that it neglects the additional support provided by steel dowels between the roof and the walls and only accounts for the shear transfer between two of the four walls. Frictional forces are also neglected.

In addition to the loads imposed by the roof, the sidewalls may undergo an increase in lateral load as a result of the Earthquake. A check for addition horizontal loads (active pressure), placed on the walls by the Earthquake, indicated that the cohesive strength of the soils is sufficient to prevent it from imposing additional loads on the wall due to a design basis earthquake.

The analysis of the response of the structure to the maximum credible earthquake, which is beyond the facility's design basis, was performed in the same manner as for the design basis earthquake. The lateral response of the roof was scaled directly from the design basis earthquake results. The resulting shear stress in the grout will be approximately 25 psi (3.3 * 8 psi); thus, the factor of safety during the Maximum Credible Earthquake is expected to be close to 2.

Table C-2 indicates that the Modified-Richmond magazines are not expected to suffer any distress from the horizontal or vertical loads associated with both the design basis earthquake and maximum credible earthquake. The values shown in Table C-2 were taken directly from the Zone 4 Safety Analysis Report.

Table C-2 - Design Basis Earthquake/Maximum Credible Earthquake Modified-Richmond Magazine Static Analysis Summary

Type of Load	Design Basis Earthquake Value (0.10 g)	Maximum Credible Earthquake Value 0.33 g)	Design Allowable	Results
Horizontal - Shear Load at Roof/Wall	8 psi	25 psi	50 psi	No Damage (remains elastic)
Vertical - Roof Bending Moment	175 in-kips	208 in-kips	453 in-kips	No Damage (remains elastic)
Vertical - Shear at Roof Supports	45 psi	54 psi	110 psi	No Damage (remains elastic)
Vertical - Load on Footing	3,940 psf	3,970 psf	4,900 psf	No Damage (remains elastic)

C.3.1.2 Design Basis Earthquake/Maximum Credible Earthquake - Steel Arch Construction Magazine Earthquake Summary

The method to calculate the total base shear on the magazine structure is also based on the general static analysis equation (Reference 6). The required strength of the structure will be based on the horizontal force (F) exerted on the structure from the weight of the surrounding soil and the corresponding equivalent hydrostatic force (P) exerted on one side of the arch only. The vertical analysis for the steel arch assumes that the structure is in a compression mode. The design pressure (P_y) is created by the weight of the soil above the arch.

The static analysis of the response of the structure to the maximum credible earthquake may be performed in the same manner as for the design basis earthquake. The response of the structure was scaled directly from the design basis earthquake results. The resulting vertical and horizontal stress may be obtained by multiplying the values for the design basis earthquake conditions by appropriate scaling factors.

Table C-3 shows no damage to the Steel Arch Construction magazines for the design basis earthquake event. The vertical analysis indicates that there is a significant safety margin in the structure to resist the maximum credible earthquake loads. In addition, the horizontal analysis indicates that under maximum credible earthquake conditions, minor damage may be expected because the maximum allowable bending stress applied to the steel arch (35.6 ksi) is greater than the capacity of the structure (33 ksi). However, because of the significant safety factors applied to the construction of the steel arch and to the analytical techniques used, only very minor damage is expected.

Table C-3 - Design Basis Earthquake/Maximum Credible Earthquake Steel Arch Construction Magazine Static Analysis Summary

Type of Load	Design Basis Earthquake Value (0.10 g)	Maximum Credible Earthquake Value (0.33 g)	Design Allowable	Results
Horizontal - Bending Stress on Arch due to Soil Loads	10.78 ksi	35.6 ksi	33.0 ksi	Minor yielding of Arch at Maximum Credible Earthquake, but no failure, Design Basis Earthquake remains elastic
Vertical - Wall Cross-Sectional Area (A)	0.386 in^2/ft	1.275 in^2/ft	3.658 in^2/ft	No Damage (remains elastic)

C.3.2 Dynamic Analysis

C.3.2.1 Design Basis Earthquake/Maximum Credible Earthquake - Modified-Richmond Magazine Earthquake Summary

For the horizontal dynamic analysis, the roof and center wall were modeled as an inverted pendulum, the motion of which is restricted by the forces developed at the roof-sidewall connection. This connection is assumed to be rigid in the analysis. The results are then checked against the capacity of the connection. If the resulting reactions are less than the capacity, the assumption of rigidity is valid.

Modeling the roof as a compression spring connecting the centerwall and the sidewalls, an equivalent earthquake static load is calculated to be 8.75 lb/ft. Since the static analysis used an earthquake load of 36 lb/ft for the design basis earthquake, the static analysis is conservative. In addition, the Maximum Credible Earthquake static analysis is also conservative. Thus, no components of the magazine facility are vulnerable to either the design basis earthquake or the maximum credible earthquake.

C.3.2.2 Design Basis Earthquake/Maximum Credible Earthquake - Steel Arch Construction Magazine Earthquake Analysis

The horizontal motions of the steel arch structure are obtained by modeling the structure as a "pinned-pinned arch," with modes being $\check{X}$ symmetric and $\check{Y}$ antisymmetric about the midspan (Reference 7, Table 9-2, Case 2).

Because the maximum horizontal bending stress of the steel arch (5,776 psi) is significantly less than the allowable bending stress of A-36 steel (33,000 psi), no failure of the structure is expected for either the design basis earthquake or the maximum credible earthquake.

Both the vertical and horizontal analyses indicate that there are significant safety margins in the structure to resist the maximum credible earthquake loads.

Table C-4 - Design Basis Earthquake/Maximum Credible Earthquake Steel Arch Construction Magazine Dynamic Analysis Summary

Type of Load	Design Basis Earthquake Value (0.10 g)	Maximum Credible Earthquake Value (0.33 g)	Steel Arch Capacity	Results
Horizontal - Maximum Bending Stress (σ_H)	5,776 psi	19,061 psi	33,000 psi	No Damage (remains elastic)
Vertical - Wall Cross-Sectional Area (A)	0.322 in²/ft	1.063 in²/ft	3.658 in²/ft	No Damage (remains elastic)

C.4 EXTERNAL EXPLOSION ANALYSIS

Based on consequence and probability estimates contained in Appendix B, "Blast Calculations" and the Zone 4 Safety Analysis Report, the maximum credible blast environment that a Modified-Richmond or Steel Arch Construction magazine could experience would result from a detonation of 50,000 lbs of high explosives in a Richmond magazine on M-9 Road (Zone 4 East). The effects of this maximum credible explosion on both types of magazine structures are discussed below.

C.4.1 Modified-Richmond Magazine

The maximum credible external explosion affecting Zone 4 could result in a side-on overpressure of 4.1 psi and a corresponding impulse of 0.18 psi-sec affecting a Modified-Richmond magazine. This blast acts as distributed load on the roof of the structure. For the purposes of the following calculation, the blast is modeled as a triangular pulse with a peak value of 4.1 psi and a duration (t_d) of 0.087 sec.

An equivalent static load may be computed based on the ratio of the time of duration for the triangular pulse to the natural period of the roof beam. The natural period of a simply supported beam was calculated in the seismic analysis section (T = 0.11 sec).

The Dynamic Load Factor obtained from Biggs (Reference 8) is 1.4. Thus, the equivalent static load is calculated to be 5.7 psi or 826 psf. The combination of the blast load and the dead load (540 psf) results in a maximum bending moment of 295 in-kips. From the seismic analysis, the ultimate capacity of the beam is 453 in-kips.

Because the maximum bending moment is less than ultimate capacity of the roof beam, the roof will not collapse as a result of a detonation in a Modified-Richmond magazine on Road M-9.

The steel doors of the facility are modeled as plates simply supported along the top, bottom, and hinged side. Since the concrete barriers in front of the doors can be expected to shield them from the effects of the reflected pressure, they are assessed only against the side-on overpressure.

The side-on pressure necessary to yield the doors is 7.56 psi. The natural frequency of the door is (Reference 9) calculated to be 115 sec^{-1}, and the period of the door is 0.054 sec. The response of the door may be obtained using $t_d/T = 0.087/0.054 = 1.61$ and $R/F = 7.56/4.1 = 1.84$ and Figure 2.24 in Biggs. The resulting ductility ratio is 0.9, indicating the plate will not yield. The door can thus withstand the expected blast pressures, provided the concrete front barriers are in place.

C.4.2 Steel Arch Construction Magazine

The maximum credible external explosion in Zone 4 could result in a peak overpressure on the roof of 5.0 psi and a specific impulse of 0.19 psi-sec affecting a Steel Arch Construction magazine. This pressure-time history may be represented by a triangular pulse with a t_d of 0.076 sec.

The period of steel arch under a pure compressive load is computed to be 0.03 sec. From Reference 6, Figure 2-7, the dynamic load factor is equal to $DLF_{max} = 2$, which leads to an equivalent static load (L_s) on the roof of the structure of 10 psi (1440 psf). Equivalent static load (L_s) is used to compute ring compression (C) of 18723 lb/ft. Therefore, the required wall cross-sectional area (A) can be computed to be 1.34 in^2/ft. Because the required wall cross-sectional area (1.34 in^2/ft) is much less than the actual cross-sectional area of the steel arch (3.658 in^2/ft), the structure is expected to withstand the blast overpressure.

The doors on the Steel Arch Construction magazine are similar to those on the Modified-Richmond magazines except in cross section. The Steel Arch Construction doors are steel plated backed angles. The plates have an equivalent thickness of approximately 1.38 in, and a capacity at yield of 3.1 psi. The natural period is 0.04 sec. Using the same design charts as for the Modified-Richmond magazine with t_d/T of $0.076/0.04 = 1.9$ and R/F of $3.1/5.0 = 0.62$ results in a ductility ratio of approximately 17. The ductility ratio of 17 implies significant deformations and is towards the upper bound (20) of allowable deformations (Reference 10). However, the loading on the door is probably overstated, given the shielding effects of the concrete barriers. Furthermore, the yield is based on the development of the plastic moment at one point, the mid-span of the unsupported side of the door. The pressures required to develop the rest of the plastic hinges will be somewhat higher. The doors are thus expected to undergo significant plastic deformations, but remain in place.

C.5 EXPLOSION-GENERATED MISSILE ANALYSIS

The maximum credible explosion-generated missiles that could threaten a Modified-Richmond or Steel Arch Construction magazine would be from a hypothetical explosion of 50,000 lbs of High Explosives in a Richmond magazine on Road M-9 (Zone 4 East) (see Appendix B). The donor Richmond magazine is constructed of unreinforced concrete and a wooden truss roof. The maximum credible missile produced by this explosion is estimated to be a 40 lb concrete fragment traveling 778 ft/sec (see Appendix B). Because all Modified-Richmond and Steel Arch Construction magazines face east (toward the Road M-9 Richmond magazines), the security barriers covering the front of each magazine would be the most likely target for explosion-generated missiles. Probability discussions in the Zone 4 Safety Analysis Report also indicate that the security barriers are the only credible missile target.

To determine if this missile penetrates the concrete barrier in front of the magazines (which is identical for both Steel Arch Construction and Modified-Richmond magazines), the methods described in Reference 11 are followed. This reference presents a general penetration equation, which can be used regardless of the source of the missiles. This equation relates the scabbing thickness (i.e., the thickness of the concrete barrier needed to resist scabbing on the inward face) to the weight, velocity and size of the missile and to the strength of the concrete barrier. The scabbing thickness serves as a very conservative estimate of the penetration thickness (i.e., the thickness of the concrete barrier needed to resist penetration) (Reference 12).

The scabbing thickness is calculated to be 24.1 in. Thus, the barrier must be 24.1 inches thick or scabbing off the back face of the barrier will occur. The barrier is 24 inches thick at its thinnest point, so scabbing by the missile is expected to occur. Because the required thickness to resist scabbing is the same as the actual barrier thickness, it would be overly conservative to conclude that the missile will actually penetrate the barrier and strike the magazine. (It is important to note that the analysis is already extremely conservative because a non-deformable missile is assumed. The real missile is concrete, which is likely to break up on impact). Since the penetration of the magazine wall will not occur, the only damage of interest would be to the concrete barrier, not to the magazine itself. Thus, the effects on the Modified-Richmond and Steel Arch Construction magazines due to the maximum credible explosion-generated missiles are negligible.

C.6 TORNADO ANALYSIS

Of the three types of winds (straight, hurricane, and tornado) investigated, tornados are considered the most pertinent and severe for the Pantex Plant. The only components of the Modified-Richmond and Steel Arch Construction magazine that may be vulnerable to these winds are the doors. The doors are blocked with large concrete blocks, which must be moved before the steel magazine doors can be opened. Because the magazines are closed and the concrete blocks replaced at the first sign of severe weather, the magazines are modeled in this secured configuration.

The design basis tornado and maximum credible tornado wind speeds used in assessing the structure are 132 mph and 200 mph, respectively. The resulting pressures are 36 psf for design basis tornado and 82 psf for maximum credible tornado. The effective pressure on the concrete blocks, depending on its orientation to the wind, is shown in Table C-5.

Table C-5 - Effective Pressure for Design Basis Tornado and Maximum Credible Tornado

Orientation of Wind	Design Basis Tornado Value (36 Psf at 132 mph)	Maximum Credible Tornado Value (82 Psf at 200 mph)	Concrete Block Toppling Capacity	Results
Windward: 80 percent of Pressure for Design Basis Tornado and Maximum Credible Tornado	29.6 psf	66.0 psf	140.0 psf	No Damage (block remains upright)
Leeward: -50 percent of Pressure for Design Basis Tornado and Maximum Credible Tornado	-18.0 psf	-41.0 psf	140.0 psf	No Damage (block remains upright)
Side: -70 percent of Pressure for Design Basis Tornado and Maximum Credible Tornado	-25.0 psf	-57.0 psf	140.0 psf	No Damage (block remains upright)

Because it requires approximately 140 psf to topple the blocks, the magazines are considered invulnerable to the design basis tornado and the maximum credible tornado.

C.7 TORNADO-GENERATED MISSILES

Two types of missiles are considered in this analysis: (1) a tornado-driven, 75-lb, 3-inch diameter pipe traveling at 50 mph, and (2) a tornado-driven, 15-lb, 2-inch by 4-inch wooden timber traveling at 100 mph. Tornado-driven missiles are specified as a Design Basis Accident in the Department of Energy design and evaluation guidelines.

Similar to Section C.5, Explosion-Generated Missile Analysis, the scabbing thickness is used to determine if the missile penetrates the magazine's concrete barrier. The scabbing thickness is calculated to be 8.0 inches for the pipe missile and 6.6 inches for the timber missile. The barrier is 24 inches thick at its thinnest point, so scabbing (and, thus, penetration) by both the pipe missile and the timber missile is not a problem.

C.8 AIRCRAFT IMPACT ACCIDENTS

General aviation aircraft represent the only credible threat to the Modified-Richmond and Steel Arch Construction magazines in Zone 4 (see Appendix E). For purposes of assessing the damage potential of these aircraft, the following parameters are used:

Aircraft Weight	=	3,500 lbs
Aircraft Impact Velocity	=	80 mph

The weight is typical of light general aviation aircraft which make up the bulk of the class. The impact velocity is approximately 1.3 multiplied by the stall speed (≈60 mph for aircraft of this class). The aircraft impact area is 20 ft^2.

The analysis consists of converting the momentum of the airplane into an impulsive load for the component (roof or front door) of interest. The roof and concrete front barriers are also checked against penetration.

C.8.1 Modified-Richmond Single Degree of Freedom

The resulting load time history is applied to a single degree of freedom system representing the magazine response. The system has the same elastic-plastic deformation properties as the magazine. The loading is not assumed to be attenuated by the soil cover, however the soil does distribute the load and serve as additional mass in the calculations. This analysis is conservative since the impulse is assumed to act normal to the structural surfaces involved.

The maximum response is calculated to be approximately 1.3 times the elastic response and well within the allowable limits.

Assessing other general aviation weight and velocity combinations in the same manner results in the following combinations, which yield the maximum allowable deflection:

Weight	3,500 lbs	5,000 lbs	6,200 lbs
Velocity	105 mph	88 mph	80 mph

Using bomb penetration data, the energy required to penetrate concrete covered with soil is estimated to be 38.0E+06 (lbs, fps) (Reference 10). Energy is typically expressed in terms of $WV^{1.8}$ for penetration problems of this type. This is a result of empirical fits rather than derivation.

The energy contained in the aircraft at impact (3,500 lbs at 117 fps) is 18.4 x 10^6 (lbs, fps). Thus, the plane is not expected to penetrate the roof.

C.8.2 Impact on Steel Arch Construction Magazine

For the analysis of the aircraft impact on the Steel Arch Construction magazine, it is conservatively assumed to be a static load because the dynamic load factor (Reference 8) is calculated to be less than 1.0. The resulting peak stress is calculated to be 6.1 psi.

Because the resulting stress (17,400 psi calculated from $F=Mc/I$) is less than the allowable (33,000 psi material strength), the arch will survive. Since the arch shape is susceptible to buckling effects, the critical stress for buckling is compared to the actual stress. The actual stress (6.1 psi) is less than the critical buckling stress (41.6 psi). Thus, the arch will not buckle.

Penetration analysis is performed assuming the aircraft generates a peak load of 77,600 lbs over a 20 ft^2 area. Allowing for a maximum dynamic load factor of 2.0, the actual shear stress is calculated to be 3,000 psi with an allowable shear stress of approximately 14,000 psi. Thus, the shear limits of the steel arch are not exceeded.

C.8.3 Impact on Concrete Barriers

The light aircraft cannot penetrate the barriers. This is based on data for general purpose bombs, which indicates that for general purpose bombs of 500 lbs or less, perforation is limited to approximately 1.7 ft (Reference 10). This occurs only at much higher velocities than being considered here. The 500 lb was used as a limit since this is the approximate weight of the engine. The rest of the aircraft is light weight and easily crushable and, therefore, not considered a penetration threat.

C.8.4 Conclusions

The Modified-Richmond magazines are more vulnerable than the Steel Arch Construction magazines to aircraft impact. Both should be able to withstand the impact of the light aircraft postulated in Appendix E.

C.9 REFERENCES

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APPENDIX D - FORKLIFT OPERATIONAL ACCIDENTS

APPENDIX D

FORKLIFT OPERATIONAL ACCIDENTS

D.1 FORKLIFT ACCIDENT

The Zone 4 operations were carefully examined for the possibility of operational accidents. The most limiting accident involves a forklift puncturing an AL-R8 pit container, which was qualitatively estimated to have potentially significant consequences in the failure modes and effects analysis performed in the Zone 4 Safety Analysis Report. This accident involves the special forklift that would operate in magazines with the planned palletized, horizontally stacked pit containers.

The forklift will have a single boom projection for picking up specially designed pit pallets, instead of the double tine fork mechanism usually found on forklifts. The forklift will also have many safety features that should prevent the puncture accident. Among these are metal guide rails that should physically prevent the forklift from veering into a stack of pallets and sensors that will prevent the movement of the forklift boom, unless it is positioned properly in both the vertical and horizontal planes for picking up a pallet. In addition, the operators will be trained to exercise extreme care in performing operations in the magazines. Many factors are involved that reduce the probability of damage to a pit, even if a forklift accident were to occur. These include the angle of incidence of the boom on the container, the range of forklift forces and velocities involved, and other factors. However, since the design of the forklift/pallet system was not complete at the time of publication, it was not possible to do a complete quantitative analysis of the system to determine the probability of occurrence of a forklift accident. Therefore, the forklift accident that involves damage to a pit in a container is assigned a probability of "Likely" according to Department of Energy guidance, and the consequences are estimated.

After consideration of the range of operational accidents that could occur, a bounding accident scenario was developed. This accident could occur when a 20,000 lb forklift traveling at 5 mph strikes a horizontally positioned AL-R8 container that is fixed. The impact occurs between the boom of the forklift and the AL-R8 container. The boom is square in cross-section and blunt on the end. The boom is presumed to impact the side of a can, puncturing the container so as to crush the pit. The pit, which contains inert gas at atmospheric pressure, expels the gas and plutonium dust as it is crushed from its original volume to an assumed final volume of zero. A conservative estimate of 20 mg of plutonium dust was selected for analysis. The exit orifice is assumed to be a 1/4 inch diameter hole where the pit tube is attached to the pit, a joint that is postulated to fail under such stress. The crushing of the pit is expected to cause no other failure of the pit due to the ductility of the shell and cladding. Thus, the pit crushing event is modeled as a cylinder/piston system in which the piston stroke forces the cylinder contents out through an exit orifice. The crushing of the pit is assumed to take place in a time based on the forklift speed. The contents of the pit exit through a known orifice, imparting a known volume flow rate and thus a known velocity to the pit contents. This velocity represents a kinetic energy imparted to the contents, a large fraction of which is imparted to gas and small fraction of which is imparted to the plutonium dust. This energy is used to estimate the amount of plutonium that becomes airborne in the air <u>inside</u> the AL-R8 container using an accepted experimentally derived equation. Then, the amount of plutonium exiting the AL-R8 can be estimated by calculating the volume change of the container during its crushing, thus producing a pressure change. The plutonium which finally escapes into the air breathed by workers is given a very conservative assumed dispersion, from which lung and whole body committed effective dose equivalent's may be calculated.

An analysis was performed in the Zone 4 Safety Analysis Report to determine the amount of plutonium released to the worker environment, worker exposure, and worker dose. These results are summarized below:

(1) The worker would be expected to receive 0.02 μCi through breathing;

(2) The resultant 50-year committed effective dose equivalent for lungs would be 24 rem; and

(3) The resultant 50-year committed effective dose equivalent for whole-body dose would be 6.6 rem.

This scenario, and the resulting radiation dose to workers, is extremely conservative for a number of reasons. First, as the pit is crushed, it is very unlikely that 100 percent of the plutonium dust inside will be expelled into the air of the AL-R8 container. Test data indicate that less than 10 percent of the plutonium contents would be expected to release in far more energetic accidents. No credit is taken for the fact that some of the plutonium dust will cling to the inside surface of the pit. Likewise, no credit was taken for the significant amount of plutonium dust that may be expected to cling to the celotex insulation and the inside surface of the AL-R8 container. As a result, arguments may be made that this analysis of the release fractions and corresponding doses could be an order of magnitude conservative.

D.2 SUMMARY OF POTENTIAL EFFECTS

The potential consequences of an accident involving the puncture of a pit container by a forklift boom could range from negligible to marginal. No permanent damage to the structures or their contents is expected, though decontamination could require the expenditure of a marginal amount of funds. No consequences to the public or the environment are anticipated. The workers in the immediate vicinity of the accident site could receive a marginal radiation dose. The effect on program continuity would be negligible.

D.3 REFERENCES

Appendix D "Forklift Operational Accidents" is provided from the Final Safety Analysis Report, Pantex Plant Zone 4 Magazines, Issue D, United States Department of Energy, April 1993.

APPENDIX E - AIRCRAFT HAZARD ANALYSIS

APPENDIX E

AIRCRAFT HAZARD ANALYSIS

This appendix presents an analysis of the likelihood of an aircraft crash into a Modified-Richmond or Steel Arch Construction magazine in Zone 4. Methodologies developed previously to estimate the probability of an aircraft crash into specific structures and current data describing the air traffic around the Pantex Plant are used in this analysis. Based on the guidance provided in Department of Energy Albuquerque Order 5481.1B, if the likelihood of any potential accident is less than 1×10^{-6} per year, the event is considered incredible and its potential consequences need not be reported in the safety analysis. However, if the annual probability of an aircraft crash into a magazine is greater than or equal to 1.0×10^{-6}, a quantitative analysis of the resulting consequences is required (Reference 1). As a quality assurance measure, all calculations were performed by one analyst and verified by a second analyst.

E.1 BACKGROUND

The Pantex Plant is located about 12.8 kilometers northeast of Amarillo, Texas, approximately 13.6 kilometers from the northeast-southwest runway at the Amarillo International Airport. There is an approximately square prohibited airspace extending to 4,800 feet mean sea level directly above the site that measures about 7.1 kilometers on a side. Sandia National Laboratories performed an assessment of the probability of aircraft impact into Pantex Plant structures in the mid-1970s (Reference 2). That study used the Best-Estimate Model of K. Solomon (Reference 3) and included a thorough characterization of the air traffic in the area, i.e., the classes of aircraft (e.g., commercial, military), the nature of the operations, the number of operations per year, and other information that could affect the probability of an aircraft crash onto the Pantex Plant.

As noted in the Sandia study, the number of air operations annually in the immediate site vicinity is influenced by several factors. There is a regional air navigational aid, known as a VORTAC, that is located within 8 kilometers of the plant. Thus, the air traffic in each of the 13 low altitude and eight high altitude air corridors serviced by the VORTAC contributes to air traffic in the vicinity of the Pantex Plant. Also, because the Pantex Plant is located in farm country, aerial application activities (i.e., crop dusting) for several farm plots near the plant add to the air traffic volume. The 1976 Sandia study estimated that the overall probability of an aircraft crash into any of the structures (including the interstructure ramps) within either Zone 4 or the production area of Zone 12 of the Pantex Plant is 4.7×10^{-6}, per year. The effective area (see Section E.2 for definition) of structures for potential impact in Zones 4 and 12 is approximately 5.6 square kilometers and includes over 50 major structures and other facilities.

The basic approach of the 1976 Sandia study is used in the current analysis, and the probability of an aircraft crash into a Zone 4 magazine is addressed in the following manner. First, the data used in the Sandia study were evaluated for applicability at this time. The 1976 assessment was based upon 141,500 yearly air operations near the plant. Discussions with Federal Aviation Administration staff (Reference 4) indicate that air operations at the Amarillo airport currently range between 80,000 and 85,000 annually. This is modestly lower (approximately 10 to 15 percent) than the activity reported for Fiscal Year 1987, which was 93,316 (Reference 5). In addition, a review of 14 days of randomly selected air traffic data from 1989 Federal Aviation Administration records suggests that there are approximately 120,000 flights per year in the air traffic corridors near the Pantex Plant, or about 15 percent less than the 1976 Sandia study. Because the more recent data is limited to 14 days, the flight count used in the 1976 Sandia study will be used to maintain conservatism in this analysis.

The 1976 Sandia study was completed 15 years ago, therefore, more recent aircraft accident statistics were reviewed to ensure that the analysis could be accomplished using the Sandia methodology. The accident rates for commercial aircraft and general aviation show a decline over the past 10 years. The 1976 Sandia study reported the fatal crash rate for commercial aircraft as 5.12×10^{-9} mile (3.2×10^{-4}/100,000 km). A review of the Federal Aviation Administration statistics (Reference 6) for the years 1978-1988 (see Table E-1) indicates that the fatal accident rate varies from approximately 0.3×10^{-9} to 1.9×10^{-9} per mile for air carriers, with a mean of 1.1×10^{-9} per mile. However, this data must be used with discretion because it includes all phases of all flights in which a fatality occurred, even if that fatality occurred on the ground. Because the Pantex Plant is located approximately 14 km (8.7 miles) from the Amarillo Airport, the accident rate of interest is that for in flight accidents in which fatalities occurred. A recent Sandia examination (Reference 7) of the Federal Aviation Administration and National Transportation Safety Board data bases indicates that in the 1980 to 1988 time frame there were 31 fatal accidents of which only 18 in flight involved fatalities and aircraft destruction. Thus, the mean fatal accident rate is reduced by the ratio 18/31 = 0.581 to provide an estimate of an in flight accident rate in which the accident is severe enough to seriously damage or destroy a Zone 4 magazine. This accident rate is 6.39×10^{-10} per mile, which is the value that will be used in the analysis.

Table E-1 - Fatal Accident Rate by Year 1978-1988

Year	Rate per 10^9 Miles
1978	1.9
1979	1.7
1980	0.3
1981	1.4
1982	1.4
1983	1.3
1984	0.3
1985	1.9
1986	0.5
1987	0.9
1988	0.4
Mean	1.1

For General Aviation, the 1976 Sandia study reported a fatal accident rate of 3.2×10^{-7}/mile, (1.976×10^{-2}/100,000 km) while current Federal Aviation Administration data of 1.4 fatal accidents/100,000 hours flown, suggest that a rate of 8.0×10^{-8}/mile (5.0×10^{-8}/km) is reasonable, assuming an average speed for general aviation of 170 mph. However, like the commercial data, this rate includes all accidents in which fatalities occurred. The National Transportation Safety Board accident reports for general aviation was recently reviewed by Sandia (Reference 8) to ascertain the proper rates for application to the Pantex Plant Zone 4 aircraft crash probability estimates. The data for the years 1977 through 1988 indicate that there is a strong correlation between the number of accidents in which there were fatalities and serious injuries and the number in which the aircraft were destroyed. (Correlation coefficient 0.936.) It is also noted that both quantities show a decline (approximately 33 to 40 percent) over the 1977 to 1988 time period (see Table E-2). This follows to some extent the decline (approximately 21 percent) in hours flown, thus there may not be such a decline in accident rates.

Table E-2 - Summary of Aircraft Accidents - United States General Aviation

Year	Aircraft Accidents Involving			
	Fatalities	Serious Injuries	Fatalities + Serious Injuries	Aircraft Destroyed
1977	661	427	1088	1129
1978	718	427	1146	1118
1979	631	374	1005	998
1980	618	398	1016	1014
1981	654	349	1003	1121
1982	591	338	929	978
1983	555	319	874	860
1984	543	348	891	894
1985	497	306	803	795
1986	431	317	748	744
1987	431	290	721	673
1988	447	288	735	668
Average	565	348	913	916

Using aircraft destroyed as the starting point, Sandia also examined the data base to determine how many aircraft were destroyed during in flight accidents as opposed to other causes. The number of aircraft destroyed in flight is approximately one-third to one-half the total destroyed. The hours flown, the number of aircraft destroyed in flight, and the number of aircraft destroyed in flight per 100,000 hours flown by class and total are presented on Tables E-3 through E-5. These data can be used to generate an accident rate, aircraft destroyed per million miles by **assuming** a reasonable average speed for the various classes of general aviation. The results are presented in Table E-6. The eight-year **average** accident rate is 7.1 x 10^{-8} per mile for all general aviation, and 3.3 x 10^{-8} per mile for general aviation exclusive of single engine aircraft.

The 1976 Sandia study assumed, based on the work of Solomon (Reference 3), that military crash rates are approximately a factor of five greater than that for commercial aviation. Recently, Sandia National Laboratories were able to access the United States Air Force Aircraft Accident Data Base through arrangements with the Defense Nuclear Agency. The data base includes information by aircraft class, hours flown, and accidents by flight regime (e.g., landing, cruise). Following the approach developed for commercial air carriers and general aviation, Sandia established the number of aircraft destroyed as a result of in Flight accidents (Reference 9). Using the Federal Aviation Administration flight data for the Amarillo area, ten specific models of military aircraft flying in the vicinity of the Pantex Plant were identified. This was supplemented with information based on actual aircraft observed from the plant site, so that 13 aircraft models are considered. The

Table E-3 - General Aviation Hours Flown (Millions) by Aircraft Class

Year	Single Engine	Multi-Engine	Turbo Prop	Turbo Jet	Total	Modified Total Without Single Engine Aircraft
1981	26.3	4.8	1.6	1.3	34.0	7.7
1982	23.2	4.0	1.5	1.3	30.1	6.8
1983	22.2	3.8	1.5	1.5	29.0	6.8
1984	22.7	3.9	1.7	1.3	29.6	6.9
1985	21.9	3.6	1.4	1.5	28.5	6.5
1986	20.9	3.5	1.3	1.5	27.2	6.3
1987	21.3	3.4	1.4	1.4	27.4	6.2
1988	21.2	3.0	1.4	1.5	27.1	5.9

Table E-4 - General Number of Aircraft Destroyed In Flight by Class

Year	Single Engine	Multi-Engine	Turbo Prop	Turbo Jet	Total	Modified Total Without Single Engine Aircraft
1981	502	59	14	1	576	74
1982	442	64	4	1	511	69
1983	291	57	6	2	356	65
1984	310	57	7	1	375	65
1985	336	56	5	2	399	63
1986	285	43	10	3	341	56
1987	235	34	6	4	279	44
1988	243	52	7	3	305	62

flight information for these aircraft was converted to an accident rate per mile by multiplying the number of hours flown by the average cruising speed of the aircraft. The results are summarized in Table E-7. An examination of a randomly selected 14 days of 1989, Federal Aviation Administration flight records for the Amarillo area indicates that approximately 90.5 percent of the military traffic came from high performance aircraft (e.g., fighters and trainers) and 9.5 percent from cargo and bomber type aircraft.

Furthermore, it is noted that nearly 53 percent of the traffic comes from T-38 aircraft and approximately 79 percent from a combination of T-37 and T-38 aircraft. Therefore, a weighted military aircraft crash rate for the Amarillo area was generated by multiplying the "raw" rate for each aircraft class by the ratio of the number of that class to the total number of military flights (e.g., from Table E-7, for T-38 aircraft, $[161/304] \cdot 4.535 \times 10^{-9} = 2.402 \times 10^{-9}$/mile). These weighted rates may then be summed to generate a new overall rate. This "reduces" the accident rate for high performance military aircraft operating in the Pantex Plant area to 4.7×10^{-9} per mile and the total to 5.04×10^{-9} per mile. The latter value will be used in the analysis.

Table E-5 - General Aviation Aircraft Destroyed in Flight Per 100,000 Hours by Class

Year	Single Engine	Multi-Engine	Turbo Prop	Turbo Jet	Total	Modified Total Without Single Engine Aircraft
1981	1.91	1.23	0.88	0.08	1.69	0.96
1982	1.91	1.60	0.27	0.08	1.70	1.01
1983	1.31	1.50	0.40	0.13	1.23	0.96
1984	1.37	1.46	0.41	0.08	1.27	0.94
1985	1.53	1.56	0.36	0.13	1.40	0.97
1986	1.36	1.23	0.77	0.20	1.25	0.89
1987	1.10	1.00	0.43	0.29	1.02	0.71
1988	1.15	1.73	0.50	0.20	1.13	1.05

NOTE:

The values reported in Table E-5 of the Environment Assessment are obtained by taking the number of aircraft destroyed inflight from Table E-4 and dividing that by the number of hours flown taken from Table E-3. The total reported in Table E-5 must be obtained by using the total number destroyed inflight from Table E-4 and the total number of hours from Table E-3. The total rate of aircraft destroyed inflight per 100,000 hours is not the sum of the individual class rates, but the weighted sum (i.e., weighted by the hours flown). Therefore, the totals from Tables E-3 and E-4 must be used to get the totals reported in Table E-5. This is also the case for the totals without single-engine aircraft.

Table E-6 - General Aviation Aircraft Destroyed in Flight Per Million Miles

Year	Single Engine	Multi-Engine	Turbo Prop	Turbo Jet	Total	Modified Total Without Single Engine Aircraft	Accidents per Mile Total	Accidents per Mile Without Single Engine Aircraft
Estimated Speed	160	225	275	450				
1981	0.119	0.055	0.032	0.002	0.091	0.035	9.12E-08	3.52E-08
1982	0.119	0.071	0.010	0.002	0.091	0.036	9.11E-08	3.64E-08
1983	0.082	0.067	0.015	0.003	0.065	0.033	6.48E-08	3.35E-08
1984	0.085	0.065	0.015	0.002	0.067	0.034	6.74E-08	3.37E-08
1985	0.096	0.069	0.013	0.003	0.074	0.034	7.42E-08	3.37E-08
1986	0.085	0.055	0.028	0.004	0.066	0.031	6.60E-08	3.08E-08
1987	0.069	0.044	0.016	0.006	0.054	0.025	5.38E-08	2.47E-08
1988	0.072	0.077	0.018	0.004	0.059	0.0365	5.97E-08	3.57E-08
	Average						7.10E-08	3.29E-08

NOTE:

The values reported in Table E-6 are obtained by dividing the number destroyed by class (Table E-4) by the product of the estimated speed (Table E-6) and hours flown (Table E-3).

The total rate destroyed per million miles (Table E-6, Column 6) is not obtained by summing the individual rates. The total number destroyed (Table E-4) must be divided by the total miles flown, that is, the sum of the products of estimated speed and hours flown for each class.

A similar approach is taken to generate the estimate of Modified Total without Single-Engine Aircraft (Table E-6, Column 7).

The values reported in Table E-6, Columns 8 and 9, i.e., the rates per mile are the values in Columns 6 and 7 divided by one million.

The accident rate for aerial application (2.945×10^{-2}/100,000 km, 4.7×10^{-7}/mile) was retained for this analysis. The number of such flights is small compared to all other traffic, therefore, changes in the rate will not have a significant impact on the overall estimate of the probability of impact.

Table E-7 - Summary of Military Aircraft Crash Rates

Aircraft Model	Hours Flown (millions)	Speed Miles Per Hour	Miles Flown (millions)	Aircraft Destroyed In flight	Crash Rate per Billion Miles	Number "Local" Flights	Weighted Crash Rate Pantex Plant
C-5	1.036	400	414.40	0	0.000	7	0.000
C-130	5.817	318	1849.81	9	4.865	14	0.224
C-135	4.286	589	2524.45	6	2.377	4	0.031
C-141	4.794	380	1821.72	1	0.549	2	0.004
B-1B	0.122	500	61.00	0	0.000	1	0.000
B-52	1.838	448	823.42	5	6.072	1	0.020
F-111	1.274	500	637.00	11	17.268	1	0.057
A-7	1.374	439	603.19	15	24.868	7	0.573
A-10	2.730	277	756.21	5	6.612	1	0.022
F-4	5.013	389	1950.06	32	16.410	9	0.486
F-15	2.531	490	1240.19	14	11.289	17	0.631
T-37	4.844	183	886.45	2	2.256	79	0.586
T-38	5.600	315	1764.00	8	4.535	161	2.402
Cargo & Bomber			8131.80	32	3.935		0.336
High Performance			7200.10	76	10.555		4.700
All Military Aircraft			15331.9	108	7.044		5.035

Certainly, the "target area" presented by the magazines to an impacting aircraft is much less than that presented by the combination of all structures in Zone 4 and the production area of Zone 12. The affected magazine areas for Zone 4 were recomputed (Section E.2) and the probability of impact re-estimated using the Sandia methodology.

E.2 ESTIMATION OF AIRCRAFT CRASH PROBABILITY

In the 1976 Sandia study, the Best-Estimate Model (Reference 3) was used to estimate the probability of aircraft crash. The Best-Estimate Model uses an exponential probability distribution to estimate the postulated aircraft impact location orthonormal to the intended flight path. In this model, the calculated probability includes all types of postulated impacts whether slight or severe in consequence (i.e., a touch is a hit approach).

A set of indices are used in the model to differentiate airways, flight categories, and flight modes. These indices are designated (i), (j), and (k), respectively. Index (i) describes the air activity and refers either to an airway or a farm plot, the latter being used to identify the crop spraying applications. Index (i) can take on the following values:

i = 1, . . ., 13	13 Low altitude airways
i = 14, . . ., 21	8 High altitude airways
i = 22, . . ., 26	5 Farmland plots

Index (j) divides the flight operations into categories and can take on the following values:

$j = 1$	Air Carrier
$j = 2$	Military Air
$j = 3$	General Aviation
$j = 4$	Aerial Applications

Index (k) differentiates the mode of operations (e.g., landing, takeoff, inflight) and can take on the following values:

$k = 1$	Takeoff (within 8 km [5 miles] of airport)
$k = 2$	Inflight
$k = 3$	Landing (within 8 km [5 miles] of airport).

An approximation of the total probability per year (P_{tot}) that any aircraft in any flight path, category, or mode of operation will impact structures is given by:

$$P_{tot} \leq \sum_i \sum_j \sum_k N_{ijk} \cdot A_{jk} \cdot f_{jk}(x) \cdot P_{jk}$$

where:

- N_{ijk} is the number of annual operations inflight path i, category j, and mode of flight k.
- A_{jk} is the effective plant area for an aircraft of flight category j and mode k.
- $f_{jk}(x)$ is the distribution of impacts, orthonormal to the intended flight path.
- P_{jk} is the probability per km that an aircraft inflight category j and mode of flight k will crash.

Because the Pantex Plant is located more than 8 km (5 miles) from the Amarillo Airport, the air operations of interest for this analysis are the inflight modes (i.e., $k = 2$) only. Therefore, the index, k, may be dropped and the equation reduces to:

$$P_{tot} \leq \sum_i \sum_j N_{ij} \cdot A_j \cdot f_j(x) \cdot P_j$$

In this model, the probability that an impact is in a strip of width Δw which is located at a distance x and parallel to the intended flight path can be represented by $\Delta w \bullet f(x)$, where f(x) is the impact distribution. If there is such an impact, the fact that the impact point lies in any perpendicular (to the flight path) strip ΔL is assumed to be probabilistically independent that it occurred in the Δw strip (see Figure E-1). The probability of both events occurring is the product of their probabilities, $\Delta w \bullet f(x) \bullet \Delta L \bullet P$, where P is the crash probability per kilometer. Thus, the distribution function f(x) is a factor by which the crash probability per kilometer is weighted relative to the distance of the plant area from the intended flight path. An exponential distribution, f(x), is symmetric and decays away from the origin.

$$f_j = 1/2\, \gamma_j \exp(-\gamma_j |x|) \qquad -\infty \leq x \leq +\infty$$

The constants, γ, reflect the impact distributions for flight categories consistent with accident statistics. In this analysis the following values of γ_j were used.

$\gamma_{j=1}$ = 0.99/km (1.58/miles) - Air Carrier
$\gamma_{j=2}$ = 0.62/km (0.99/miles) - Military Air
$\gamma_{j=3}$ = 1.24/km (1.99/miles) - General Aviation
$\gamma_{j=4}$ = 0.62/km (0.99/miles) - Aerial Application

E.2.1 Estimation of the Impact Area

The total effective area (A_{eff}) required for the probability model is the sum of the base area, a shadow area, and a skid area. It is postulated that if an aircraft impact occurs within this total effective area, the structure will be hit either before ground impact or as a result of an aircraft skid after impact. In estimating each area, allowance is made for aircraft dimension. Initially, there is no consideration of mutual shadowing or shielding of the structures.

In this current study, 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. In this analysis, the Modified-Richmond magazines are considered as single structures (18 total), while the Steel Arch Construction magazines are analyzed as 9 groups of 3 (27 total) and as 3 groups of 5 (15 total). 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 analyzed, i.e., 18 Modified-Richmond magazines, 9 groups of 3 Steel Arch Construction magazines, and 3 groups of 5 Steel Arch Construction magazines.

The true area (A_t) is the base area of the building adjusted for aircraft dimension and is defined as:

$$A_T = a(b+2d)$$

where a is the magazine length, b is the magazine width, and d is 1/2 the aircraft wingspan. In the 1976 Sandia study, the "typical" wingspans used for the various classes of aircraft were: 42.6 meters for air carriers, 12.0 meters for general aviation and aerial application, and 12.2 meters for military aircraft. Thus, if even the tip of a wing struck the structure, it was included as a hit. In this analysis, the wingspans were modified to include essentially only the inboard one-third of the span. This was based primarily on two considerations: (1) the magazines are very compact structures, well shielded with earth; therefore, it will require more than a grazing hit by a wing tip to cause damage, and (2) the arrangement of the magazines in Zone 4 West (see Figure E-2) is such that if just the tip of a large wing were to impact one magazine, major portions of the aircraft could be impacting another. Therefore, in this analysis the wingspans used are: 14.2 meters for air carriers, 4 meters for general aviation and aerial applications, and 61 meters for military aviation.

The shadow area, A_{sh}, is determined by the structure height, Z, and the angle, ϕ, of the postulated aircraft impact (see Figure E-3) and is defined as:

$$A_{sh} = Z(2d + D)/\tan\phi \quad D = (a^2 + b^2)^{0.5}$$

where a is the magazine length, b is the magazine width, Z is the magazine height, d is 1/2 the aircraft wingspan, and ϕ is the angle the aircraft path makes with the horizon at impact. In this analysis, the impact angle is assumed to be 15 degrees, consistent with the recommendations of Solomon (Reference 3). This is a conservative approach; however, the 1976 Sandia study parameter sensitivity investigation indicated that the results are relatively insensitive to impact angle.

There is a possibility that an aircraft could impact the ground at some distance from a magazine and still strike the structure as a result of skidding into it. The skid area is defined as:

$$A_{skid} = (2d + D)X_m$$

where d and D are as defined above and X_m is the skid length. The 1976 Sandia study used the skid distances recommended by Solomon (Reference 3), that is, X_m for air carriers of 500 meters, for military aircraft 1000 meters, and for general aviation and aerial application 100 meters. However, over the past several years there has been considerable discussion as to the "correct" value to use in estimating aircraft skid distances. The values used in the Sandia study represent a conservative position. In his report (Reference 3), Solomon states:

> "If an aircraft were postulated to impact the land immediately in front of a structure, it is conceivable that the aircraft might skid into that structure. Depending upon aircraft weight, size and its horizontal component of velocity, the aircraft can skid up to approximately 1 mile **(for a high velocity military aircraft on a very smooth terrain)**. [Emphasis added] For a high velocity military aircraft, the skid length is typically 0.6 miles. For a United States Air Carrier, the typical skid length may be 0.3 miles and for a United States General Aviation, the skid length is typically 0.06 miles.
>
> Insight into the phenomenon of skidding may be gained by considering the motion of an aircraft on the ground as the linear motion of a body with an initial horizontal velocity V_o(mph) and a uniform deceleration equal to a multiple K of gravity. The simplest model leads to a skid distance of:
>
> $$X_m = (6.3 \times 10^{-6})(V^2_o/K) \text{ miles}$$
>
> The value of K is directly proportional to the amount of friction between the skidding aircraft and the terrain. Typical values of K may be estimated to vary between 2.5 and 5.

Thus, the values used earlier are apparently based upon the "typical values" information provided by Solomon. However, it must be noted that these maximum distances represent skids on smooth surfacès, probably airfields. It is also worth noting that using the simple model cited, the initial impact velocity would have to be approximately 500 mph (730 fps) in order for the predicted skid distance to be 1000 meters (3280 ft). This is a factor of two to three above typical landing speeds, thus it is difficult to imagine aircraft striking the ground with horizontal velocities this high. If an aircraft is falling out of control from high altitudes, its forward velocity may be 300 to 500 mph (440 to 733 fps), but the angle of impact will be high and, therefore, the horizonal component of velocity significantly lower.

Although the terrain surrounding the Pantex Plant is relatively level, it would be difficult to describe it as "smooth" in the sense that airfields and runways are smooth. Therefore, it is concluded that using the information from the Solomon report is, in fact, conservative. The simple model predicts skid distances on the order of 50 to 365 meters (164 to 1200 ft) for impact velocities between 150 and 300 mph (220 and 440 f/s). Based upon discussions with a number of experienced aviators, these seem to be much more realistic values.

A 1983 Sandia report (Reference 10) provided an indication of aircraft skid distance for several aircraft classes that is linear in nature. For an impact velocity of 220 mph (323 f/s), it was estimated that military (high performance aircraft) skid approximately 675 meters (2210 ft) and air carrier approximately 480 meters (1575 ft). A subsequent Sandia analysis (Reference 11) of a sliding body acted upon by friction (Coulomb friction assumed, i.e., sliding on dry surface) yielded the following relationships:

$$x\ (\text{ft}) = V_o t - (\mu g/2)t^2$$
$$dx/dt\,(\text{f/s}) = V_o - \mu g t$$

where:

x	=	skid distance
dx/dt	=	remaining velocity
V_o	=	impact velocity
μ	=	coefficient of sliding friction
t	=	time after impact

It should be noted that the analysis yields a relationship that is independent of aircraft weight and only a function of the impact velocity and the coefficient of friction. A set of estimates using this relationship are shown on Figure E-4. A sliding coefficient of friction of 1.0 was assumed along with four impact velocities: 400, 220, 170, and 68 mph (or 587, 323, 250, and 100 f/s, respectively). (The individual curves end at the point where velocity (dx/dt) is zero.) It may be noted that at initial impact velocities of 170 to 220 mph (250 to 323 f/s), skid distances on the order of 300 to 500 meters (980 to 1640 ft) are predicted. These are less than those of the 1983 Sandia report, but within a factor of 1 to 1.5 of those values. This model predicts a skid distance of approximately 1600 meters (5250 ft), given an initial impact velocity of 400 mph (587 f/s). It should be noted that the value used above for the coefficient of sliding friction, $\mu = 1.0$, is greater than that for smooth materials (metals) sliding over one another (typically on the order of 0.2 to 0.6), but not significantly so (Reference 12).

Another source (Reference 13) quotes a value of 0.67 for "rough steel" sliding over sand, but again this is a smooth metal in contact with a well defined material. In an impact of an aircraft, even at low angles of incidence, the terrain surrounding Zone 4 is not a smooth surface. Although it is "level" in a very macroscopic sense, it is not smooth in the sense of a well-maintained airfield. In this regard, it also should be noted that if K = 1.0, the correlation quoted by Solomon yields the same result as the Coulomb analysis when C = 1.0. Thus, the correlation assumes that the coefficient of friction for sliding aircraft is significantly higher than that for smooth materials in contact with each other.

Based upon these considerations, the skid distances for the aircraft impact in this analysis were set at 300 meters (984 ft) for air carriers, 600 meters (1970 ft) for military aircraft (also based, in part, on the fact that the smaller high performance military aircraft dominate the military traffic in the Pantex Plant area), and 50 meters (164 ft) for general aviation. In addition to these general arguments for reducing the skid distances for this analysis, it must be noted that the geometry of Zone 4 (see Figure E-2) affects the areas exposed to potential aircraft impacts. Aircraft approaching from either the north or south have a very small "view" angle for the majority of the magazines, so the problem may be treated essentially as one in which aircraft approach either from the east or west. Any such aircraft does not "see" all the magazines with equal likelihood. An aircraft that impacts the ground prior to reaching a line of magazines, (i.e., it is now in a skid mode) can impact one line of magazines, but is essentially precluded from reaching the second. Therefore, the effective areas for one line of magazines (and the five isolated Modified-Richmond magazines) are estimated using the revised skid distances described above. However, the skid distances for magazines in the second line are reduced to no more than the distance between the two rows of magazines (125 m). These calculations are illustrated below.

E.2.2 Example Area Calculation Steel Arch Construction Magazine Group of Three

The following section illustrates the calculation of the individual areas and the effective area for the Steel Arch Construction Magazine group of three. In this calculation, the magazines are assumed to be in a position (e.g., east row on Figure E-2) that allows the longest skid distance prior to impact with a magazine.

True Area (A_t): $A_t = a(b + 2d)$

Air Carrier	$13 \cdot (24 + [2 \cdot 7.1])$	= 4.97E-04 km^2
Military Aviation	$13 \cdot (24 + [2 \cdot 2.03])$	= 3.65E-04 km^2
General Aviation	$13 \cdot (24 + [2 \cdot 2.00])$	= 3.64E-04 km^2
Aerial Application	$13 \cdot (24 + [2 \cdot 2.00])$	= 3.64E-04 km^2

Shadow Area (A_{sh}): $A_{sh} = Z(2d + D)/\tan\phi$

$D = (24^2 + 13^2)^{0.5} = 27.3m$, $Z = 5.3m$, $\phi = 15°$
$\tan(\phi) = 0.26795$, $Z/\tan(\phi) = 19.78m$

Air Carrier	$19.78 \cdot ([2 \cdot 7.1] + 27.3)$	= 8.21E-04 km^2
Military Aviation	$19.78 \cdot ([2 \cdot 2.03] + 27.3)$	= 6.21E-04 km^2
General Aviation	$19.78 \cdot ([2 \cdot 2.0] + 27.3)$	= 6.19E-04 km^2
Aerial Application	$19.78 \cdot ([2 \cdot 2.0] + 27.3)$	= 6.19E-04 km^2

Skid Area (A_{skid}): $A_{skid} = (2d + D)X_m$

Air Carrier	$([2 \cdot 7.1] + 27.3) \cdot 300$	= 1.24E-02 km^2
Military Aviation	$([2 \cdot 2.03] + 27.3) \cdot 600$	= 1.88E-02 km^2
General Aviation	$([2 \cdot 2.0] + 27.3) \cdot 50$	= 1.56E-03 km^2
Aerial Application	$([2 \cdot 2.0] + 27.3) \cdot 50$	= 1.56E-03 km^2

Therefore, the Steel Arch Construction Magazine (group of three) Effective Areas (A_{eff}) with the longer skid distances are:

Air Carrier	(4.97E-04) + (8.21E-04) + (1.24E-02) = 1.37E-02 km^2
Military Aviation	(3.65E-04) + (6.21E-04) + (1.88E-02) = 1.98E-02 km^2
General Aviation	(3.64E-04) + (6.19E-04) + (1.57E-03) = 2.54E-03 km^2
Aerial Application	(3.64E-04) + (6.19E-04) + (1.57E-03) = 2.54E-03 km^2

Similar calculations were performed for the Steel Arch Construction Magazine group of five and the Modified-Richmond magazines in the same row and for those Modified-Richmond magazines on the west side of Zone 4 that are not effectively shielded by the east row. The calculations were repeated for the Steel Arch Construction Magazine group of three and the Modified-Richmond magazines in the west row, but in this latter instance, the skid distances for air carrier and military air were reduced to 125 meters, the inter-row distance. The computed effective area for each of the magazine types and skid distance combinations is summarized in Table E-8.

Table E-8 - Summary of Effective Areas for Zone 4

	Steel Arch Construction 3	Steel Arch Construction 5	Modified Richmond
Effective Areas (km^2) - 300/600 Meter Skid Distances			
Air Carrier	1.37E-02	1.87E-02	1.03E-02
Military Aviation	1.98E-02	2.92E-02	1.33E-02
General Aviation	2.55E-03	3.79E-03	1.63E-03
Aerial Application	2.55E-03	3.79E-03	1.62E-03
Effective Areas (km^2) - 125 Meter Skid Distance			
Air Carrier	6.50E-03	8.85E-03	4.77E-03
Military Aviation	4.91E-03	7.25E-03	3.22E-03
General Aviation	2.55E-03	3.79E-03	1.63E-03
Aerial Application	2.55E-03	3.79E-03	1.62E-03
Total Effective Areas (km^2) - Zone 4			
Air Carrier		2.81E-01	
Military Aviation		3.45E-01	
General Aviation		6.35E-02	
Aerial Application		6.35E-02	

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 of the Steel Arch Construction group of three magazines, three of the Steel Arch Construction group of five magazines, and six Modified-Richmond magazines. All of these effective areas were computed using the larger skid distances for air carriers and military air (e.g., 300 and 600 meters, respectively). The effective area for magazines in the west row is the sum of the effective areas for six of the Steel Arch Construction group of three magazines and seven of the Modified-Richmond magazines. All of these effective areas were computed using the 125 meter inter-row separation as the skid distance for air carriers and military air. The total effective area for Zone 4 is the sum of the effective areas for the east and west row plus the effective areas of the five Modified-Richmond magazines on the western side of Zone 4. These areas are also summarized on Table E-8.

Table E-9 - Yearly Operations

Flight Path	Distance (km)	Traffic Volume				Total
		Air Carrier	Military	General	Aerial	
V81S	9.7	5900	1400	9000	0	16300
V81E	9.7	0	0	2700	0	2700
V114S	9.7	500	500	4500	0	5500
V114	9.7	0	300	2400	0	2700
V140	4.0	900	2000	8100	0	11000
V140N	0.8	300	0	900	0	1200
V12-230	2.4	0	0	4200	0	4200
V304-12N	6.4	0	1100	0	0	1100
V81NW	9.7	0	0	300	0	300
V81W	9.7	100	600	5100	0	5800
V12N	9.7	0	300	6600	0	6900
V12W	9.7	700	300	10500	0	11500
V280SW	9.7	0	0	900	0	900
J-26-NE	2.4	3200	1200	4800	0	9200
J-6-14-78	4.0	2600	2800	3300	0	8700
J-58W	9.7	2500	1300	3000	0	6800
J-17S	9.7	300	2000	1200	0	3500
J-26SW	9.7	400	2500	900	0	3800
J-6-78	9.7	3200	3200	7800	0	14200
J-58SE	8.0	5800	2100	6600	0	14500
J-17NW	9.7	3200	2700	4800	0	10700
Farm Plot #1	2.1	0	0	0	2	2
Farm Plot #2	0.8	0	0	0	10	10
Farm Plot #3	0.3	0	0	0	3	3
Farm Plot #4	6.4	0	0	0	10	10
Farm Plot #5	8.8	0	0	0	4	4
		29600	24300	87600	29	141529

E.2.3 Estimation of Aircraft Crash Probability

An estimate of an aircraft crash into any of the Zone 4 magazines was generated using the probability equation defined in Section E.2.1, the effective areas calculated in Section E.2.2, flight information data extracted from the 1976 Sandia report (see Table E-9), and the aircraft crash rates developed in Section E-1. Pertinent information is summarized in Table E-10.

The estimates of the aircraft crash probabilities by aircraft class are summarized in Table E-11.

The analysis indicates that the likelihood of any class of aircraft impacting into <u>any</u> of the 60 Zone 4 Material Access Area magazines (regardless of the magnitude of that impact) is approximately 1.9 x 10^{-6} per year. The overall estimated probability of impact is greater than

1 x 10^{-6} per year. However, it must be observed that this estimate is dominated by the results for general aviation in that approximately 82 percent of the total probability comes from that source. This arises from the fact that general aviation clearly dominates the air traffic in the Amarillo area. From Table E-9 it may be noted that 62 percent of the total traffic count is general aviation. Given this situation, and the fact that these single-engine aircraft are light-weight and fly at low speeds compared to the air carriers and military aircraft, the vulnerability of the magazines in Zone 4 to impacts from general aviation aircraft was examined.

Table E-10 - Aircraft Operational Data

	Air Carrier	Military Aviation	General Aviation	Aerial Application
Operations/Yr	29,800	24,300	87,600	29
1/2 Wingspan* (m)	7.1	2.03	2	2
Skid Length (m)	125 or 300	125 or 600	50	50
Impact Angle ϕ (deg)	15	15	15	15
(γ /km)	0.99	0.62	1.24	0.62
In flight Crash Rate (#/mi)	6.39 x 10^{-10}	5.04 x 10^{-9}	7.10 x 10^{-8}	2.95 x 10^{-7}
In flight Crash Rate (#/km)	3.97 x 10^{-10}	3.13 x 10^{-9}	4.41 x 10^{-8}	1.83 x 10^{-7}
Effective Areas (km^2)	2.81 x 10^{-1}	3.45 x 10^{-1}	6.35 x 10^{-2}	6.35 x 10^{-2}

* In this instance, 1/2 wingspan is 1/6 of the wingspan reported in the 1976 Sandia report. See Section E.2.1 for a discussion of this change.

Table E-11 - Annual Probabilities of Aircraft Crashes

Aircraft Class	Crash Probability/Year
Air Carrier	2.78 x 10^{-8}
Military Aviation	2.50 x 10^{-7}
General Aviation	1.52 x 10^{-6}
Aerial Application	5.42 x 10^{-8}
Total	1.86 x 10^{-6}

E.2.4 Vulnerability of Zone 4 Magazines to Impact by General Aviation

Analyses by Jacobs Engineering (see Appendix C) indicate that light aircraft (i.e., single-engine aircraft) moving at typical speeds will not penetrate or collapse a Zone 4 magazine structure. These light aircraft were modeled as a 3,500-pound aircraft moving at 80 mph. This weight is representative of single-engine aircraft (e.g., Cessna 172/182, Piper 28, Beech 33/35) in the 2,500 to 5,000-pound range. The speed is nominally 30 percent above stall speed. The results suggest that it is reasonable to exclude single-engine aircraft from further consideration in the accident

Table E-12 - Yearly Operations (77 Percent General Aviation Below 18,000 Ft Deleted)

Flight Path	Distance (km)	Traffic Volume				Total
		Air Carrier	Military	General	Aerial	
V81S	9.7	5900	1400	2070	0	9370
V81E	9.7	0	0	621	0	621
V114S	9.7	500	500	1035	0	2035
V114	9.7	0	300	552	0	852
V140	4.0	900	2000	1863	0	4763
V140N	0.8	300	0	207	0	507
V12-230	2.4	0	0	966	0	966
V304-12N	6.4	0	1100	0	0	1100
V81NW	9.7	0	0	69	0	69
V81W	9.7	100	600	1173	0	1873
V12N	9.7	0	300	1518	0	1818
V12W	9.7	700	300	2415	0	3415
V280SW	9.7	0	0	207	0	207
J-26-NE	2.4	3200	1200	4800	0	9200
J-6-14-78	4.0	2600	2800	3300	0	8700
J-58W	9.7	2500	1300	3000	0	6800
J-17S	9.7	300	2000	1200	0	3500
J-26SW	9.7	400	2500	900	0	3800
J-6-78	9.7	3200	3200	7800	0	14200
J-58SE	8.0	5800	2100	6600	0	14500
J-17NW	9.7	3200	2700	4800	0	10700
Farm Plot #1	2.1	0	0	0	2	2
Farm Plot #2	0.8	0	0	0	10	10
Farm Plot #3	0.3	0	0	0	3	3
Farm Plot #4	6.4	0	0	0	10	10
Farm Plot #5	8.8	0	0	0	4	4
		29600	24300	45096	29	99025

analysis and to focus attention on those aircraft that have some potential for penetration or destructive impact. A limited set of sensitivity calculations indicates that a 5,000-pound aircraft impacting at a speed below 80 mph will not collapse or penetrate a magazine, nor will a 3,500-pound aircraft impacting at a speed below 105 mph. However, a simple reduction in the accident rate per mile, as presented in Table E-10, is insufficient. These single-engine aircraft must also be excluded from the flight activity data base. The difficulty lies in estimating the number of aircraft that fall into this category. Using the data in Table E-3, and postulating that the average individual flight time is essentially the same for all categories of general aviation (discussions with a number of general aviation pilots leads to the conclusion that this is a reasonable assumption), it can be shown that the single-engine aircraft represent approximately 77 percent of the general aviation activity. However, the vast majority of the single-engine aircraft will operate at flight levels below 18,000 ft; therefore only those airways (Victor Airways) below 18,000 ft are affected.

Therefore, the first approach taken was to reduce the number of general aviation aircraft below 18,000 ft by 77 percent (see Table E-12). When the probability calculation was redone with the change, the overall estimate of the probability of aircraft crash dropped below 1 x 10^{-6} per year. The results by aircraft class are shown in Table E-13.

Table E-13 - Annual Probabilities of Aircraft Crashes Capable of Producing Significant Consequences

Aircraft Class	Crash Probability/Year
Air Carrier	2.78 x 10^{-8}
Military Aviation	2.50 x 10^{-7}
General Aviation	3.31 x 10^{-7}
Aerial Application	5.42 x 10^{-8}
Total	6.63 x 10^{-7}

Using similar rationale, it also may be argued that the number of aircraft in the lower flight levels should be reduced even more than 77 percent, because although the single-engine aircraft represent 77 percent of all flights, they will represent a significantly higher fraction of those in the lower flight levels. Unfortunately, there is insufficient information in the available data base to make this additional correction with certainty. Nevertheless, the above approach is considered conservative, and on the basis of this analysis, an aircraft crash into a Zone 4 magazine sufficient to cause damage and potential release of radioactive material is considered incredible and no consequence estimates are presented.

E.3 REFERENCES

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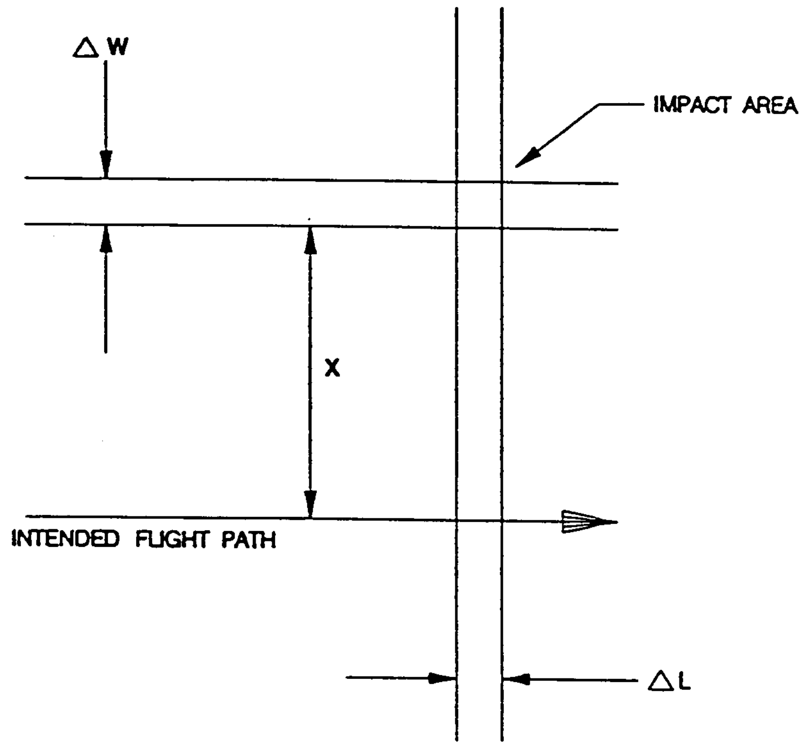


Figure E.1 - Relationship of Flight Path and Impact Areas

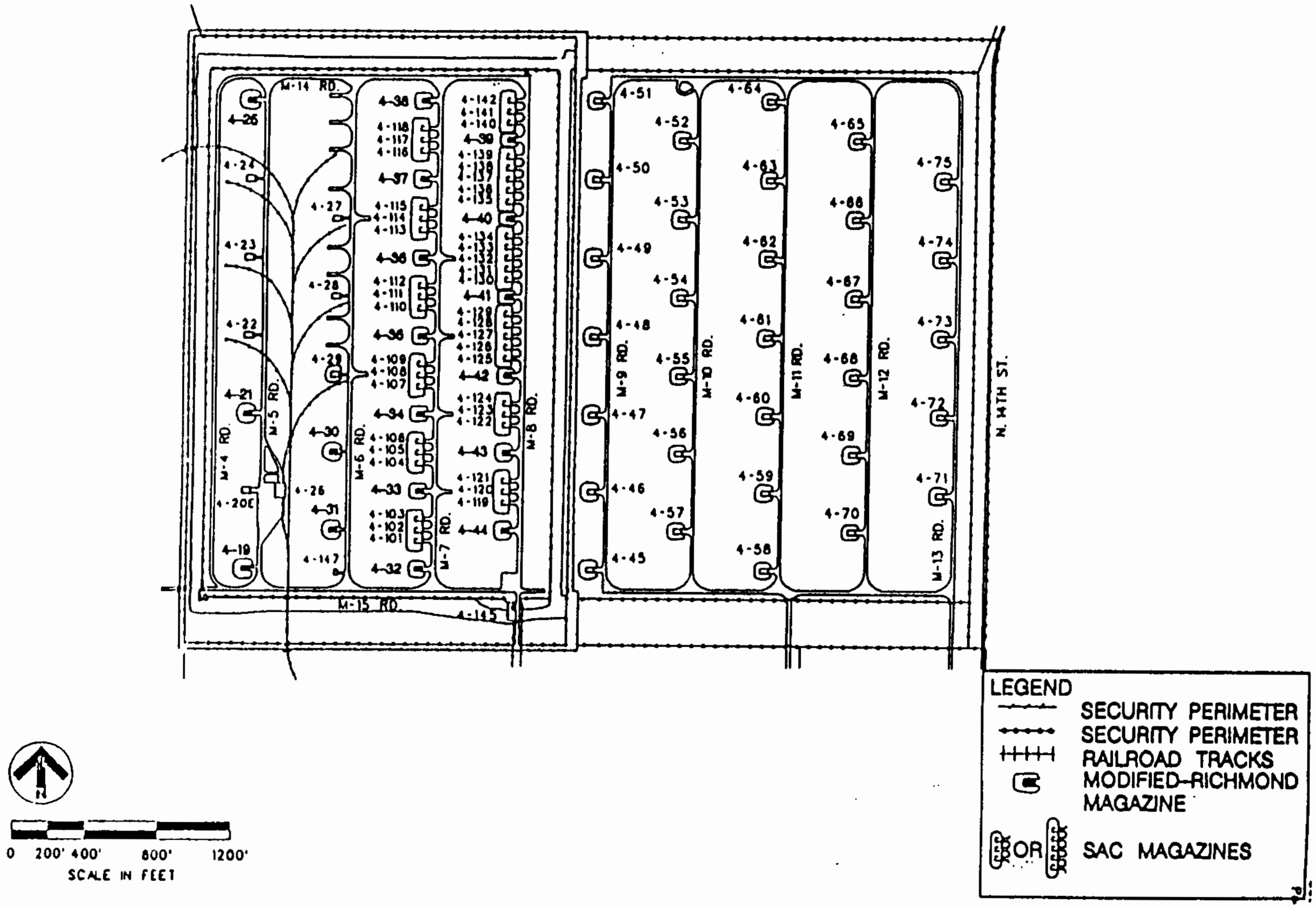
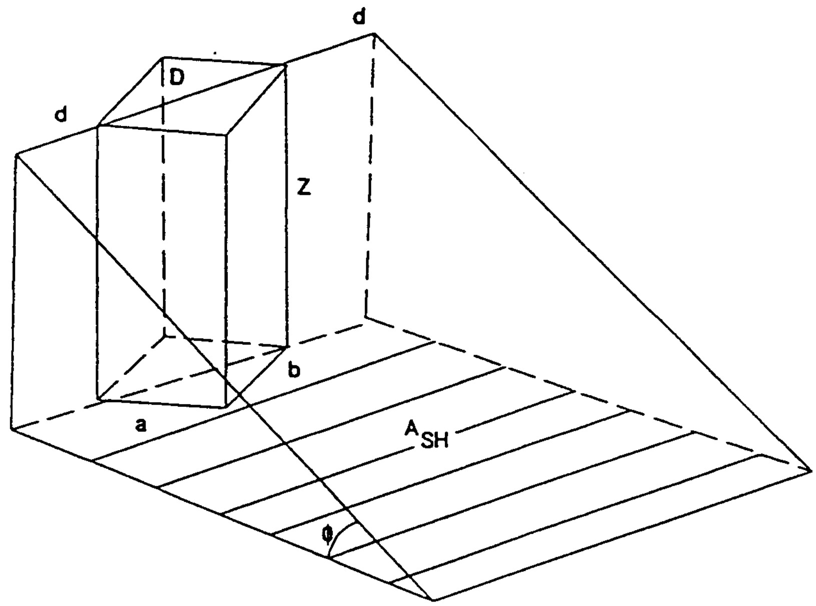


Figure E.2 - Zone 4 Layout



A_{SH} = SHADOW AREA

Figure E.3 - Illustration of True Area and Shadow Area for Structure

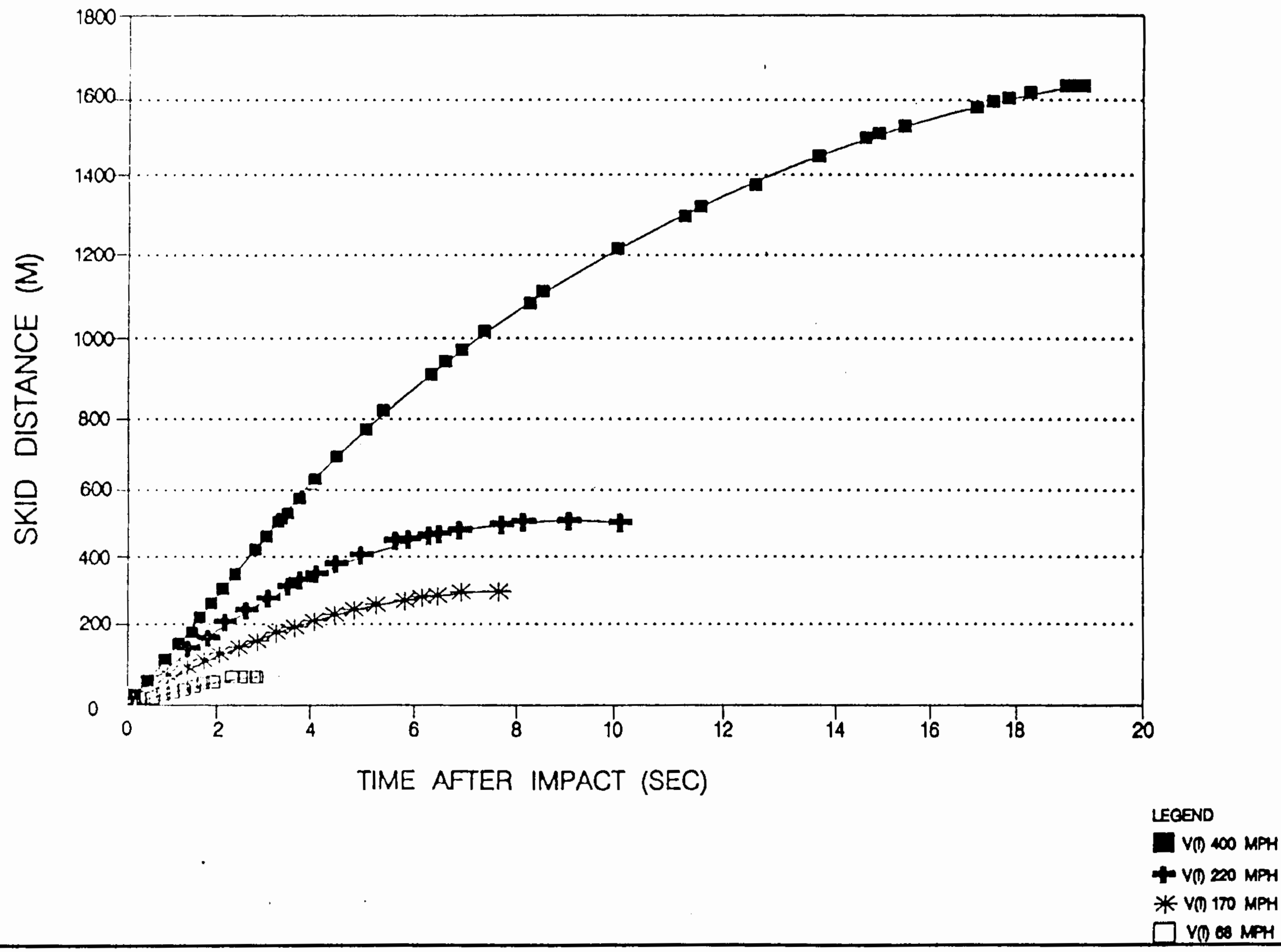


Figure E.4 - Skid Distance as Function of Time After Impact

APPENDIX F - WORKER RADIATION EXPOSURE

APPENDIX F

WORKER RADIATION EXPOSURE

Additional worker radiation exposure has been identified as the only impact from routine operations associated with increased interim storage of pits in Zone 4. To address this concern, bounding worker exposure doses have been calculated for these activities. Information provided in this appendix has been coordinated with the Safety Analysis Report for Zone 4 magazines as well as the Radiation Safety Department and the Operations Manager of Zone 4.

F.1 DESCRIPTION OF OPERATIONS

F.1.1 Inventory

Inventory is a safeguards and security requirement for Zone 4 pit interim storage activities. Inventory includes verification of contents using bar codes and readers. Inventory for the vertical single-layer configuration would be performed manually by workers entering the magazines and reading the assigned code for each pit container. Inventory for the horizontal palletized stacking configuration would be performed with the use of a forklift equipped with a bar code reader. Proposed inventory frequencies for interim storage activities will include each magazine every 18 months. The time required to perform inventories is estimated as follows:

- Modified-Richmond magazines (vertical single-layer configuration): Two workers will be involved with inventories. For this interim storage configuration, 70 minutes is estimated for each side of the magazine for conducting each inventory.

- Steel Arch Construction magazines (vertical single-layer configuration): Two workers will be involved with inventories. For this interim storage configuration, 140 minutes is estimated per Steel Arch Construction magazine for conducting each inventory.

- Modified-Richmond magazines (horizontal palletized stacking configuration): Two workers will be involved with inventories. For this interim storage configuration, 45 minutes is estimated for each side of the magazine for conducting each inventory.

- Steel Arch Construction magazines (horizontal palletized stacking configuration): Two workers will be involved with inventories. For this interim storage configuration, 90 minutes is estimated per Steel Arch Construction magazine for conducting each inventory.

Estimates are based on current inventory operations and knowledge of what is proposed for future activities for each interim storage configuration. In all cases, estimates are considered conservative in comparison to current inventory time requirements.

F.1.2 Pit Evaluation

Random pit evaluations are required to meet weapons component reliability requirements. Approximately 10 to 20 pits will be randomly selected each year for these evaluation activities. In order to minimize impacts to Zone 4 operations, random sampling for evaluations will be performed coincidental with magazine inventories. Additional Zone 4 worker exposure time associated with these evaluations is considered negligible and is subsumed in the exposure time estimated for inventory operations.

F.1.3 Corrosion Inspection

Under normal circumstances, water would not be expected to come in contact with pit containers. In the absence of water, there is no mechanism to cause corrosion and possible failure of pit containers. Since the vertical single-layer configuration requires containers to be placed directly on the floor, it is possible for water to come in contact with pit containers in the event it accidentally enters a magazine. This is not considered likely for the horizontal palletized stacking configuration, because all containers will be placed on pallets holding them several inches above the floor.

A 100 percent container inspection for corrosion is included in the analysis for the vertical single-layer configuration in each Steel Arch Construction and Modified-Richmond magazine. Inspection frequencies are estimated to be 18 months for each magazine. Two workers will remove each container from magazines and visually examine the exterior for corrosion. It is anticipated to take one minute per container for these inspections (includes removal, inspection and returning containers to the magazines).

F.1.4 Miscellaneous Operations

Miscellaneous operations include loading and unloading of magazines. These operations are performed using forklifts and hand carts. Estimates for these activities include 2 workers for one Steel Arch Construction and one Modified-Richmond magazine, 2 hours each workday.

F.2 MAGAZINE CAPACITIES

Proposed storage configurations for Steel Arch Construction and Modified-Richmond magazines include a vertical single-layer configuration on the floor, a horizontal palletized stacking configuration and a combination of the two. Maximum magazine capacities are as follows:

Magazine Type	Vertical Single-Layer Configuration	Horizontal Palletized Stacking Configuration
Modified-Richmond	378 pits/magazine	440 pits/magazine
Steel Arch Construction	406 pits/magazine	392 pits/magazine

For the vertical single-layer configuration, operational limitations prevent utilizing the physical capacities shown above. Operational limits are 384 pits/magazine for Steel Arch Constructions and 336 pits/magazine for Modified-Richmonds. A conservative capacity of 384 was used in this analysis for simplification and because 70 percent of the magazines available for interim storage activities are Steel Arch Construction magazines.

F.3 RADIATION EXPOSURE

The radiation types of concern for interim storage of pits are gamma, x-ray and neutron. These radiation types are sufficiently penetrating to pass through pit containers and deliver a whole body dose to workers present in the magazines. Information provided in this section was taken from the Safety Analysis Report for Zone 4 Magazines.

F.3.1 Modeling

The Safety Analysis Report for Zone 4 Magazines presented a conservative model for the magazine interim storage configurations (Reference 1). The models were incorporated into the General Monte Carlo Code for Neutron and Photon Transport (MCNP4) (References 2 and 3). The conservative generic facility models were constructed with the following features:

Vertical Single-Layer Configuration:

- The magazines were modeled with half the nominal floor area, and floor, roof and walls on three sides constructed of 12-inch thick concrete equivalent.
- No center divider wall was considered, but a "reflection" plane was included in MCNP4 to include the effect of the other half of Modified-Richmond magazines.
- A single layer of upright AL-R8 containers 29 deep by 9 across was included. The actual container radius was reduced by approximately 7 percent to allow a square pitch to model hexagonal close-pack arrangements. The 522 containers in this model are greater than the maximum capacity of 378 containers for Modified-Richmond magazines and 406 containers for Steel Arch Construction magazines, as well as the operational limit of 384 containers used in the cumulative worker exposure analysis.
- Two dosimetry volumes were selected. One volume was a slab 6 inches thick on top of the container array. The second dosimetry volume was an aisle created adjacent to the reflecting plane that is one container wide and extends the length of the magazine. The second dosimetry volume resulted in a higher dose rate and was included in the cumulative worker dose calculations.

Horizontal Palletized Stacking Configuration:

- A building was modeled with half of the nominal floor area, and floor, roof and walls on three sides constructed of 12-inch thick concrete equivalent.
- A center divider void was modeled (as opposed to the concrete dividing wall in Modified-Richmond magazines) and used as a "reflection" plane in MCNP4 to include the effect of the other half of the structure.
- Two rows of "palletized" AL-R8 containers in groups of 4 containers per pallet, stacked 3 pallets (6 containers) vertically and 11 pallets (22 containers) horizontally in each half of the building were included in the model. This configuration has 528 containers compared to the maximum capacity of 440 containers for Modified-Richmond magazines or the maximum capacity of 392 containers for Steel Arch Construction magazines.

- An aisle 70 inches wide was used between the two rows of containers. The aisle between the stacks of palletized containers was used as the volume for dosimetry purposes.
- The roof was modeled at 13 feet, 4 inches to accommodate pallet heights.

F.3.2 Results of MCNP4 Calculations

For the vertical single-layer configuration, the radiation dose rate calculations resulted in:

(expected dose rate in an aisle one container wide extending the depth of the magazine)

Neutron Dose Rate	35 mrem/hr
Photon Dose Rate	487 mrem/hr
TOTAL	**522 mrem/hr**

Dose rates for the vertical single-layer configuration should be considered very conservative, because all pits were modeled as having a generic high mass, 532 pits were included in the model, no gaps were modeled for the close pack hexagonal pattern other than the aisle, and all plutonium was considered aged to more than 45 years. 525 mrem/hr is used in the worker exposure analysis.

For the horizontal palletized stacking configuration, the radiation dose rate calculations resulted in:

Neutron Dose Rate	37 mrem/hr
Photon Dose Rate	211 mrem/hr
TOTAL	**248 mrem/hr**

Dose rates for the horizontal palletized stacking configuration should also be considered very conservative, because all pits were modeled as having a generic high mass, 528 pits were included in the model, and all plutonium was considered aged to more than 45 years. 250 mrem/hr is used in the worker exposure analysis.

F.3.3 Other Radiation Dose Rates

All activities associated with the Zone 4 interim storage of pits will not occur in magazines filled to capacity (e.g., loading, unloading and corrosion inspection). Health physicists of the Pantex Radiation Safety Department have performed surveys to measure actual dose rates for typical worker exposure from miscellaneous activities (averaged 30 mrem/hr) as well as dose rates at 30 centimeters from pit containers (60 mrem/hr). For corrosion inspection activities, closer handling of pit containers warrants the use of 60 mrem/hr, and miscellaneous loading and unloading activities would be more typical of the 30 mrem/hr dose rate. These dose rates were used in calculating the bounding worker doses.

F.4 CALCULATIONS

This section provides the calculations performed to arrive at bounding cumulative worker doses for the Proposed Action (vertical single-layer, and horizontal palletized stacking configurations in both Modified-Richmond and Steel Arch Construction magazines), and the No-Action Alternative (vertical single-layer configuration in Modified-Richmond magazines).

F.4.1 Proposed Action Calculations

The Proposed Action addresses both the vertical single-layer configuration and the horizontal palletized stacking configuration for 18 Modified-Richmond and 42 Steel Arch Construction magazines.

ASSUMPTIONS:

Inventory Process: (Vertical Single-Layer Configuration)	2 people, 70 minutes for each side of a Modified-Richmond magazine. Also assumes 140 minutes per Steel Arch Construction magazine. Inventory of each magazine once every 18 months (40 magazines/yr).
Inventory Process: (Horizontal Palletized Stacking Configuration)	2 people, 45 minutes for each side of a Modified-Richmond magazine, and 1 person, 90 minutes for each Steel Arch Construction magazine. Inventory of each magazine once every 18 months (40 magazines/yr).
Corrosion Inspections:	100 percent container corrosion inspection for each magazine every 18 months (vertical single-layer configuration only). Assume 1 minute per container for surveillance operations, 2 workers (100 percent inspection).
Miscellaneous Operations:	One Steel Arch Construction magazine and one Modified-Richmond magazine opened every workday for 2 hours with 2 workers.
Magazine Capacities:	For the vertical single-layer configuration 384 containers is the operational maximum for Steel Arch Construction magazines and is used for both magazine types in the calculations. For horizontal palletized stacking configuration, the maximum capacity is 440 containers in Modified-Richmond and 392 containers for Steel Arch Construction magazines.
Radiation Dose Rates:	525 mrem/hr for the vertical single-layer configuration inventory process. 250 mrem/hr for the horizontal palletized stacking configuration inventory process. 60 mrem/hr for corrosion inspection activities. 30 mrem/hr for miscellaneous operations.

PROPOSED ACTION-18 MODIFIED-RICHMOND AND 42 STEEL ARCH CONSTRUCTION MAGAZINES (vertical single-layer configuration)

Inventory Operations:

2 persons x 140 min/magazine x 40 magazines/yr = 11,200 min/yr

11,200 min/yr x (525 mrem/hr)/60 min/hr = 98,000 person-mrem/yr = 98 person-rem/yr

Corrosion Inspections:

2 persons x 384 min/magazine x 40 magazines/yr = 30,720 min/yr

60 mrem/hr x (30,720 min/yr)/60 min/hr = 30,720 person-mrem/yr = 30.7 person-rem/yr

Miscellaneous Operations:

2 persons x 2 magazines/day x 2 hrs/day x 260 workdays/yr = 2,080 hr/yr

2,080 hrs/yr x 30 mrem/hr = 62,400 person-mrem/yr = 62.4 person-rem/yr

Totals for the Vertical Single-Layer Configuration:

Operation	Cumulative Personnel Exposure (person-rem/year)
Inventory	98.0
Corrosion Inspection	30.7
Miscellaneous	62.4
TOTAL	**191.1**

Conservatism in Calculations:

- 525 mrem/hr dose rate based on most conservative analysis from Safety Analysis Report
- No credit was taken for personnel shielding (lead aprons)
- Assumes worker exposure over the duration of activities
- Assumes 384 pits for Steel Arch Construction and Modified-Richmond magazines
- 100 percent corrosion inspection will probably be no more than 20 percent
- Duration for miscellaneous operations may be reduced with plans for the future (approximately 1/2 hr/day is anticipated)

PROPOSED ACTION - 18 MODIFIED-RICHMOND AND 42 STEEL ARCH CONSTRUCTION MAGAZINES (horizontal palletized stacking configuration)

Inventory Operations:

2 persons x 90 min/magazine x 40 magazines/yr = 7,200 min/yr

7,200 min/yr x (250 mrem/hr)/60 min/hr = 30,000 person-mrem/yr = 30.0 person-rem/yr

Corrosion Inspections:

Not applicable for the horizontal palletized stacking configuration.

Miscellaneous Operations:

2 persons x 2 magazines/day x 2 hrs/day x 260 workdays/yr = 2,080 hr/yr

2,080 hrs/yr x 30 mrem/hr = 62,400 person-mrem/yr = 62.4 person-rem/yr

Totals for the Horizontal Palletized Stacking Configuration:

Operation	Cumulative Personnel Exposure (person-rem/year)
Inventory	30.0
Corrosion Inspection	0.0
Miscellaneous	62.4
TOTAL	**92.4**

Conservatism in Calculations:

- Calculation for inventory of magazines assumed 2 workers for duration of time
- 250 mrem/hr dose rate based on worst case analysis from Safety Analysis Report for horizontal palletized stacking configuration
- No credit was taken for personnel shielding (shielded forklift, lead aprons)
- Assumes worker exposure over the duration of activities
- Duration for miscellaneous operations may be reduced with plans for the future (approximately 1/2 hr/day is anticipated)

F.4.2 No Action Calculations

The No-Action alternative addresses the vertical single-layer configuration for the 18 Modified-Richmond magazines only.

ASSUMPTIONS:

Inventory Process: (Vertical Single-Layer Configuration)	2 people, 70 minutes for each side of an Modified-Richmond magazine. Inventory 2 sides each month. Frequency is in accordance with current operations.

<u>Corrosion Inspections:</u>	100 percent container corrosion inspection for each Modified-Richmond magazine every 18 months. Assume 1 minute per container for surveillance operations, 2 workers (100 percent inspection of 12 magazines/yr).
<u>Miscellaneous Operations:</u>	One Modified-Richmond magazine opened every day for 2 hours with 2 workers. Loading, unloading, use of forklifts, continuous close exposure is limited.
<u>Radiation Dose Rates:</u>	525 mrem/hr for the vertical single-layer configuration inventory process. 60 mrem/hr for corrosion inspection activities. 30 mrem/hr for miscellaneous operations.

<u>NO-ACTION - 18 MODIFIED-RICHMOND MAGAZINES ONLY</u>
<u>(vertical single-layer configuration)</u>

Inventory Operations:

2 persons x 70 min/side x 2 sides/mo x 12 mo/yr = 3,360 min/yr

(3,360 min/yr)/60 min/hr x 525 mrem/hr = 29,400 person-mrem/yr = <u>29.4 person-rem/yr</u>

Corrosion Inspections:

2 persons x 384 min/magazine x 12 magazines/yr = 9,216 min/yr

(9,216 min/yr)/60 min/hr x 60 mrem/hr = 9,216 person-mrem/yr = <u>9.2 person-rem/yr</u>

Miscellaneous Operations:

2 persons x 2 hr/day x 260 workdays/yr = 1,040 hrs/yr

1,040 hrs/yr x 30 mrem/hr = 31,200 person-mrem/yr = <u>31.2 person-rem/yr</u>

Totals for the Vertical Single-Layer Configuration:

Operation	**Cumulative Personnel Exposure (person-rem/year)**
Inventory	29.4
Corrosion Inspection	9.2
Miscellaneous	31.2
TOTAL	**69.8**

<u>Conservatism in Calculations:</u>

- 525 mrem/hr dose rate based on most conservative analysis from Safety Analysis Report

- No credit was taken for personnel shielding (lead aprons)
- Assumes worker exposure over the duration of activities
- Assumes 384 pits for Modified-Richmond magazines
- 100 percent corrosion inspection will probably be no more than 20 percent
- Duration for miscellaneous operations may be reduced with future plans (approximately 1/2 hr/day is anticipated)

F.5 CONCLUSIONS

The analysis provided in this appendix results in the following cumulative worker exposure estimates:

Proposed Action (vertical single-layer configuration)	191.1 person-rem/yr (bounding range of 100 to 200 person-rem/yr)
Proposed Action (horizontal palletized stacking configuration)	92.4 person-rem/yr (bounding range of 50 to 100 person-rem/yr)
No Action (vertical single-layer configuration)	69.8 person-rem/yr (bounding range of 50 to 100 person-rem/yr)

Each configuration calculation includes a high degree of conservatism in the results. Although extremely conservative, the intent of this analysis was to provide bounding numbers for the cumulative personnel dose to Zone 4 workers and is considered to meet National Environmental Policy Act requirements established for identifying consequences in Environmental Assessment documents.

F.6 REFERENCES

1. Final Safety Analysis Report, Zone 4 Magazines, Issue D, United States Department of Energy, April 1993.

2. MCNP - A General Monte Carlo Code for Neutron and Photon Transport, Version 3, Briesmeister, J. (ed), LA-7396-M, Revision 2, Los Alamos National Laboratory, September 1986.

3. "MCNP Newsletter," Briesmeister, J., Los Alamos National Laboratory, April 1991.

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Introduction

An earlier draft Environmental Assessment for Interim Storage of Plutonium Components at Pantex was provided to the State of Texas in December 1992 in accordance with the Department of Energy National Environmental Policy Act Implementing Procedures [10 Code of Federal Regulations 1021.301] that require the Department to provide Environmental Assessments to the host State and Indian Tribes for review prior to approval. Comments from State and local government officials, national and local interest groups and private citizens were forwarded to the Department through the Office of the Governor for response. In total, forty-six letters were received (see Table ES-1) and from those letters, 423 comments were extracted and categorized into the general topical areas described below. The Department also recently received comments regarding the aircraft crash analysis from the Defense Nuclear Facilities Safety Board. The comments were carefully reviewed and considered; and where appropriate, this draft Environmental Assessment has been modified to address those comments.

A. **Nuclear Weapons Complex Programmatic Environmental Impact Statement and Long-Term Plutonium Storage Issues** - concerns regarding the interim storage period and the decisions to be made in the Record of Decision in the Nuclear Weapons Complex Reconfiguration Programmatic Environmental Impact Statement. (50 comments)

B. **National Environmental Policy Act Issues** - concerns regarding the adequacy of an Environmental Assessment for the proposed action, changes in mission for the Pantex Plant, and concern that the programmatic requirements for U.S. nuclear weapons dismantlement should be addressed. (42 comments)

C. **Alternatives to the Proposed Action** - concerns regarding the Department's obligation to evaluate and consider all reasonable alternatives to the proposed action. (39 comments)

D. **Operational Issues** - general concerns and requests for clarification of various operational issues and hazards analyses performed for Zone 4 operations. These include the 1) worker exposure calculations; 2) storage configuration; 3) the forklift operational accident scenario; and 4) other general hazards analyses such as tornadic winds. (140 comments)

E. **Ogallala Aquifer** - technical differences regarding data used and methodology of the analysis. (35 comments)

F. **Aircraft Crash Hazard Analysis** - technical differences regarding data used and methodology of the analysis. (45 comments)

G. **General Topics** - those issues and concerns that do not fit into the previous categories. (72 comments)

H. **Comments from the Defense Nuclear Facilities Safety Board** - technical concerns regarding the methodology and adequacy of the aircraft crash analysis. (4 comments)

Response Summaries

With the exception of the "General Topics" category, a summary of the Department's overall response is provided below.

A. Nuclear Weapons Complex Programmatic Environmental Impact Statement and Long-Term Plutonium Storage Issues

The proposed action analyzed in this document has evolved as a result of recent developments in the areas of national security and foreign policy. As originally envisioned, the proposed action was to provide additional storage for up to 20,000 pits at Pantex for a period of approximately six to ten years. The anticipated duration of the interim storage was based on the December 1994 expected completion of the Department's Reconfiguration Programmatic EIS, allowing sufficient time to implement the decision regarding the future nuclear weapons complex that would be made on the basis of that Programmatic Environmental Impact Statement. It was expected that one of the elements of the future weapons complex would be a new long-term storage facility, to be constructed within the six to ten year time frame.

The President, on September 27, 1993 established an interagency task force to determine the disposition of plutonium surplus to national defense requirements. This task force is being led by the National Security Council and the Office of Science and Technology Policy with the participation of the Arms Control and Disarmament Agency, the Central Intelligence Agency, the Office of Management and Budget, and the Departments of State, Defense and Energy. The public and certain foreign nations will also be invited to participate in the task force. The results and implementation of its recommendations are likely to have significant impact on both the number of pits requiring long-term storage, and the duration of the storage period. It is likely that a substantial majority of the pits proposed to be stored at Pantex, which are surplus to the nation's defense needs, will be affected by decisions resulting from the work of the task force. Because the task force was so recently chartered, however, it is impossible to now predict the timing of its recommendations or their implementation.

In addition to its participation in this task force, the Department is conducting or will shortly commence the following National Environmental Policy Act reviews which also will address the storage of plutonium:

First, as noted above, the Reconfiguration Programmatic Environmental Impact Statement is examining the alternatives for the long-term storage of all Department of Energy owned plutonium. The alternatives being considered for long-term storage include "no-action," which, if selected in the Record of Decision on that Environmental Impact Statement, would continue the storage of the pits at Pantex in the existing facilities. Another alternative being considered is to upgrade the existing facilities. If this alternative is selected in the Record of Decision, upgrades to existing storage facilities, including Pantex, could occur following a likely additional project specific review under the National Environmental Policy Act. The final alternative under consideration is the siting and construction of a new long-term storage facility which, if selected in the Record of Decision, would result in the pits stored at Pantex being moved to that facility, at 1 of 5 considered sites. The Record of Decision is expected to be issued in January, 1995. It should be noted that the Pantex site is among five sites under consideration for the location of a new long-term storage facility.

Second, the Department is commencing the preparation of a new site-wide Environmental Impact Statement for the Pantex site. This Environmental Impact Statement will examine all aspects of current and foreseeable activities and operations of the Pantex Plant, including all dismantlement and storage-related issues. This Environmental Impact Statement will include analysis of measures to further mitigate the impacts of Pantex operations. While the scope of the Environmental Impact Statement cannot be defined precisely until the public scoping process has been completed, the Department of Energy expects that alternatives to the continued storage of pits at Pantex will be considered. This review will take 2-3 years to complete. The Public will be invited to help determine the scope of issues to be addressed and provide comments on the Draft Environmental Impact Statement when completed.

Third, the Department is committed to include in an Environmental Impact Statement any implementation actions it proposes to take in conjunction with the task force on the disposition of surplus plutonium. This will help ensure meaningful public involvement in the examination of alternative means of disposition.

The resolution of all these uncertainties and the preparation of these documents will require time, making it less likely to site and construct a new long-term storage facility on the schedule previously indicated and which would have led to storage relief at Pantex in six to ten years. Because of the national security and foreign policy considerations previously described, which highlights the importance of the continued disassembly of nuclear weapons and the consequent interim storage of the fissile material they contain, the Department cannot wait for these longer-term programmatic decisions. If the proposed action is not adopted, shipment of nuclear weapons to Pantex for dismantlement will cease in the first quarter of 1994 and actual dismantlement will cease within weeks of the cessation of shipments.

Accordingly, the Department is proposing to provide interim storage for up to 20,000 pits in the Pantex facility on an interim basis until the longer-term decisions on storage/disposition are made and implemented. The Department is now contemplating that the new site-wide Environmental Impact Statement for the Pantex site will consider the environmental impacts for a period of 5-10 years associated with continued operation of the Pantex Facility, including storage. The long-term decisions regarding the storage/disposition of plutonium will be made following the completion of the Reconfiguration Programmatic Environmental Impact Statement now scheduled for late 1994, and the work of the task force on plutonium disposition. These decisions will be made on the basis of the various activities and analyses described above. The Environmental Assessment has been revised to include a discussion of these developments.

Several comments observed that the initial Nuclear Weapons Complex Reconfiguration Programmatic Environmental Impact Statement scope did not include consideration of the long-term storage of plutonium weapon components. This observation is correct; long-term plutonium pit storage was not a requirement at the time the Department published its Nuclear Weapons Complex Reconfiguration Study (DOE/DP-0083, January 1991). At that time, the Department's nuclear weapons complex was required to support a much larger nuclear weapons stockpile that is now the case. Accordingly, it was expected that nuclear materials would be recycled without the need for long-term storage capacity. Consequently, initial planning for the Reconfiguration Programmatic Environmental Impact Statement did not consider analysis of the environmental impacts associated with a long-term plutonium storage facility. Neither the "Notice of Intent" (56 Federal Register 5590, February 11, 1991) announcing the preparation of the Programmatic Environmental Impact Statement nor the Implementation Plan, Nuclear Weapons Reconfiguration Programmatic Environmental Impact Statement (DOE/EIS-0161IP, February 1992) dealt specifically with the need for such future long-term storage.

Subsequent events dictated that the complex of the future (Complex 21) must provide for long-term storage of plutonium. The first of three arms reductions initiatives by former President George Bush was announced in September 27, 1991 and, together with the initiative announced on the January 28, 1992 State of the Union address and the June 16, 1992 Bush/Yeltsin agreement (later codified in the Strategic Arms Reduction Treaty II), resulted in large reductions in the nation's nuclear weapons stockpile requirements. These reductions resulted in the retirement of weapons in the stockpile in much larger numbers and in a much more compressed timeframe than had been previously contemplated. In addition, the Department was faced with a situation in which the present authorized storage capacity at the Pantex Plant would be exhausted long before the announced weapons retirements were completed and before the Reconfiguration Programmatic Environmental Impact Statement could be completed and reconfiguration decisions made concerning long-term storage. Thus, in order to continue the dismantlement of weapons, the additional interim storage capacity would be required regardless of any decisions that are subsequently made concerning reconfiguration.

Since it has now been determined that Complex 21 must provide for long-term plutonium storage capacity, the environmental impacts of locating such a facility at any one of several alternative sites must be included in the Reconfiguration Programmatic Environmental Impact Statement. Conceptual design efforts have already begun for long-term storage capacity. A Revised Notice of Intent that includes these changes to the original reconfiguration proposal as well as other potential modifications to that proposal was published in the Federal Register on July 23, 1993 (58 Federal Register 39528). The Department has held additional scoping hearings to assure opportunity for input and comments, and the Department will revise the Programmatic Environmental Impact Statement Implementation Plan to include any changes.

Following completion of a Draft Programmatic Environmental Impact Statement, public review and comment, and preparation of a Final Programmatic Environmental Impact Statement, it is expected that a Record of Decision can be issued in early 1995. The Pantex Plant is one of the sites being considered for location of nuclear facilities in the reconfigured complex, including long-term plutonium storage. Environmental analyses will include, among other things, evaluations of the impacts of transportation of plutonium from sites where it is now stored to potential long-term storage locations, as well as the risks of long-term storage of pits and other forms of plutonium. The Record of Decision will be followed by a Site-Specific Environmental Impact Statement which will examine the environmental impacts of any construction and operation of the facility at the location selected. In accordance with the Department's implementing regulation for the National Environmental Policy Act [10 Code of Federal Regulations Part 1021] affected States, Indian Tribes, and the general public will continue to have opportunities for review and comment regarding the planning for and analyses contained in both the Programmatic Environmental Impact Statement and the Site-Specific Environmental Impact Statement. The Secretary of Energy's decisions regarding reconfiguration will be based on a combination of environmental impact, cost, and technical consideration.

Several comments questioned when the Department would complete moving plutonium pits stored in Zone 4 at the Pantex Plant. The timing for completion of any transfer will depend on where the long-term storage function is performed, the rate at which materials can be moved safely, and the priorities established for moving various types of nuclear material.

Several comments questioned what would occur if a long-term storage facility is not available at the end of the interim storage period. The Department will do all within its control to expedite timely completion of the Programmatic Environmental Impact Statement, Record of Decision and site-specific National Environmental Policy Act reviews. The nature of the National Environmental Policy Act process, as well as possible changes in national policy or funding availability, prevents the Department from guaranteeing against unexpected delays. The Department is committed to working closely with the State of Texas and the public to resolve issues that arise during the interim storage period and during any transfer of the plutonium components to long-term storage.

A few comments expressed concern that if the interim storage period were incorrectly estimated, the conclusions of the Environmental Assessment might also be incorrect. The conclusions of the Environmental Assessment are not dependent on the length of the interim storage period, but rather the environmental impacts from routine storage, as well as potential accidents. Section 6.0 of the Environmental Assessment evaluates the potential impacts of using certain Steel Arch Construction and Modified-Richmond magazines to provide interim storage capability for plutonium weapons components. Increases in worker radiation exposures due to on-site interim storage operational activities were evaluated on an annual basis, and personnel would be monitored to ensure administratively controlled annual limits on exposure are met. Container integrity during the interim storage period will be ensured by a surveillance program that would detect any change in the integrity of the container or packaging materials. Deterioration is expected to occur very infrequently since, especially after the horizontal storage configuration is implemented, container exposure to moisture that might cause corrosion would be minimal. Pit stability during the interim storage period will be monitored by conducting pit surveillance testing in conjunction with the pit container surveillance program. The Environmental Assessment's analysis of potential accidents found frequencies and effects to be insignificant.

The Department is aware of no issue which would limit interim storage duration to a specified time period.

B. National Environmental Policy Act Issues

The Pre-Approval Environmental Assessment was provided to the State of Texas for review and comment in accordance with the Department's National Environmental Policy Act Implementing Procedures [10 Code of Federal Regulations 1021.301(d)]. The Department has carefully considered all of the comments on the Environmental Assessment provided by the State of Texas, including comments by State and local agencies and officials, interest groups, and the public. The Department met with the State and stakeholders to discuss the comments and the revisions made in the Environmental Assessment to incorporate State and public input. When the Environmental Assessment is finalized, the Department will determine whether to issue a Finding of No Significant Impact for the proposed action or prepare an Environmental Impact Statement. The Department will issue a Finding of No Significant Impact only if the Environmental Assessment supports the finding that the proposed action will not have a significant effect on the human environment, in accordance with the Council on Environmental Quality Regulations for Implementing the National Environmental Policy Act [40 Code of Federal Regulations Parts 1500-1508] and the Department's National Environmental Policy Act regulations [10 Code of Federal Regulations Part 1021].

Comments on the scope of the Environmental Assessment stated that the proposed action should include long-term storage of plutonium components and/or dismantlement operations

Comments on the scope of the Environmental Assessment stated that the proposed action should include long-term storage of plutonium components and/or dismantlement operations at the Pantex Plant. The decisions on long-term storage of plutonium components are being addressed in the Programmatic Environmental Impact Statement for reconfiguration of the weapons complex, as discussed in Section A of this document. However, in order to proceed with the reduction of the nuclear weapons stockpile, the Department determined that a decision on additional interim storage would be needed prior to completion of the Programmatic Environmental Impact Statement. To support this decision, the Department prepared the Environmental Assessment in accordance with the Department's National Environmental Policy Act Implementing Procedures [10 Code of Federal Regulations Part 1021]. Additional National Environmental Policy Act analysis of dismantlement activities is not needed to decide whether to increase interim pit storage at the Pantex Plant. Dismantlement has historically been part of the Pantex Plant mission and is addressed by the Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983). Weapons dismantlement is being conducted in much the same way it has always been conducted, with ongoing improvements to safety and environmental protection in accordance with regulatory requirements. Dismantlement operations will remain within the normal historic range of assembly/disassembly activity at the Pantex Plant.

To address any potential concerns regarding cumulative impacts from increased dismantlement activities, the Department will prepare a new Pantex Site-Wide Environmental Impact Statement. A Notice of Intent to prepare this document will be issued in the Federal Register soon. The Department has initiated assembly of environmental baseline information in support of this effort. This Environmental Impact Statement will examine all aspects of current and foreseeable activities and operation of the Pantex Plant, including dismantlement and storage-related issues. This Environmental Impact Statement will include analyses of measures to further mitigate the effect of Pantex activities. Although the scope of the Environmental Impact Statement cannot be defined until the public scoping process has been completed, the Department now envisions considering alternatives to the continued storage of pits at Pantex. The Department cannot predict how long this review will take but best efforts will be made to complete the Environmental Impact Statement on an expedited basis. The public will be invited to help determine the scope of issues to be addressed and comment on the draft Environmental Impact Statement when it is available. When the Nuclear Weapons Complex Programmatic Environmental Impact Statement Record of Decision is issued, aspects specific to the Pantex Plant will be incorporated into the new Site-Wide Environmental Impact Statement.

Comments stated that the interim storage of plutonium components constitutes a change in mission for the Pantex Plant, and therefore an Environmental Impact Statement should be prepared. The Department believes that the proposed action is consistent with the historical mission of the plant, as it relates to the temporary staging of plutonium components after disassembly of retired weapons and prior to shipping to Rocky Flats for processing. The proposed action analyzed in the Environmental Assessment is the augmentation of the capability to store plutonium components temporarily, in response to the cessation of plutonium operations at the Rocky Flats Plant.

C. Alternatives to the Proposed Action

Several comments suggested inadequate treatment of the Department's discussion of alternatives to interim storage at the Pantex Plant. In response, the Department has substantially enhanced this discussion. The major issues follow:

1. *All possible alternatives were not discussed or were not discussed in sufficient detail.*

The National Environmental Policy Act requires that reasonable alternatives to a proposed action be discussed in an Environmental Assessment. Several alternatives were developed and are described in Section 4.0 of the Environmental Assessment. Both Department of Defense sites and other Department of Energy sites were considered as alternative storage areas.

While every conceivable alternative was not mentioned, those alternatives discussed were potentially available and were considered to be potentially reasonable alternatives. Sites which commenters mention that are not specifically discussed in the Environmental Assessment are either in use now or slated for future uses other than pit storage.

The discussion of alternatives in the Environmental Assessment explains that a combination of factors led to the conclusion that none of the other sites considered (those of the Department of Energy and the Department of Defense) is reasonable in that none meet the criteria for the proposed action. The sites considered do not meet programmatic goals for interim storage because of the following factors: 1) increased cost (for facility modification, to augment or reactivate enhanced security, for increased transportation requirements, etc.), 2) untimely implementation of alternative interim storage (time to modify facilities, perform required safety analyses, develop site-specific procedures, train personnel, etc.), and 3) no apparent environmental benefit to interim storage at an alternate site. Under the proposed action, there are no increased transportation requirements, only minor facility enhancements are required, and activities required for implementation are essentially in place.

2. *No basis was presented in the Environmental Assessment to support the Department's conclusion that no environmental advantage would be gained by moving and storing the pits at an alternative site on an interim basis.*

In the Department's discussion of alternatives, the Environmental Assessment analyzes whether environmental benefit could be derived by storing pits off-site (either at up to four separate Department facilities or at a Department of Defense facility). The Environmental Assessment analysis indicates that radiation exposure to workers is the principal impact of the proposed action, and there is no significant impact to the environment. While impact to the environment would be no different, worker exposure could be increased in the implementation of off-site or decentralized interim storage. Decentralization of interim pit storage (at more than one site) would generate duplication of security, handling, and inventory requirements. The processes of moving (for shipping, receiving, movement into storage facility), transporting, repackaging (as required), storing, and inventorying pits contribute to total person exposure levels, thereby increasing the total cumulative person-rem exposure. Efficiency in handling, monitoring, and inspecting the plutonium components is achieved by conducting interim storage operation at one site rather than multiple sites and could result in lower cumulative radiation exposure to workers.

The relative number of handling steps that would be required by the proposed action and storage at another site is compared in the attached process flow diagram (Figure ES-1). Eliminating transportation to alternate sites eliminates some of these processes as well as the total work load and costs involved in pit storage management and is consistent with "as low as reasonably achievable" principles. Although exposures from implementing alternatives would not be unacceptable from the standpoint of worker safety, worker exposures would be expected to be higher relative to the proposed action. This conclusion does not imply that occupational exposure standards for workers would be exceeded for any alternative.

3. *The Department does not discuss specific Department of Defense facilities (as cited in the comments) and, therefore, appears not to have considered them.*

The Department has been working since May 1992 with the Department of Defense concerning potential use of Department of Defense sites for interim pit storage. The Environmental Assessment discussion has been expanded to reflect the most recent results from this interaction. The Department has concluded that Department of Defense sites are not feasible alternatives to the proposed action for the following reasons:

- The Department of Defense is restructuring its forces to reflect both troop reductions and base closures. As part of this effort, some Department of Defense bases are being configured to accommodate only conventional forces and their weapons. The remaining active weapon storage facilities are committed to storing both nuclear and conventional weapons, which are being moved from overseas bases and from facilities designated for closure. This restructuring process could take several years. The requirement for additional continental U.S. storage capacity is further strained by the backlog of retired weapons.

- All Department of Defense excess sites are placed on the Base Realignment and Closure List. To store special nuclear material and establish special nuclear material repository infrastructure (e.g., security, environmental study, training, and negotiation of site-sharing agreements) at an inactive Department of Defense site would require significant new funding and implementation time.

- No environmental benefit is apparent in the use of Department of Defense sites for the interim storage of plutonium components.

The Environmental Assessment also discusses the implication that the No Action alternative (and the resulting need to store an increasing number of weapons at Defense sites) would have on Department of Defense plans for realignment and closure of bases.

D. Operational Issues

Several commenters questioned the inspection types and schedules and voiced concern over pit, pit container, and magazine stability. Some comments concerned the possibilities of a plutonium release caused by either a forklift puncturing a container, a battery exploding, an internal fire, or some other vehicle accident. There were also concerns raised with respect to the analysis performed to project worker exposures.

The configurations (single-layer vertical with and without aisles and horizontal palletized multiple stacking) for the storage magazines allow for access to accomplish appropriate inspection of containers. Inspection for both configurations would be carried out concurrent with planned inventory activities (every 18 months), and would consist of a visual inspection of magazine conditions and of exposed pit container surfaces and removal of surveillance samples for the container and pit surveillance programs. The surveillance programs consist of complete visual inspection of the pits and individual container parts. Container integrity would be further evaluated via inspection (both visual and using non-destructive evaluation techniques) of the container surfaces (for corrosion), weld integrity, and integrity of insulation and plastic parts. In addition, pits from these containers would be evaluated at the Los Alamos National Laboratory to evaluate the pit integrity and monitor for aging-related defects.

These programs are consistent with and draw from the sampling and testing criteria used in the Department's Weapons Quality Assurance Testing Program and will also draw from historical pit surveillance data to ensure integrity of the pits and pit container. With respect to magazine integrity, analysis has shown the magazines are capable of withstanding the Maximum Credible Tornado (200 mph).

A spectrum of accident initiators was addressed in the analysis. Of the initiators examined, the forklift accident was the only credible event that could conceivably cause damage to the container or pit and therefore the effect of this initiator was evaluated. Using conservative assumptions, the committed effective dose equivalent[1] to an individual at two kilometers would be 0.00013 rem over 50 years (compared to the Environmental Protection Agency standard of 0.010 rem/year) and to the unprotected forklift operator, the committed effective dose equivalent would be 6.6 rem over 50 years (compared to the Federal radiation limit of 5 rem/year). The shielded forklift that was designed to reduce routine worker exposure, and is now at the Pantex Plant, also includes features to specifically reduce the probability of this initiator. Sensors have been installed in the forklift, along with electrical and mechanical interlocks to reduce the possibility of puncturing a container.

With the increased number of pits for interim storage at the Pantex Plant, there exists a potential for increased worker exposure. The Pantex Plant management has proactively taken several steps to reduce worker exposure over current levels in keeping with its "as low as reasonably achievable" goals. The horizontal palletized multiple stacking configuration will reduce the dose rates, compared to the single-layer vertical configuration, by a factor of two (Appendix F, Section F.3.2 of the Environmental Assessment) due to self-shielding of the containers. In addition, the proposed horizontal configuration allows the use of a shielded forklift to manipulate a pallet of containers to reduce exposure time. In the present configuration, the containers must be individually handled for the inspection process. Only the person inside the shielded forklift will occupy the magazine during the operation (currently two individuals normally conduct the inspection operation) and shielding on the forklift should provide a dose reduction factor of at least 20 over current inventory methods. An Automated Guided Vehicle, estimated to be available for Zone 4 operations by fall of 1994, will eliminate the need for personnel to enter the magazine for inventory and inspection by using a bar code reader and camera. By eliminating the need for personnel to enter the magazines for routine inventory activities, radiation exposure will be drastically reduced. All of these steps will ensure that the worker exposure dose for the interim storage of pits will be less than the current dose.

E. Ogallala Aquifer

The Department tasked the Los Alamos National Laboratory to analyze the potential effects on the Ogallala Aquifer from a hypothetical plutonium dispersal accident. This analysis assessed the effect of a surface contamination of 0.2 microCuries per square meter ($\mu Ci/m^2$) on the aquifer. This level of contamination is expected to be the maximum amount remaining after decontamination efforts. The Department has carefully considered and responded to each comment concerning the analysis. The concerns raised by the comments can be grouped into four major areas of concern. Below, the main ideas of the detailed responses to comments in these four areas are summarized.

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[1] Committed effective dose equivalent is the weighted sum of committed dose equivalent to specified organs and tissues, deposited over 50 years following intake.

1. *Comment authors were concerned about the Department's ability to perform a cleanup to 0.2 μCi/m^2 and about the validity of the assumption that surface transport would concentrate plutonium in the playas by a factor of ten.*

In 1977, the U.S. Environmental Protection Agency proposed 0.2 μCi/m^2 as the cleanup guideline for plutonium in soil. It should be noted that this Environmental Protection Agency guideline is the more restrictive of two cleanup levels discussed and analyzed in Section 4.2.7 of the Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983). This guideline was never adopted by the Environmental Protection Agency as a standard; however, it is a level achievable using current technology. This technology has been demonstrated at such cleanups as those performed at Johnston Island, Eniwetok Atoll, and current research and development activities at the Nevada Test Site. The analysis assumes a scenario that was analyzed elsewhere in the environmental assessment and found to have a frequency of occurrence of less than 7 x 10^{-7} per year. The scenario is that a large and/or fast flying airplane crashes into and penetrates a Zone 4 nuclear weapons component storage magazine at the Pantex Plant. In addition, for 25 percent of the magazine inventory (approximately 100 containers), either the AL-R8 storage container is mechanically damaged such that a fuel fire resulting from the ignition of aircraft fuel could breach the pit cladding, melt and aerosolize the plutonium or for undamaged AL-R8 containers, the resulting fuel fire is sufficiently long lasting as to defeat the thermal cladding and thus melt and aerosolize the plutonium. The thermal energy from the fire also provides the necessary energy to disperse the aerosolized plutonium to areas surrounding the plant site. The maximum size of the area that might be contaminated above this cleanup guideline was estimated to be approximately 75 km^2. See memorandum from Sandia National Laboratory, dated April 30, 1993 from Y.T. Lin, N.R. Grandjean, R.E. Smith to D.R. Rosson (Department of Energy/Albuquerque) titled "Plutonium Dispersal Deposition Area Estimates of a Hypothetical Aircraft Crash Into Pantex Zone 4, (which is provided in the Environmental Assessment Comment Response, Appendix I). The 75 km^2 area is much smaller than the 1036 km^2 area that the Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983) projected to be contaminated by a hypothetical plant accident that involves plutonium dispersal from assembled weapons by high explosives detonation. Therefore, the analysis and conclusions reached in the Final Environmental Impact Statement, Pantex Plant Site regarding the effects of a plutonium dispersal accident caused by an incident already have taken into account effects that might be caused by the hypothetical interim storage accident. Also, the discussions contained in the Final Environmental Impact Statement, Pantex Plant Site concerning cleanup of any contaminated area would apply equally well to the hypothetical accident. 1) See Palomares Summary Report. Field Command, Defense Nuclear Agency, Technology and Analysis Directorate, Kirtland Air Force Base. 2) Thule. United States Air Force Nuclear Safety, AFRP 122, January/February/March 1970, No. 1, Volume 65 (Part 2), Special Edition: "Project Crested Ice". 3) Johnston Island. Thermo Analytical (Attention: Nels Johnson/5635 Jefferson Street, N.E., Albuquerque, New Mexico 87109), Soil Clean of Technologies.

If soil removal were required, several years might be needed to clean all affected areas. However, a delay on the order of a few years would not significantly change the Environmental Assessment's conclusions concerning the potential effects of a plutonium dispersal accident on the Ogallala Aquifer. Although there is uncertainty concerning the long-term rate of plutonium transport, soil scientists generally agree that it is relatively immobile and that it will not migrate beyond remediable depths within the few years that could be needed to complete a cleanup. An exception to this could occur, however, if short-circuits (i.e., artificial recharge projects or improperly constructed or abandoned water wells) existed. In the extremely unlikely event of a plutonium-dispersal accident, these areas would receive priority for decontamination and steps taken to eliminate the short-circuit path to groundwater. The Department has initiated steps to identify and document preferential pathways that may exist within the postulated area of contamination.

Following the hypothetical accident, plutonium would be expected to concentrate prior to infiltration in playa lakes as a result of surface transport processes. Therefore, a conservative concentration factor of ten was applied to the cleanup level to estimate the initial plutonium concentration in playa lakes. Actual field data from the Trinity Site were used to confirm that the concentration factor of ten was reasonable, yet conservative.

See Palomares Summary Report, Field Command, Defense Nuclear Agency, Technology and Analysis Directorate, Kirtland, Air Force Base, Thule, United States Air Force Nuclear Safety, AFRP 122, January/February/March 1970, No. 1, Volume 65 (Part 2), Special Edition: "Project Crested Ice", Johnson Island, Thermo Analytical (Attention: Nels Johnson/5635 Jefferson Street, N.W., Albuquerque, New Mexico 87109), Soil Clean of Technologies.

2. *Comment authors expressed concern that the assumed operational recharge rate of 3 centimeters/year (cm/yr) was not sufficiently conservative.*

The Los Alamos National Laboratory reviewed existing literature to estimate local playa lake recharge rates because local, rather than regional, rates are the key to forecasting plutonium transport to groundwater. The Los Alamos National Laboratory concluded that 3 cm/yr is a reasonable estimate. Subsequently, the Texas Bureau of Economic Geology offered new evidence based on tritium-dating which suggests that a local recharge rate as high as 63 cm/yr may be possible.

Based on an analysis of the literature values and technical concerns about the tritium dating method, the Los Alamos National Laboratory believes that the extremely high recharge rates suggested by the Texas Bureau of Economic Geology, when combined with the other Los Alamos National Laboratory/Department of Energy conservative assumptions assigned to the hypothetical accident scenario, is so conservative as to be unreasonable. Given all these assumptions, even with a very low assumed dispersivity of one centimeter, the maximum plutonium concentration in recharge is higher than the most conservative public water system drinking water standard, but significantly lower than the total exposure based standard of 30 picoCurie/Liter. However, when aquifer and well-casing dilution is considered, anticipated plutonium concentrations reaching a potential receptor are lower than either standard. With a more realistic dispersivity of 1 meter, the analysis predicts that even the recharge concentration would be lower than any applicable standard.

Considering these results, the Department believes that the Environmental Assessment's original conclusion that the hypothetical plutonium dispersal accident would not significantly impact the Ogallala Aquifer, remains valid.

3. *Comment authors expressed concern that preferential flow was not adequately considered.*

The overall approach taken in evaluating the potential effects of the hypothetical plutonium dispersal accident on the Ogallala Aquifer was to use conservative but reasonable assumptions. In the absence of local site-specific field experiments, the Los Alamos National Laboratory judged it to be conservative, but reasonable, to accelerate the flow velocity by a factor of 2 to account for preferential flow conditions.

Since determining preferential flow effects is an active soil science research area, the Los Alamos National Laboratory's professional judgment concerning the appropriate acceleration factor can be disputed and cannot be confirmed without local field experiments. The Los Alamos National Laboratory based its professional judgment on seven published studies, of which six reported acceleration factors of two or less. Mobile/immobile water models were not used because of the paucity of site-specific experimental data needed to estimate the numerous parameters required by such models.

F. Aircraft Crash Hazard Analysis

The State of Texas comments raised a number of concerns about the methodology used for the aircraft crash hazard analysis in the Environmental Assessment. To better address these concerns, an analysis of the vulnerability of Zone 4 magazines to impact by general aviation single-engine aircraft was performed. The result concluded that the annual probability of general aviation crashes having the potential for significant consequences presented in the Environmental Assessment is valid.

Issues related to aircraft crash methodology have been treated in the detailed responses to the comments. The following paragraphs summarize those responses. The concerns were focused on the following points:

1. *Concern was expressed regarding the overall methodology used in the aircraft hazard analysis.*

The basic methodology used in the aircraft crash hazard analysis for the Environmental Assessment (and the supporting safety analysis report) is that previously employed by Sandia National Laboratories in the work that supports the Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983). The Sandia National Laboratories methodology is based on earlier work by K. Solomon for commercial nuclear power plants. This basic methodology is accepted in the risk assessment community. The Argonne National Laboratory, on behalf of the U.S. Nuclear Regulatory Commission, reviewed the body of public literature in this field in the early 1980's. Argonne found that the data bases, methodologies, and modeling approaches are adequate to estimate the threat and plant response. Thus, the Department of Energy feels that the method used in the Environmental Assessment is sound and reasonable. In the course of the current work, a number of conservative assumptions in the method were examined and modified to better model the specifics of Zone 4 compared with the plant site as a whole.

Additionally, an independent assessment of the "Vulnerability of Zone 4 Magazines to Impact by General Aviation Single Engine Aircraft" was performed and is contained in Appendix J. It concluded that annual probability of general aviation crashes with the potential for significant consequences presented in the Environmental Assessment on Interim Storage of Plutonium Components at Pantex is a valid and reasonable assessment of such probability.

2. *Concern was expressed regarding the subdivision of aircraft crash data into separate aircraft categories.*

The analysis considers the four stated aircraft categories (commercial aviation, military aviation, general aviation, and aerial applications) separately for several reasons. First, the data (e.g., hours flown, accidents) gathered and collated by government agencies are by aircraft category. Second, the nature of the operations are decidedly different. Commercial aviation is conducted under regulations established by the Federal Aviation Administration for licensed air carriers. While general aviation is also controlled by the Federal Aviation Administration, there are significant differences in the applicable rules. Military aviation operates under guidelines established by the services (e.g., U.S. Air Force, U.S. Navy), except when flying designated airways and using commercial facilities. The data, particularly that for accidents, is quite different. Third, the characteristics of the aircraft are different, particularly in terms of size and speed, which has a significant effect on the potential consequences of an accident. Therefore, the crash probabilities are generated for each category and then combined to provide an overall estimate of the likelihood of any aircraft crash.

3. *Concern was expressed regarding the development of aircraft crash rates.*

Early studies had used the fatal accident rates published by the Federal Aviation Administration. However, careful examination of the published information indicated that the Federal Aviation Administration designates as a fatal flight those flights in which a fatality of any type occurs. For example, if a commercial aircraft is arriving or departing from a passenger gate and strikes and kills a ramp worker, that flight is listed as one with fatalities. Similarly, if a passenger should suffer a fatal heart attack enroute, the flight would be listed as one with fatalities. These sorts of events have no relevance to accidents that could cause damage to structures on the Pantex Plant. Therefore, in examining the data, only those accidents that involved both fatalities and destruction of the aircraft were selected. This results in a crash rate lower than the published fatal accident rate, but one that is more representative of the actual situation that represents a risk to the Pantex Plant. However, even using the Federal Aviation Administration published fatal accident rate for commercial aviation, the probability is not significantly increased.

4. *Concern was expressed that aircraft that are landing or taking-off from the Amarillo Airport should be considered in the analysis.*

Aircraft using the Amarillo Airport (approximately 13.6 kilometers from the plant) are included in the overall traffic counts. However, the literature contains ample data to indicate that beyond 8 kilometers from an airport, the aircraft crash rates are those characterized as "inflight." Any aircraft observed to be "over the Pantex Plant" must be at least 366 meters above the terrain (to comply with Federal Aviation Administration rules) and more than 13 kilometers from the runway. Therefore, the use of inflight crash rates is reasonable.

5. *Concern was expressed regarding the calculation of the total effective area used in the analysis.*

The total effective area required for the probability model is the sum of the base area, a shadow area, and a skid area. It is postulated that if an aircraft impact occurs within this total effective area, either the structure will be hit directly, or before ground impact by an aircraft grazing the structure because it has some height, or as a result of an aircraft skidding into it after impact with the ground. In estimating each area, allowance is made for aircraft dimension (i.e., wingspan). In the Environmental Assessment, the total effective area is the sum of the true areas (the magazine base areas adjusted for aircraft dimension by aircraft category), the shadow areas (defined by the magazine height and the angle of postulated impact), and the skid areas (the potential area covered by an aircraft skidding after impact with the ground at some point away from the structure of interest). The 15 degree angle of impact selected is representative of an aircraft on a controlled descent to the ground and provides a conservative estimate of a shadow area (the projection of the structure height into a horizontal plane). The shadow area is only a portion of the effective area, therefore, the total effective area is not strongly dependent upon the angle selected.

G. General Topics

A variety of comment were received that did not fit neatly into the specific categories described above. The responses to these comments are found in this section.

H. Comments from the Defense Nuclear Facilities Safety Board

During October 1993, the Defense Nuclear Facilities Safety Board (the Board) and the Department met to discuss the Zone 4 aircraft crash analysis. In an October 1, 1993 letter, the Board identified issues regarding the methodology used and the adequacy of the analysis used by the Department in assessing the Zone 4 aircraft crash analysis. After meeting with the Department to discuss the concerns, on October 29, 1993, the Board concluded that the results shown in the Environmental Assessment Report and the Final Safety Analyses Report for the Pantex Plant Zone 4 do meet the Nuclear Regulatory Commission assessment criteria for evaluating aircraft hazards. This summary of the events as well as the correspondence between the Board and the Department is included in this section. No revisions to the Environmental Assessment resulted from these discussions with the Board.

I. Sandia National Laboratories Memorandums

R.E. Smith, Plutonium Dispersal Consequence Analysis of Hypothetical Aircraft Crash into Pantex Zone 4, dated December 11, 1992.

Y.T. Lin, N.R. Grandjean, and R.E. Smith, Plutonium Dispersal Deposition Area Estimates for Hypothetical Aircraft Crash into Pantex Zone 4, dated April 30, 1993.

References provided.

J. Sandia National Laboratories Memorandum

Y.T. Lin, J.L. Tenney, and R.E. Smith - Vulnerability of Zone 4 Magazines to Impact by General Aviation Single Engine Aircraft.

References provided as independent assessment of vulnerability of Zone 4 Magazines to Impact by General Aviation Single Engine Aircraft.

K. Index to Comment Responses

L. Los Alamos National Laboratory Report

H.J. Turin, et al., November 1992 - Potential Ogallala Aquifer Impacts of a Hypothetical Plutonium Dispersal Accident in Zone 4 of the Pantex Plant.

Table ES-1 - List of Comment Documents

Document	Author	Affiliation
1001	Ann W. Richards, Governor	State of Texas
1002	Alison A. Miller	Texas Air Control Board
1003	Thomas A. Griffy	University of Texas at Austin, Department of Physics
1004	C. Ross Schulke	U.S. Department of Transportation Federal Aviation Administration
1005	Jeri Osborne & Family	Citizen Comments
1006	Auburn L. Mitchell	University of Texas at Austin, Texas Bureau of Economic Geology
1007	Joseph A. Martillotti	Texas Department of Health, Bureau of Radiation Control
1008	Boyd Deaver	Texas Water Commission
1009	Tom Millwee, Chief	Texas Department of Public Safety, Division of Emergency Management
1010	Walt Kelley	City of Amarillo/Counties of Potter and Randall Emergency Management
1011	Dana O. Porter	Citizen Comments
1012	Margie K. Hazlett (1)	Citizen Comments
1013	Margie K. Hazlett (2)	Citizen Comments
1014	Sam Day, Director	Nukewatch
1015	Addis Charless, Jr.	Panhandle Area Neighbors and Landowners (PANAL)
1016	Jeri Osborne	Citizen Comments
1017	Jim Osborne	Citizen Comments
1018	Bob Bullock, Lt. Governor	State of Texas
1019	W.H. O'Brien	Operation Commonsense
1020	Benito J. Garcia, Chief	State of New Mexico, Environmental Department
1021	Lawrence D. Egbert, MD	Physicians For Social Responsibility
1022	James Thomas	Hanford Education Action League (HEAL)
1024	Jay R. Roselius, County Judge	Carson County
1025	William and Mary Klingensmith	Citizen Comments
1026	Tamara Snodgrass	Citizen Comments
1027	Portia Dees	Citizen Comments
1030	Judy Osborne	Citizen Comments
1031	Louise Daniel	Citizen Comments
1032	Betty E. Barnard	Citizen Comments
1033	Norbert Schlegal	Citizen Comments
1034	48 signatures/form letter	Citizen Comments
1035	Karen Son	Citizen Comments
1036	Arjun Makhijani, Ph.D.	Institute for Energy & Environmental Research
1037	Bishop Leroy T. Matthiesen	Diocese of Amarillo
1038	Boyd M. Foster, President	Arrowhead Mills
1039	Tonya Kleuskens, Chairman	The Texas Nuclear Waste Task Force
1040	Carl L. King, President	Texas Corn Growers Association
1041	Beverly Gattis	Military Production Network
1042	Beverly Gattis	Save Texas Agriculture and Resources (STAR)
1043	Mavis Belisle, Director	The Peace Farm
1044	Margie K. Hazlett (3)	Citizen Comments
1045	Beverly Gattis	Serious Texans Against Nuclear Dumping (STAND) of Amarillo, Inc.
1046	Dan Morales, Attorney General	State of Texas, Office of the Attorney General
1048	Doris & Phillip Smith	Panhandle Area Neighbors and Landowners (PANAL)
1049	Jerome W. Johnson	Panhandle 2000
1050	Senator Teel Bivins (Dist 31)	The Senate of The State of Texas

46 letters forwarded from the State of Texas. Document numbers not necessarily sequential.

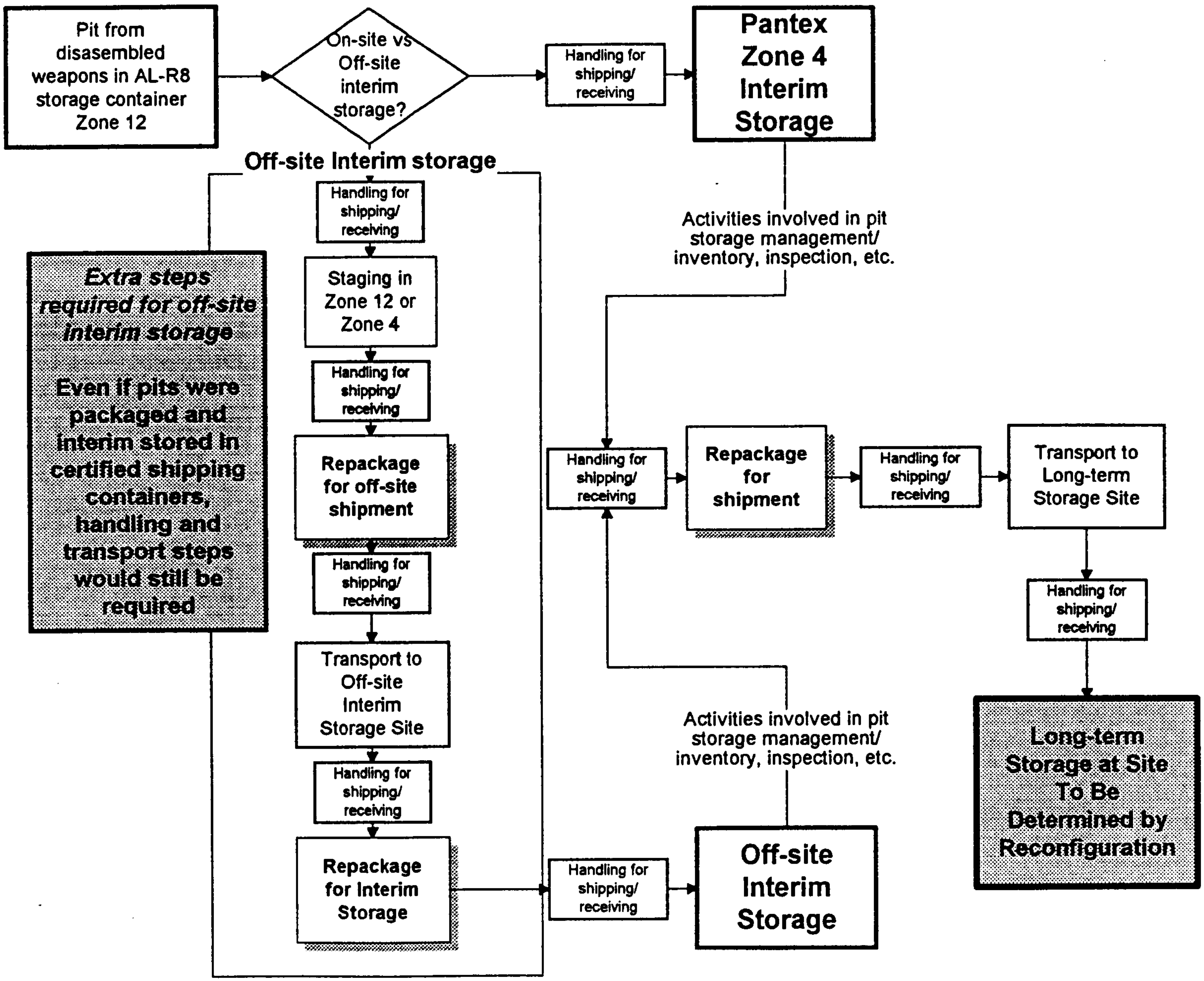


Figure ES-1 - Comparison of Steps Required For Interim Storage at the Pantex Plant With Any Other Site

Introduction to Comment Response Sections

The Environmental Assessment for Interim Storage of Plutonium Components at Pantex was forwarded to the Governor of Texas on December 21, 1992, for review and comment. Subsequently, forty-six letters were returned to the Department of Energy containing 423 comments covering a wide range of issues. The letters and the issues therein were addressed in this way:

- The letters were entered in an organizational data base as Documents and assigned a control number for identification. Some of the letters addressed a single issue, while others remarked on several issues and listed a number of points for each issue.

- To keep track of these issues, Comment numbers were assigned within each letter (Document). The numbers used for identification and tracking imply no other purpose and are not to be interpreted as indicators of priority.

The following is provided for each comment:

- Document #: The control number assigned to each letter.
- Comment #: The number assigned to one or more comments within the same letter.
- Date: The date on the letter.
- Name/Org.: The signature on the letter and organization or other identifier.
- Comment: The specific comment or issue raised regarding the Environmental Assessment as written in the letter.

The comments were aggregated into like subjects in Sections A through F. Following a grouping of similar comments is the Department of Energy's answer to the comments. Comments falling outside these areas are captured in Section G under the category of General Topics.

Note: Due to limitations within the database used to compile the individual comments, text formatting (bolding, underlining and italics) and tables were not reproduced.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (A.1) FOLLOWS ON PAGE A-9.

Document #: *1001* **Comment #:** *3* **Date:** *2/25/93*

Ann W. Richards, Governor
State of Texas

Comment:
I am most concerned about the 6-10 year interim storage period. Specifically, I want to know when this 10-year period officially begins and ends. I also need clear and definite information about what procedures will be followed if the plutonium is still sitting at Pantex at the end of the 10-year period.

Document #: *1008* **Comment #:** *3* **Date:** *2/1/93*

Boyd Deaver
Texas Water Commission

Comment:
Comment: 2.0 PURPOSE AND NEED FOR THE PROPOSED ACTION: p. 2-1, third paragraph. - "4....This is expected to be within a timeframe of 6-10 years.
Question: What if the 10 year goal is exceeded? What effect will NEPA have on this goal commencement?

Document #: *1011* **Comment #:** *1* **Date:** *2/18/93*

Dana O. Porter
Citizen Comments

Comment:
The report states that the intention of the D.O.E. project is to provide temporary storage for the plutonium pits. The difficulty in finding a permanent storage or disposal site for the plutonium is obvious. In other words, if these "temporary" storage plans are approved, the pits will likely move into the Texas panhandle to stay.

Document #: *1015* **Comment #:** *3* **Date:** *2/20/93*

Addis Charless, Jr.
Panhandle Area Neighbors and Landowners (PANAL)

Comment:
Page 2-1: The estimated interim storage period of 6-10 years is questionable if only for the DOE's assurances in times past of a "temporary" anything.

Document #: *1015* **Comment #:** *17* **Date:** *2/20/93*

Addis Charless, Jr.
Panhandle Area Neighbors and Landowners (PANAL)

Comment:
If, because the pits are at PX and where better to have a reprocessing facility than where the pits already are, PX becomes a reprocessing facility for Pu, what will become of the waste thus generated? For every cubic unit of Pu reprocessed, 17 million cubic units of toxic waste are generated.

Document #: *1016* **Comment #:** *7* **Date:** *2/16/93*

Jeri Osborne
Citizen Comments

Comment:
There is nothing about the storage that really needs to be classified. The storage and management of all plutonium must be review (sic) throughout the DOE complex (sic) should be addressed through an environmental impact statement for all facilities.

Document #: *1016* **Comment #:** *12* **Date:** *2/16/93*

Jeri Osborne
Citizen Comments

Comment:
What does DOE plan to do with the Pu after six to ten years?

Document #: *1018* **Comment #:** *3* **Date:** *1/20/93*

Bob Bullock, Lt. Governor
State of Texas

Comment:
I would also like information regarding the proposed consolidated nuclear unit, its functions, and the criteria that will be used in deciding its location.

Document #: *1019* **Comment #:** *6* **Date:** *1/20/93*

W. H. O'Brien
Operation Commonsense

Comment:
Additionally, incremental risks created by extending the storage period longer than 10 years is not assessed, nor is the method of indemnification provided this community that the period will not be longer than 10 years. Temporary storage fails to be credible without the designation of a permanent storage site, if past histories are to be believed.

Document #: *1020* **Comment #:** *1* **Date:** *2/4/93*

Benito J. Garcia, Chief
State of New Mexico, Environmental Dept.

Comment:
Given that the proposed activity evaluated for this assessment is an enlargement of activities which have been on-going at the site for the past 40 years, the document seems to adequately addresses (sic) any associated environmental impacts. The proposed action seems to be the most favorable of the alternatives considered for interim storage. Of greater interest to the state of New Mexico is the long-term storage/disposal options being considered for these components, as presently under consideration in the Programmatic EIS for the Nuclear Weapons Complex Reconfiguration. The state of New Mexico would appreciate any future documentation on plans for long term storage including transportation impacts.

Document #: *1021* **Comment #:** *1* **Date:** *1/25/93*

Lawrence D. Egbert, MD
Physicians For Social Responsibility

Comment:
We should insist that the storage of plutonium (Pu) in Texas should be TEMPORARY. The DOE mentions six to ten years but the text gives no details of how this will be terminated, no discription (sic) of research going on to prepare for storage elsewhere.

Document #: *1021* **Comment #:** *4* **Date:** *1/25/93*

Lawrence D. Egbert, MD
Physicians For Social Responsibility

Comment:
Are you aware that Hanford originally prepared "interim storage" which then became the de facto standard for storage for the U.S. The limits of TEMPORARY should be very carefully spelled out.

Document #: *1021* **Comment #:** *9* **Date:** *1/25/93*

Lawrence D. Egbert, MD
Physicians For Social Responsibility

Comment:
No mention is found in their text of any research about long term storage or destroying or modifying Pu, all projects which a responsible DOE would have done decades ago if their sense of responsibility had been toward the environment rather than toward military power.

Document #: *1022* **Comment #:** *4* **Date:** *2/11/93*

James Thomas
Hanford Education Action League (HEAL)

Comment:
p. 3-1 -- DOE has failed to sufficiently define what it means by interim.

Document #: *1026* **Comment #:** *2* **Date:** *2/19/93*

Tamara Snodgrass
Citizen Comments

Comment:
The draft EA declares that the plutonium pits will be stored at Pantex for the next 6 -10 years. There appears to be no basis for these figures. Where the pits will go after the ten year period was not discussed. Further, it does not provide assurance that pits will not be stored for more than ten years.

Document #: *1026* **Comment #:** *4* **Date:** *2/19/93*

Tamara Snodgrass
Citizen Comments

Comment:
The draft EA does not analyze the environmental effects of pit storage for more than ten years.

Document #: *1027* **Comment #:** *2* **Date:** *3/5/93*

Portia Dees
Citizen Comments

Comment:
I understand that this is interim storage for a period of 6 to 10 years. What happens to the plutonium and other nuclear materials after ten years?

Document #: *1031* **Comment #:** *1* **Date:** *3/1/93*

Louise Daniel
Citizen Comments

Comment:
Length of storage is estimated to be 6 to 10 years. In reality, there are no plans being considered for longterm storage. What is the basis for the 6 to 10 year estimate?

Document #: *1032* **Comment #:** *2* **Date:** *2/19/93*

Betty E. Barnard
Citizen comments

Comment:
The draft EA declares that the plutonium pits will be stored at Pantex for the next 6-10 years. There appears to be no basis for these figures. Where the pits will go after the ten year period was not discussed. Further, it does not provide assurance that pits will not be stored for more than ten years.

Document #: *1032* **Comment #:** *4* **Date:** *2/19/93*

Betty E. Barnard
Citizen comments

Comment:
The draft EA does not analyze the environmental effects of pit storage for more than ten years.

Document #: *1033* **Comment #:** *2* **Date:** *2/19/93*

Norbert Schlegal
Citizen Comments

Comment:
The draft EA declares that the plutonium pits will be stored at Pantex for the next 6 -10 years. There appears to be no basis for these figures. Where the pits will go after the ten year period was not discussed. Further, it does not provide assurance that pits will not be stored for more than ten years.

Document #: *1033* **Comment #:** *4* **Date:** *2/19/93*

Norbert Schlegal

Citizen Comments

Comment:

The draft EA does not analyze the environmental effects of pit storage for more than ten years.

Document #: *1034* **Comment #:** *2* **Date:** *2/19/93*

48 signatures/form letter

Citizen Comments

Comment:

The draft EA declares that the plutonium pits will be stored at Pantex for the next 6-10 years. There appears to be no basis for these figures. Where the pits will go after the ten year period was not discussed. Further, it does not provide assurance that pits will not be stored for more than ten years.

Document #: *1034* **Comment #:** *4* **Date:** *2/19/93*

48 signatures/form letter

Citizen Comments

Comment:

The draft EA does not analyze the environmental effects of pit storage for more than ten years.

Document #: *1035* **Comment #:** *2* **Date:** *2/19/93*

Karen Son

Citizen Comments

Comment:

The draft EA declares that the plutonium pits will be stored at Pantex for the next 6-10 years. There appears to be no basis for these figures. Where the pits will go after the ten year period was not discussed. Further, it does not provide assurance that pits will not be stored for more than ten years.

Document #: *1035* **Comment #:** *4* **Date:** *2/19/93*

Karen Son

Citizen Comments

Comment:

The draft EA does not analyze the environmental effects of pit storage for more than ten years.

Document #: *1036* **Comment #:** *2* **Date:** *3/1/93*

Arjun Makhijani, Ph.D.

Institute for Energy & Environmental Research

Comment:

II. Interim Storage Period - The EA claims that pit storage at Pantex will be for 6 to 10 years and that long-term storage or disposition options will be implemented after this. It provides no justification for the length of this interim storage period and no information on how it was calculated.

Document #: *1036* **Comment #:** *3* **Date:** *3/1/93*

Arjun Makhijani, Ph.D.

Institute for Energy & Environmental Research

Comment:

The EA states that long-term options will be decided as part of the Programmatic Environmental Impact Statement (PEIS) on the Reconfiguraion of the Weapons Complex. Since even a draft of this decision (which is supposed to take public comments on the draft into account), it is quite mysterious how the DOE arrived at the estimate that interim storage would be for a 6 to 10 year period. The EA should provide a clear and complete justification for this figure, including any assumptions about final disposition and the pace of final disposition measures assumed in estimating the interim storage period.

Document #: *1037* **Comment #:** *2* **Date:** *3/1/93*

Bishop Leroy T. Matthiesen
Diocese of Amarillo

Comment:
The draft EA declares that the plutonium pits will be stored at Pantex for the next 6-10 years. There appears to be no basis for these figures. Where the pits will go after the ten year period was not discussed. Further, it does not provide assurance that pits will not be stored for more than ten years.

Document #: *1037* **Comment #:** *4* **Date:** *3/1/93*

Bishop Leroy T. Matthiesen
Diocese of Amarillo

Comment:
The draft EA does not analyze the environmental effects of pit storage for more than ten years.

Document #: *1038* **Comment #:** *2* **Date:** *2/26/93*

Boyd M. Foster, President
Arrowhead Mills

Comment:
The draft EA declares that the plutonium pits will be stored at Pantex for the next 6 - 10 years. There appears to be no basis for these figures. Where the pits will go after the ten-year period was not discussed. Further, it does not provide assurance that pits will not be stored for more than ten years.

Document #: *1038* **Comment #:** *4* **Date:** *2/26/93*

Boyd M. Foster, President
Arrowhead Mills

Comment:
The draft EA does not analyze the environmental effects of pit storage for more than ten years.

Document #: *1039* **Comment #:** *1* **Date:** *3/10/93*

Tonya Kleuskens, Chairman
Texas Nuclear Waste Task Force

Comment:
We are presently very concerned about the Department of Energy's Environmental Assessment regarding the proposal to increase plutonium storage at the Pantex Plant near Amarillo, Texas.

The EA's basis is seriously flawed because it categorically presumes that plutonium storage at Pantex will be temporary, limited to ten years. This premise does not take into account the immense obstacles to siting an alternative storage facility.

Document #: *1039* **Comment #:** *2* **Date:** *3/10/93*

Tonya Kleuskens, Chairman
Texas Nuclear Waste Task Force

Comment:
Any realistic proposal for the storage of plutonium pits should take into consideration the uncertainty of storage time at any DOE or Department of Defense facility. Furthermore, if long-term storage should become a reality, additional buildings would likely be necessary, a possibility not addressed in the present EA. The cost, logistics and environmental impacts of these structures should be studied, accordingly.

Document #: *1039* **Comment #:** *4* **Date:** *3/10/93*

Tonya Kleuskens, Chairman
Texas Nuclear Waste Task Force

Comment:
Further complicating this issue are the political realities that other states have established opposition to storage and/or transportation of radioactive materials within their borders. This factor raises the importance of the EA's need to consider the likelihood of pit storage becoming long-term or permanent.

Document #: *1040* **Comment #:** *2* **Date:** *3/9/93*

Carl L. King, President

Texas Corn Growers Assn.

Comment:

One big problem is that the draft of the Environmental Assessment does not analyze the environmental effects of pit storage for more than ten years.

Document #: *1041* **Comment #:** *2* **Date:** *3/12/93*

Beverly Gattis

Military Production Network

Comment:

The success of announced arms control agreements is critical to our nation's future, and DOE's dismantlement program is vital to the success of these agreements. We believe it is possible to conduct the dismantlement program in a way that enhances public confidence in DOE and builds the foundation for many of the difficult, long-term decisions which must be made about disposition of retired warhead materials.

Unfortunately, the predecisional EA on plutonium storage at Pantex does not move us toward this positive future. Moreover, DOE's lack of a coherent policy for complying with the National Environmental Policy Act (NEPA) in regard to its dismantlement program causes us concern. Each of these areas is discussed below.

The Predecisional EA.

1) The storage period assumed in the proposed action is not supported by credible analysis. The predecisional EA states: "The proposed action is to provide additional storage for an interim time period, expected to within (sic) 6-10 years, for up to 20,000 pits and does not constitute a decision to store pits at the Pantex Plant for the long term." (p. vii) The only basis presented for this "interim" storage period is the time required to complete DOE's Reconfiguration Programmatic Environmental Impact Statement (R-PEIS) and additional site specific NEPA review and documentation. (pp. 2-1 & 3-1)

However, the schedule for completing the R-PEIS has slipped over the last year, and there is currently no publicly available schedule for even beginning site specific NEPA reviews to implement decisions reached in the R-PEIS.

Also, it is not clear from the R-PEIS Implementation Plan (IP) (DOE/EIS-0161IP, February 1992) that dismantlement is to be addressed in the manner the predecisional EA implies. Dismantlement activities were not widely considered during the R-PEIS scoping periods, and the R-PEIS IP contains few references to the subject.

The IP indicates little more than that the future DOE complex will "[m]aintain the capability to decommission the large number of weapons expected to be retired during stockpile downsizing or replacement," and that the R-PEIS will evaluate "impacts of managing wastes generated by...assembly/disassembly of nuclear weapons." (R-PEIS IP, pp. ES-8 & 2-3) In our review of the IP, it is not at all clear that the R-PEIS will in fact consider proposals for long-term storage or disposition of plutonium, as the predecisional EA states. (p. 2-1) If the final EA relies on the R-PEIS, then DOE must first supplement the IP with a detailed description of how issues related to dismantlement will be addressed.

Document #: *1041* **Comment #:** *3* **Date:** *3/12/93*

Beverly Gattis

Military Production Network

Comment:

Finally, history demonstrates that interim or temporary storage facilities for nuclear materials tend to become long-term storage sites. This is clearly illustrated by the experience at numerous DOE and commercial waste storage locations. This issue is not addressed in the predecisional EA. The final EA should clearly explain the steps DOE will take to ensure that Pantex does not become another de facto long-term storage facility.

Document #: *1042* **Comment #:** *4* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

3) The 6 to 10 year time frame is totally arbitrary and is an unreliable basis for any decision making. On July 6, 1992, then DOE Secretary Watkins wrote Attorney General Dan Morales that the draft PEIS would be available for public comment by the end of 1992. That schedule was not kept, nor does any reliable schedule for the PEIS exist. If issuance of the draft PEIS, which is totally in DOE's control, is so uncertain, then implementation of a PEIS ROD, which may be more controlled by the courts or Congress than DOE, cannot be relied upon at all.

In an EIS, DOE should fully discuss the useful lifetime of all existing and proposed storage facilities so that decisions about the length of time for storage would have some realistic basis, not DOE speculation.

Document #: *1042* **Comment #:** *8* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

2. An adequate NEPA document would fully discuss the long-term hazards of plutonium storage at Pantex.

The 6 to 10 year "interim storage" period is without support in the draft EA. Thus, an adequate EA would describe long-term hazards of plutonium storage in order to adequately inform the decision maker and the public of the necessity to develop alternative storage and disposal facilities.

The only basis that the draft EA states for that 6 to 10 year time frame is that within that time decisions could be implemented from the Reconfiguration PEIS Record of Decision (R-PEIS/ROD) (pp. 2-1 and 3-1). However, the R-PEIS Implementation Plan (DOE/EIS-01611P, February 1992), does not clearly state that any decisions related to long-term storage or disposition of plutonium will be made in the ROD. In fact, dismantlement is only briefly mentioned in the R-PEIS Implementation Plan (see pages ES-8, 2-3, and 3-9). Thus, if the final EA is going to rely on the R-PEIS, the latter document must be supplemented with a detailed description of how storage and disposal, as well as other dismantlement issues, will be addressed.

Moreover, the schedule for issuance of the R-PEIS itself is totaly unknown. Secretary Watkins's (sic) July 6, 1992 letter to Attorney General Morales stated that the draft R-PEIS would be available for public review by the end of 1992. Secretary Watkins did not meet that schedule, and to our knowledge Secretary O'Leary has not established any schedule for the R- PEIS.

Document #: *1042* **Comment #:** *9* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

Clearly, the draft EA cannot use the R-PEIS as the basis for any decisions to be made now. Instead, the EA must provide the basis for any time frame used for interim storage. In addition, the EA must fully discuss DOE's history of not meeting deadlines for "interim storage." For example, Idaho has been promised for years that transuranic wastes that were brought from Rocky Flats to the Idaho National Engineering Laboratory (INEL) were for "interim storage," supposedly no more than 10 years. However, some of those wastes have been at INEL for more than 20 years, and DOE still has no reliable schedule as to when, if ever, those wastes will go to a disposal facility.

As another example, DOE has stated for years its intention to have a permanent repository for spent fuel and high-level waste available by 1998. Even with congressional approval for work at Yucca Mountain, Nevada, DOE is more than a decade behind meeting that 1998 date.

Similarly, even if the R-Peis/ROD states a preference for having one long-term storage or disposal facility, there is no precedent for having such a facility available within a decade. At least one additional NEPA process would be required for such a facility and congressional authorization and appropriation would be necessary.

Document #: *1042* **Comment #:** *10* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

Issues that must be specifically discussed include:

a. Stability of plutonium pits during long-term storage, based on actual experience (if any) and realistic projections;

b. Deterioration of storage containers over 10 years or longer and the need to develop new storage containers that meet independent certification requirements;

Document #: *1042* **Comment #:** *31* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

Does the 6 to 10 year interim storage time frame start from 1989, from 1993, or what date?

Document #: *1042* **Comment #:** *32* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

Will pits stored longest be moved first once some other storage or disposal facility is available?

Document #: *1042* **Comment #:** *34* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

If 20,000 pits are stored at Pantex by 2003, how long would it take to ship that entire inventory to another location? What NEPA analysis or safety analysis has been done of the relative risk of continuous shipment off-site for 10 years versus accelerated shipment in higher volumes after the large inventory has been accumulated?

Document #: *1043* **Comment #:** *3* **Date:** *3/12/93*

Mavis Belisle, Director

the Peace Farm

Comment:

Because of the irreplaceable value of the Ogallalah (sic) Aquifer and the agricultural productivity of the area, Pantex should not be considered as a site for longterm storage of the pits, final disposition, or any plutonium processing activities. The burden of proof for any of these activities should be on DOE to assure that this is the most suitable alternative in terms of environmental safety and security, and that in event of a catastrophe, this is the site for which consequences would be least.

Document #: *1043* **Comment #:** *7* **Date:** *3/12/93*

Mavis Belisle, Director

the Peace Farm

Comment:

At the same time, the State should urge that the long-delayed Programmatic Environmental Impact Statement should be reopened to include dismantling and storage on the scale at which it now occuring (sic), or an additional system-wide EIS should be initiated to cover effects of dismantling activities throughout the complex and options for final disposition of plutonium, tritium and highly enriched uranium.

Document #: *1046* **Comment #:** *6* **Date:** *3/22/93*

Dan Morales, Attorney General

State of Texas, Office of the Attorney General

Comment:

IV. Closing Comments

DOE provides no basis for the estimated interim storage time frame of 6-10 years. Given that DOE does not yet have a proposal for long-term plutonium disposition, the statement in the EA that the time required to implement decisions regarding long-term storage and/or disposition is expected to be within a 6-10 years time frame is not credible. I am concerned that the analysis of potential environmental impacts has been premised on an interim storage period that is unrealistic. If anything can be learned from DOE's civilian high-level waste site experience and the attempts by the states to locate low-level radioactive waste sites, it is that nuclear waste storage issues are very difficult to resolve and take far longer to resolve than first anticipated.

Many of the concerns raised in this letter are addressed in detail in the comments submitted to you by the Texas Air Control Board, the Bureau of Economic Geology, and the Texas Department of Health's Bureau of Radiation Control. Comments by other state agencies, individuals, and citizen groups identify other areas of concern in the draft EA. I am hopeful that the DOE will respond to each of these comments, especially those of the above-mentioned state agencies.

When DOE first proposed increased interim storage of plutonium pits at Pantex, I requested that your predecessor direct DOE to prepare an EIS that would address the impacts of the increased dismantlement and storage activities at Pantex. I respectfully repeat this request now. It is apparent from the draft EA that DOE will not run out of storage capacity at the Pantex plant until the fourth quarter of 1993, at the earliest. DOE has sufficient time to complete an EIS that will adequately address the potentially devastating environmental impacts that could result from the proposed increased interim storage.

The preparation of an EIS by DOE would demonstrate DOE's commitment under your guidance to fully protecting the health, safety, and environment of this state and its citizens and would mark an historic new direction for DOE towards full and legitimizing public participation and open decision making. I welcome your suggestions as to how we might encourage and support your efforts in the future.

Document #: *1048* **Comment #:** *6* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

(2-1, 4-2, 4-3) "...long term storage or disposition of these valuable national assets will be made in the...PEIS" - why is this EA being done outside the PEIS/ROD?

Document #: *1048* **Comment #:** *20* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

"The proposed action is to provide additional storage for an interim time period, expected to within 6 - 10 years, for up to 20,000 pits....at the Pantex Plant" What will happen in 10 years - 15 years - 20 years, etc.? Where is the plutonium going at the end of 10 years - we want to know! This is not identified in the EA. Where or what is being planned for this plutonium after 20 years.

Response #: A.1

The proposed action analyzed in this document has evolved as a result of recent developments in the areas of national security and foreign policy. As originally envisioned, the proposed action was to provide additional storage for up to 20,000 pits at Pantex for a period of approximately six to ten years. The anticipated duration of the interim storage was based on the December 1994 expected completion of the Department's Reconfiguration Programmatic EIS, allowing sufficient time to implement the decision regarding the future nuclear weapons complex that would be made on the basis of that Programmatic Environmental Impact Statement. It was expected that one of the elements of the future weapons complex would be a new long-term storage facility, to be constructed within the six to ten year time frame.

The President, on September 27, 1993 established an interagency task force to determine the disposition of plutonium surplus to national defense requirements. This task force is being led by the National Security Council and the Office of Science and Technology Policy with the participation of the Arms Control and Disarmament Agency, the Central Intelligence Agency, the Office of Management and Budget, and the Departments of State, Defense and Energy. The public and certain foreign nations will also be invited to participate in the task force. The results and implementation of its recommendations are likely to have significant impact on both the number of pits requiring long-term storage, and the duration of any storage period. It is likely that a substantial majority of the pits proposed to be stored at Pantex, which are surplus to the nation's defense needs, will be affected by decisions resulting from the work of the task force. Because the task force was so recently chartered, however, it is impossible to now predict the timing of its recommendations or their implementation.

In addition to its participation in this task force, the Department is conducting or will shortly commence the following National Environmental Policy Act reviews which also will address the storage of plutonium:

First, as noted above, the Reconfiguration Programmatic Environmental Impact Statement is examining the alternatives for the long-term storage of all Department of Energy owned plutonium. The alternatives being considered for long-term storage include "no-action," which, if selected in the Record of Decision on that Environmental Impact Statement, could continue the storage of the pits at Pantex in the existing facilities. Another alternative being considered is to upgrade the existing facilities. If this alternative is selected in the Record of Decision, upgrades to the existing storage facilities, including Pantex, could occur following a likely additional project specific review under the National Environmental Policy Act. The final alternative under consideration is the siting and construction of a new long-term storage facility which, if selected in the Record of Decision, would result in the pits stored at Pantex being moved to that facility, at a location to be decided. The Record of Decision is expected to be issued in January, 1995. It should be noted that the Pantex site is among five sites under consideration for the location of a new long-term storage facility.

Second, the Department is commencing the preparation of a new site-wide Environmental Impact Statement for the Pantex site. This Environmental Impact Statement will examine all aspects of current and foreseeable activities and operations of the Pantex Plant, including all dismantlement and storage-related issues. This Environmental Impact Statement will include analysis of measures to further mitigate the impacts of Pantex operations. While the scope of the Environmental Impact Statement cannot be defined precisely until the public scoping process has been completed, the Department of Energy expects that alternatives to the continued storage of pits at Pantex will be considered. This review will take several years to complete. The public will be invited to help both scope the appropriate review and review the draft Environmental Impact Statement when completed.

Third, the Department is committed to include in an Environmental Impact Statement any implementation actions it proposes to take in conjunction with the task force on the disposition of surplus plutonium. This will help ensure meaningful public involvement in the examination of alternative means of disposition.

The resolution of all these uncertainties and the preparation of these documents will require time, making it less likely to site and construct a new long-term storage facility on the schedule previously indicated and which would have led to storage relief at Pantex in six to ten years. Because of the national security and foreign policy considerations previously described, which highlights the importance of the continued disassembly of nuclear weapons and the consequent interim storage of the fissile material they contain, the Department cannot wait for these longer-term programmatic decisions. If the proposed action is not adopted, shipment of nuclear weapons to Pantex for dismantlement will cease in the first quarter of 1994 and actual dismantlement will cease within weeks of the cessation of shipments.

Accordingly, the Department is proposing to provide interim storage for up to 20,000 pits in the Pantex facility on an interim basis until the longer-term decisions on storage/disposition are made and implemented. The Department is now contemplating that the new site-wide Environmental Impact Statement for the Pantex site will consider the environmental impacts associated with continued operation of the Pantex Facility, including storage, for a period of 5-10 years from the completion of the Environmental Impact Statement. The long-term decisions regarding the storage/disposition of plutonium will be made following the completion of the Reconfiguration Programmatic Environmental Impact Statement now scheduled for late 1994, and the work of the task force on plutonium disposition. These decisions will be made on the basis of the various activities and analyses described above. The Environmental Assessment has been revised to include the above discussion.

Also, several comments noted that the initial scope of the Programmatic Environmental Impact Statement did not include consideration of the long-term storage of plutonium weapon components. These comments are addressed below.

Long-term plutonium pit storage was not a contemplated requirement at the time the Department published the Nuclear Weapons Complex Reconfiguration Study (DOE/DP-0083, January 1991). At that time, the Department's nuclear weapons complex was required to support a nuclear weapons stockpile that was projected to be very large. This being the case, it was expected that nuclear materials would be recycled without the need for long-term storage capacity. Consequently, initial planning for the Reconfiguration Programmatic Environmental Impact Statement did not consider analysis of the environmental impacts associated with a long-term plutonium storage facility. Neither the "Notice of Intent" (56 Federal Register 5590, February 11, 1991) announcing the preparation of the Programmatic Environmental Impact Statement nor the Implementation Plan, Nuclear Weapons Complex Reconfiguration Programmatic Environmental Impact Statement (DOE/EIS-0161IP, February 1992) dealt specifically with the need for such future long-term storage.

However, subsequent events dictated that the complex of the future (Complex 21) must contain a facility for long-term storage of plutonium. In September 1991, former President George Bush announced the first of three arms reduction initiatives that had a significant effect on both present Pantex Plant operations and the planning for Complex 21. The September 27, 1991 announcement, together with the initiative announced in the January 28, 1992, State of the Union address and the June 16, 1992, Bush/Yeltsin agreement (later codified in the Strategic Arms Reduction Treaty II) resulted in large reductions in the nation's nuclear weapons stockpile. These reductions resulted in the retirement of weapons in the stockpile in much larger numbers and in a much more compressed timeframe than had been previously contemplated. In addition, the Department was faced with a situation where presently authorized capacity of storage facilities at the Pantex Plant would be exhausted long before the announced weapons retirements were completed and before the Programmatic Environmental Impact Statement could be completed and reconfiguration decisions made with regard to long-term storage. Thus, to continue the dismantlement of weapons resulting from the three recent arms reduction initiatives, the additional interim storage capacity would be required regardless of any decisions that are subsequently made concerning reconfiguration.

Since it has already been determined that Complex 21 must include an alternative for long-term plutonium storage capacity, the environmental impacts of locating such a facility at one of several alternative sites must be included in the Programmatic Environmental Impact Statement. Conceptual design efforts have already begun for long-term storage capacity. A Revised Notice of Intent that includes these changes to the original reconfiguration proposal as well as other potential modifications to that proposal was published in the Federal Register on July 23, 1993 (58 Federal Register 39528). The Department has held additional scoping hearings to assure opportunity for input and comments, and the Department will revise the Programmatic Environmental Impact Statement Implementation Plan to include any changes.

Following completion of the Final Programmatic Environmental Impact Statement, it is expected that a Record of Decision can be issued by early 1995. The Pantex Plant is one of the sites being considered for location of nuclear facilities in the reconfigured complex, including long-term plutonium storage. The Record of Decision will be followed by a Site-Specific Environmental Impact Statement which will examine the environmental impacts of construction and operation of the facility at the location selected. This environmental analysis will include, among other things, evaluations of the impacts of transportation of plutonium from sites where it is now stored to potential long-term storage locations, as well as the risks of long-term storage of pits and other forms of plutonium. Affected States, Indian Tribes, and the general public will continue to have opportunities to review and comment the planning for and analyses contained in both the Programmatic Environmental Impact Statement and later Site-Specific Environmental Impact Statement. The Secretary of Energy's decisions regarding reconfiguration will be based on a combination of environmental impact, cost, and analysis of alternatives.

Several comments questioned when the Department would complete moving plutonium pits stored at the Pantex Plant as a result of the proposed action. Timing for completion of the movement will depend on where the long-term storage function is performed, the rate at which materials can be moved safely, and the priorities established for moving various types of nuclear material.

Some comments questioned what would occur if a long-term storage facility is not available at the end of the interim storage period. The Department will do all within its control to expedite timely completion of the Programmatic Environmental Impact Statement, Record of Decision, and site-specific National Environmental Policy Act reviews. The nature of the National Environmental Policy Act process, as well as possible changes in national policy or funding availability, prevents the Department from guaranteeing against unexpected delays. The Department is committed to working closely with the State of Texas and the public to resolve issues that arise during the interim storage period and during the transfer of the plutonium components to permanent storage.

A few comments expressed concern that if the interim storage period was incorrectly estimated, the conclusions of the Environmental Assessment might also be incorrect. Section 6.0 of the Environmental Assessment evaluates the potential environmental effects of using certain Steel Arch Construction and Modified-Richmond magazines to provide interim storage capability for plutonium weapons components. The conclusions of the Environmental Assessment are not dependent on the length of the interim storage period, but rather the environmental effects from routine storage, as well as potential accidents.

Increases in worker radiation exposures due to on-site interim storage operational activities were evaluated on an annual basis, and worker exposure is controlled since personnel would be monitored to ensure administratively controlled annual limits on exposure are met . The assessment found that routine storage will require no new construction and will cause no off-site radiological emissions, no surface or ground water effluent, and only minor air emissions in the form of vehicle emissions and fugitive dust from vehicle movements. Container integrity during the interim storage period will be ensured by a surveillance program that would detect any change in the integrity of the container or packaging materials. Deterioration is expected to occur very infrequently since, especially after the horizontal storage configuration is implemented, container exposure to moisture that might cause corrosion will be minimal. Pit stability during the interim storage period will be monitored by conducting pit surveillance testing in conjunction with the surveillance program. Similarly, the length of the storage period does not influence the conclusion of the Environmental Assessment that no significant impacts would occur as a result of credible accident sequences including explosions, forklift operational accidents, earthquakes, tornadoes, and aircraft crashes. The analysis of these accidents was based on the annual probability of occurrence of each accident in combination with other time-independent factors. Accidents with sufficiently low annual probability are categorized as to their likelihood to occur during the lifetime of a facility. The duration of 6 to 10 years did not enter into this determination.

ENVIRONMENTAL ASSESSMENT TEXT CHANGE

Section 2.0 was changed to reflect the comments.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (B.1) FOLLOWS ON PAGE B-11.

Document #: *1016* **Comment #:** *2* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

I have reviewed the Environmental Assessment For Interum (sic) Storage of Plutonium Components at Pantex and found that its inadequancy to be typical of the "Pantex attitude". The plan does not adequately address the health and safety of either the workers or the peoples living near the plant. The plan contains much false information and lack of accurate information to conclude the storage of plutonium in any amount to be safe.

Document #: *1016* **Comment #:** *10* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

Doe (sic) must do a full EIS.

Document #: *1016* **Comment #:** *25* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

We believe the United States Department of Energy must proceed to initiate an environmental impact statement (EIS) on the issue of plutonium storage and management at Pantex and throughout the DOE and DOD complexes. The questions raised because of the inadequacy and inaccracies (sic) of the draft must be answered prior to the storage for even the six to ten years proposed. We must be certain, without a doubt, that the interim storage of plutonium at Pantex is completely safe for the workers at the plant, the peoples living nearby and in the area of the plant, and for the Ogallala Aquifer and perched water zones. The highly productive agricultural lands and livestock must be safe also.

Document #: *1017* **Comment #:** *20* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

I would like to call for an Environmental Impact Statement.

Document #: *1019* **Comment #:** *1* **Date:** *1/20/93*

W. H. O'Brien

Operation Commonsense

Comment:

This environmental assessment sets forth operations more properly designated as a new mission, from holding plutonium in inventory for current use, to holding it in storage with no planned use. I believe this is a very important distinction, and might well require additional disclosure and public comment.

Our concerns are solely with the impact of your plans on Amarillo and the surrounding area. It is obvious from the assessment that this new mission has not been previously tested and that the storage plans set forth involve varying degrees of risk and uncertainty.

Document #: *1022* **Comment #:** *1* **Date:** *2/11/93*

James Thomas

Hanford Education Action League (HEAL)

Comment:

The Department of Energy should have prepared an Environmental Impact Statement (EIS) instead of the EA. The proposed action constitutes a change in mission for the Pantex facility (i.e. interim storage) and, as such, constitutes a major federal action which requires an EIS under the National Environmental Policy Act (NEPA). ....

In conclusion, DOE should prepare an EIS to provide for a more thorough examination of all alternatives, more extensive public participation, and sufficient time for citizens to prepare comments and the Department to review nuclear safety at Pantex (DNFSB recommendation 93-1). Such a delay for EIS preparation need not prevent the United States from continuing to withdraw nuclear weapons from active deployment as set forth in recent agreements and initiatives. The delay would also provide time for public review of the dismantlement study now underway by the Office of Technology Assessment.

Document #: *1026* **Comment #:** *1* **Date:** *2/19/93*

Tamara Snodgrass

Citizen Comments

Comment:

As a responsible citizen committed to preserving the quality of life for all future generations I am gravely concerned about the Environmental Assessment prepared by the United States Department of Energy regarding the proposal to increase the storage of plutonium at the Pantex Nuclear Weapons Plant near Amarillo, Texas.

Because I believe that the quality of a Democracy depends on the participation of informed citizens, it is my opinion that this Environmental Assessment (EA) does not adequately address the full range of the issue.

Since historically plutonium pits have been refabricated and reused, the proposal to store the pits for any period of time is a significant new action that should be analyzed in its own right, and all reasonable alternatives and environmental impacts should be considered now.

Document #: *1026* **Comment #:** *8* **Date:** *2/19/93*

Tamara Snodgrass

Citizen Comments

Comment:

Rather than issuing a final environmental assessment and a Finding of No Significant Impact (FONSI), the Department of Energy should proceed to initiating an environmental impact statement (EIS) on the issue of plutonium management at Pantex.

Document #: *1030* **Comment #:** *2* **Date:** *3/2/93*

Judy Osborne

Citizen Comments

Comment:

We request a full environmental Impact statement (EIS) with the possibility of a large tornado be done on the issue of plutonium storage at the Pantex plant.

Document #: *1031* **Comment #:** *6* **Date:** *3/1/93*

Louise Daniel

Citizen Comments

Comment:

Therefore, I request that the Department of Energy prepare an environmental impact statement on the issue of plutonium management in the United States and that full public hearings be held. This EIS should consider the problem as a whole, not as an isolated operation at Pantex, and include the safety of workers, long term storage methods and facilities, transportation, the eventual uses and/or disposal of plutonium and other chemical and nuclear materials. There should be thorough long range planning and a carefully considered, integrated, nationwide policy on this extremely critical issue.

Document #: *1032* **Comment #:** *1* **Date:** *2/19/93*

Betty E. Barnard

Citizen comments

Comment:

As a responsible citizen committed to preserving the quality of life for all future generations I am gravely concerned about the Environmental Assessment prepared by the United States Department of Energy regarding the proposal to increase the storage of plutonium at the Pantex Nuclear Weapons Plant near Amarillo, Texas.

Because I believe that the quality of a Democracy depends on the participation of informed citizens, it is my opinion that this Environmental Assessment (EA) does not adequately address the full range of the issue.

Since historically plutonium pits have been refabricated and reused, the proposal to store the pits for any period of time is a significant new action that should be analyzed in its own right, and all reasonable alternatives and environmental impacts should be considered now.

Document #: *1032* **Comment #:** *8* **Date:** *2/19/93*

Betty E. Barnard

Citizen comments

Comment:

Rather than issuing a final environmental assessment and a Finding of No Significant Impact (FONSI), the Department of Energy should proceed to initiating an environmental impact statement (EIS) on the issue of plutonium management at Pantex.

Document #: *1033* **Comment #:** *1* **Date:** *2/19/93*

Norbert Schlegal

Citizen Comments

Comment:

As a responsible citizen committed to preserving the quality of life for all future generations I am gravely concerned about the Environmental Assessment prepared by the United States Department of Energy regarding the proposal to increase the storage of plutonium at the Pantex Nuclear Weapons Plant near Amarillo, Texas.

Because I believe that the quality of a Democracy depends on the participation of informed citizens, it is my opinion that this Environmental Assessment (EA) does not adequately address the full range of the issue.

Since historically plutonium pits have been refabricated and reused, the proposal to store the pits for any period of time is a significant new action that should be analyzed in its own right, and all reasonable alternatives and environmental impacts should be considered now.

Document #: *1033* **Comment #:** *8* **Date:** *2/19/93*

Norbert Schlegal

Citizen Comments

Comment:

Rather than issuing a final environmental assessment and a Finding of No Significant Impact (FONSI), the Department of Energy should proceed to initiating an environmental impact statement (EIS) on the issue of plutonium management at Pantex.

Document #: *1034* **Comment #:** *1* **Date:** *2/19/93*

48 signatures/form letter

Citizen Comments

Comment:

As a responsible citizen committed to preserving the quality of life for all future generations I am gravely concerned about the Environmental Assessment prepared by the United States Department of Energy regarding the proposal to increase the storage of plutonium at the Pantex Nuclear Weapons Plant near Amarillo, Texas.

Because I believe that the quality of a Democracy depends on the participation of informed citizens, it is my opinion that this Environmental Assessment (EA) does not adequately address the full range of the issue.

Since historically plutonium pits have been refabricated and reused, the proposal to store the pits for any period of time is a significant new action that should be analyzed in its own right, and all reasonable alternatives and environmental impacts should be considered now.

Document #: *1034* **Comment #:** *8* **Date:** *2/19/93*

48 signatures/form letter

Citizen Comments

Comment:

Rather than issuing a final environmental assessment and a Finding of No Significant Impact (FONSI), the Department of Energy should proceed to initiating an environmental impact statement (EIS) on the issue of plutonium management at Pantex.

Document #: *1035* **Comment #:** *1* **Date:** *2/19/93*

Karen Son

Citizen Comments

Comment:

As a responsible citizen committed to preserving the quality of life for all future generations I am gravely concerned about the Environmental Assessment prepared by the United States Department of Energy regarding the proposal to increase the storage of plutonium at the Pantex Nuclear Weapons Plant near Amarillo, Texas.

Because I believe that the quality of a Democracy depends on the participation of informed citizens, it is my opinion that this Environmental Assessment (EA) does not adequately address the full range of the issue.

Since historically plutonium pits have been refabricated and reused, the proposal to store the pits for any period of time is a significant new action that should be analyzed in its own right, and all reasonable alternatives and environmental impacts should be considered now.

Document #: *1035* **Comment #:** *8* **Date:** *2/19/93*

Karen Son

Citizen Comments

Comment:

Rather than issuing a final environmental assessment and a Finding of No Significant Impact (FONSI), the Department of Energy should proceed to initiating an environmental impact statement (EIS) on the issue of plutonium management at Pantex.

Document #: *1037* **Comment #:** *1* **Date:** *3/1/93*

Bishop Leroy T. Matthiesen

Diocese of Amarillo

Comment:

I am gravely concerned about the Environmental Assessment prepared by the United States Department of Energy regarding the proposal to increase the storage of plutonium at the Pantex Nuclear Weapons Plant near Amarillo, Texas.

It is my opinion that this Environmental Assessment (EA) does not adequately address the full range of the issue.

The proposal to store the pits for any period of time is a significant new action that should be analyzed in its own right, and all reasonable alternatives and environmental impacts should be considered now.

Document #: *1037* **Comment #:** *8* **Date:** *3/1/93*

Bishop Leroy T. Matthiesen

Diocese of Amarillo

Comment:

Rather than issuing a final environmental assessment and a Finding of No Significant Impact (FONSI), the Department of Energy should proceed to initiating and (sic) environmental impact statement (EIS) on the issue of plutonium management at Pantex.

Document #: *1038* **Comment #:** *1* **Date:** *2/26/93*

Boyd M. Foster, President
Arrowhead Mills

Comment:

As a responsible citizen committed to preserving the quality of life for all future generations, I am gravely concerned abou(sic) the Environmental Assessment prepared by the United States Department of Energy regarding the proposal to increase the storage of plutonium at the Pantex Nuclear Weapons Plant near Amarillo, Texas.

Because I believe that the quality of a Democracy depends on the participation of informed citizens, it is my opinion that this Environmental Assessment (EA) does not adequately address the full range of the issue.

Since historically plutonium pits have been refabricated and reused, the proposal to store the pits for any period of time is a significant new action that should be analyzed in its own right, and all reasonable alternatives and environmental impacts should be considered now.

Document #: *1038* **Comment #:** *8* **Date:** *2/26/93*

Boyd M. Foster, President
Arrowhead Mills

Comment:

Rather than issuing a final environmental assessment and a Finding of No Signficant Impact (FONSI), the Department of Energy should proceed to initiating an environmental impact statement (EIS) on the issue of plutonium management at Pantex.

Document #: *1039* **Comment #:** *7* **Date:** *3/10/93*

Tonya Kleuskens, Chairman
Texas Nuclear Waste Task Force

Comment:

We are deeply concerned at DOE's Finding of No Significant Impact (FONSI), considering the critical nature of this proposal. Rather than issuing a final environmental assessment, the Department of Energy should proceed to initiating an Environmental Impact Statement (EIS) on the issue of plutonium management at Pantex.

Document #: *1040* **Comment #:** *1* **Date:** *3/9/93*

Carl L. King, President
Texas Corn Growers Assn.

Comment:

As President of the Texas Corn Growers Association and Executive Director of the Texas Corn Producers Board, I am writing about our concerns about the Environmental Assessment prepared by the United States Department of Energy regarding the proposal to increase the storage of plutonium at the Pantex Nuclear Weapons Plant near Amarillo, Texas.

We do not feel that the Environmental Assessment adequately addresses these issues that are created at this site. I have been associated with the Department of Energy for several years now and I certainly do not trust their analysis and statement on what is actually going on at this location. We feel that reasonable alternatives of environmental impact should be considered now.

Document #: *1041* **Comment #:** *8* **Date:** *3/12/93*

Beverly Gattis

Military Production Network

Comment:

Dismantlement and NEPA. - In addition to our concerns about the predecisional EA itself, we are troubled by DOE's overall approach to NEPA compliance in regard to its dismantlement program. As described above, there are discrepancies between the way the treatment of dismantlement is described in the R-PEIS Implementation Plan and the predecisional EA.

DOE needs to clarify how dismantlement and related efforts will be addressed in the R-PEIS, as well as in the Environmental Restoration and Waste Management PEIS. If DOE's goal is -- as the predecisional EA implies -- to use the PEIS process as the mechanism for evaluating long-term storage and disposition of plutonium from retired warheads, then an additional scoping period for the PEIS's may be necessary. Also, DOE should ensure that the PEIS process allows a fair evaluation of whether to treat surplus plutonium as a waste or an asset, and full consideration of all other long-term issues associated with dismantlement.

For the short-term, DOE appears to be pursuing NEPA compliance through separate reviews of related activities. The predecisional EA on plutonium component storage at Pantex is an example of this. Related activities include increased shipments of warheads to Pantex, disposition of high explosives and other non-nuclear materials from retired warheads, shipment to and expanded storage of highly-enriched uranium at Oak Ridge, shipment to and storage of radioisotope thermoelectric generators at LANL, and expanded shipment to and processing of tritium reservoirs at SRS.

All activities which support DOE's dismantlement program should be evaluated in a single NEPA document. This approach would facilitate a consistent and thorough review of the many activities, public understanding of and involvement in the decision making process, and full compliance with NEPA.

Dismantling as many as 20,000 warheads -- and transporting, storing, and disposing of the resulting materials -- is a major federal action significantly affecting the quality of the human environment within the meaning of NEPA. Therefore, we believe an Environmental Impact Statement (EIS) is the appropriate level of NEPA review. Such an EIS should be conducted with ample opportunity for public participation in the scoping process and review of a draft EIS before a final decision is made. If DOE does not agree that an EIS is called for at this time, then we ask that the Department immediately begin preparation of an EA on its dismantlement program and that that EA be circulated for public comment in order that the Department's position be subject to public review and comment.

Document #: *1042* **Comment #:** *1* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

STAR calls for full public disclosure of all information necessary for sound decision making regarding the past, present and future operations of the Pantex facility, and for substantive public participation in those decisions.

In summary, we find major legal and substantive deficiencies in the Predecisional Environmental Assessment (hereafter "draft EA"). The draft EA is insufficient and cannot be used as the basis for a Finding of No Signficant Impact (FONSI), which is clearly DOE's plan.

Document #: *1042* **Comment #:** *2* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

We believe that DOE's proposal addresses only a small portion of the new but fundamental reality driving the changes at Pantex. The unparalleled situation of dismantlement of up to 20,000 warheads, and the immediate need to begin accommodating the work load and variety of materials which that generates, is the essential change affecting Pantex and other nuclear weapons complex sites. This constitutes a major federal action significantly affecting the quality of the human environment and requires issuance of an environmental impact statement (EIS).

Such an EIS should be issued in draft form for extended public comment. The draft should include all reasonable alternatives to the proposed actions as well as realistic analysis of environmental effects, as required by NEPA, before a final EIS is issued. DOE should complete that process, including issuing a Record of Decision (ROD), before proceeding even with the action presented in the draft EA.

Major Comments:

1. We strongly object to DOE's misuse of the National Environmental Policy Act (NEPA). We believe that DOE's proposal to dismantle 20,000 warheads, store plutonium pits at Pantex, and ship highly enriched uranium (HEU) and tritium to other DOE facilities Is a major federal action significantly affecting the quality of the human environment that requires issuance of an environmental impact statement (EIS) which comprehensively discusses the entire proposal and all reasonable alternatives.

Document #: *1042* **Comment #:** *3* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

A. DOE's proposed action is so narrowly defined that it constitutes illegal segmentation, contrary to the requirements of NEPA [See, for example, Sierra Club v. Callaway, 499 F.2d 982 (5th Cir. 1974), Taxpayers Watchdog, Inc. v. Stanley, 819 F.2d 294 (D.C.Cir. 1987)].

The draft EA says the proposed action is "to provide for the interim storage of up to 20,000 pits, pending the implementation of the ROD on the Nuclear Weapons Complex Reconfiguration PEIS. This is expected to be completed within a time frame of 6-10 years" (p. 3-1).

There are several problems with that description:

1) The total scope of the proposed action is not included. The 20,000 pits come from an unprecedented dismantlement of warheads which inevitably will yield significantly increased quantities of many materials. This unprecedented dismantlement has not been subjected to NEPA analysis. There has been no NEPA analysis of what to do with any of the resulting materials -- not only plutonium pits, but also HEU, tritium, high explosives and non-nuclear components.

2) Even within the limits of DOE's proposal as currently stated, the positive and negative aspects of plutonium pit storage in one location or multiple locations should be discussed. Total existing storage capabilities at all facilities should be described.

However, the fundamental assumption underlying the proposed action is to do all dismantlement and interim storage at Pantex. Therefore, the dismantlement capabilities of other DOE facilities should be discussed in the EIS.

Document #: *1042* **Comment #:** *27* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

2. ES-vii. The first sentence states that the primary mission of Pantex is assembly and disassembly of weapons. Why is plutonium storage not considered to be a new mission, requiring an EIS?

Document #: *1043* **Comment #:** *6* **Date:** *3/12/93*

Mavis Belisle, Director

the Peace Farm

Comment:

The Peace Farm believes that the State of Texas should not accept a Finding of No Significant Impact on the basis of the EA, and should require a full Environmental Impact Statement that covers the entire range of dismantling and interim storage activities at Pantex.

Document #: *1045* **Comment #:** *1* **Date:** *3/22/93*

Beverly Gattis

Serious Texans Against Nuclear Dumping (STAND)

Comment:

STAND is committed to full public participation in the decision-making processes involving the Department of Energy's (DOE) nuclear weapons complex (hereafter "complex"). It also believes that sound public policy can be achieved only when that public participation is substantive and based on full access to all relevant information. The only exceptions to full disclosure should be limited to information which poses legitimate national security concerns, such as protection of weapons design data.

STAND finds there are major legal and substantive deficiencies in the draft EA. The draft EA is insufficient to support a Finding of No Significant Impact because the information presented is inadequate. We believe the draft EA fails, as well, in its approach to the basic issues and NEPA processes involved.

Most importantly, we find the scope of the draft EA to be so narrowly defined that it cannot responsibly address the issues affecting Pantex. The proposed dismantlement of up to 20,000 warheads, and the immediate need for the complex to accommodate both the work and variety of materials generated, is the fundamental situation driving the changes involving Pantex and other sites.

Additionally, the proposed dismantlement is already underway. It is proceeding without the benefit of any integrated evaluation of the demands of the work or facilities needed for the interim disposition of the variety and quantities of materials inevitably produced.

The unprecedented dismantlement of up to 20,000 nuclear warheads, and its inevitable ramifications, constitutes a major federal action significantly affecting the quality of the human environment and requires issuance of an environmental impact statement (EIS).

Document #: *1045* **Comment #:** *2* **Date:** *3/22/93*

Beverly Gattis

Serious Texans Against Nuclear Dumping (STAND)

Comment:

Major Comments

1) The scope of the draft EA must fully respond both to the nature of current dismantlement work affecting Pantex and to interim disposition not only of plutonium pits but of all other materials which inevitably will result. Significant circumstances which must be taken into account are:

a) Both the number of warheads to be dismantled and the pace scheduled for dismantlement is unprecedented.

b) There is no current defense program need for the pits. Long-term future need is anticipated to be small, conceivably even zero. What used to be a closed-loop cycle of plutonium reprocessing and re-use no longer exists.

c) There is a breakdown of the historic pattern of materials flow within the complex. The facility which used to receive and reprocess/recycle the plutonium pits from Pantex, the Rocky Flats Plant, is closed; no other such facility currently exists in the complex.

In the past (as recently as 1991) Pantex officials stated uncategorically that pits were "staged," not stored, at Pantex. Though citizens always assume staging is an extremely flexible proposition convenient to DOE, it is, even by the definition in the draft EA, inherently different from storage.

"Staging is the temporary holding of materials (weapons or components) as they await the next step in their process flow (i.e. disassembly or transport off-site). There is no set time limit for staging since movement of materials (for transport, disassembly, etc.) is dependent on scheduling, upstream process flow stream conditions, resource availability, etc." (p. 1-1)

With no interim "upstream process flow" available, years of storage will be required. This is a fundamental change in work and mission for Pantex.

e). Though the draft EA focuses on plutonium pits, the unprecedented dismantlement yields a variety of other materials which must be temporarily staged or stored in areas able to provide proper security.

Existing storage space qualified to provide proper safeguards and security is limited. These materials require such space not only at Pantex, but compete for the limited space available in other parts of the complex.

Pantex itself must accommodate at least: 1) special nuclear material (SNM) such as highly enriched uranium (HEU), or other closely held material such as tritium, 2) warheads awaiting dismantlement, 3) other weapons components, 4) mixed waste containing SNM or closely held material, 5) warheads needing maintenance/evaluation.

The draft EA does not adequately discuss the space neeeded(sic) to accommodate these materials.

For the complex in general, the draft EA states, "The complex has limited storage capacity, and each site's capability to store material (pits and SNM in various other forms) must be maximized...." The draft EA continues by referring to "many ongoing programs" to assess current storage, and explains that other residues, wastes and material "vie for the existing or potential storage capacity...." (p. 4-4) The explanations are clearly intended to create a sense of inevitability and necessity for acceptance of the draft EA's proposed action of intensified pit storage at Pantex.

However, the explanation just as clearly establishes that there is an urgent need for integrated evaluation of the demands on the complex. The effect of adding materials from dismantlement to already existing materials is straining the storage facilities needed to house them.

Document #: *1046* **Comment #:** *1* **Date:** *3/22/93*

Dan Morales, Attorney General

State of Texas, Office of the Attorney General

Comment:

The Office of the Attorney General ("OAG") has reviewed the draft environmental assessment ("EA") for the "interim" storage of plutonium components at the Pantex plant. We appreciate the opportunity to review the draft EA and look forward to working with the Department of Energy ("DOE") to ensure that the operation of the Pantex plant does not threaten the health and safety of its workers and neighbors and the natural resources of the Panhandle area.

I strongly believe, however, that the draft EA is deficient and that until an environmental impact statement ("EIS") is completed, DOE will not be in compliance with the National Environmental Policy Act of 1969 ("NEPA"). The EIS process would ensure the full input of the public and ensure that DOE would take a "hard look" at the environmental and socio-economic consequences of its proposed activities, consider viable alternatives to the method currently chosen by DOE, and ensure that the adverse environmental and socio-economic consequences of its action are minimized.

I have been deeply concerned about the activities at Pantex since I first came into office in 1991. [footnote 1 (For your convenience, I have enclosed copies of all of the correspondence I sent to your predecessor, Secretary Watkins. See Attachment A.)] While I remain proud of the work done by the workers at Pantex, I also remain profoundly concerned that generations of Texans will be forced to live with a decision regarding the storage of thousands of pounds of plutonium made behind closed doors.

As you know, DOE has operated in the past pursuant to a policy of "decide, announce, defend." I believe that addressing this legacy is one of your greatest challenges. Your office, reflecting the new direction of a new administration, has an historic opportunity to break with the past 12 years and to ensure that DOE does not continue with an exclusionary vision of how it ought to accomplish its mission.

DOE's conclusions regarding environmental impacts in the draft EA reflect the extremely--and impermissible--narrow crafting of the issue assessed by the draft EA rather than the reality of dismantling thousands of nuclear warheads over the coming years and storing, it would appear, nearly 50 tons of plutonium at a single site for an unknown period of time. Moreover, I believe that the conclusions constitute a post hoc rationalization of a DOE decision to turn Pantex into the de facto storage facility for plutonium, rather than the product of a "hard look" at the consequences of DOE's dismantling and storage activities it desires to undertake at Pantex.

More specifically, the draft EA is deficient for the following reasons:

(1) DOE has failed to adequately consider viable alternatives to increasing the storage capacity at Pantex;

(2) DOE has improperly segmented the dismantling and storage activities undertaken and to be undertaken at Pantex; and

(3) DOE has failed to adequately assess the risk of dismantling thousands of nuclear warheads and storing the plutonium pits at Pantex.

Document #: *1048* **Comment #:** *1* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

After consideration of the DOE's predecisional EA we believe that our livelihood and our potential to produce quality food for the world is in jeopardy, The modeling used in this document was intended to justify the storage of plutonium pits at Pantex and has not taken into consideration the human environment or the $4 billion agricultural economy which is the lifeblood of this area.

Document #: *1048* **Comment #:** *16* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

According to NEPA, our basic national charter for protection of the environment, "procedures must insure that environmental information is available to the citizens before decisions are made and before actions are taken." Furthermore, it is stated that "ultimately, it is not better documents but better decisions that count." "Federal agencies shall encourage and facilitate public involvement in decisions which affect the quality of the human environment. We state this as a preface to our comments, because there is a lack of sufficient, accurate information provided to warrant the continuation of the present mission of the storage of plutonium at Pantex. Furthermore, the public is not involved in the decision making - we are only given a short time to "comment". Under NEPA all information must be presented and all reasonable alternatives must be defined. Alternatives are the heart of an EA, every alternative should be discussed.

The focus presented in the Predecisional EA is too narrow, as only one option was discussed. The presentation does not legally address all alternatives. The only discussion is -STORAGE- as opposed to looking at the full picture, the entire scope of the plutonium issue or plutonium management, which is bigger than just storing pits at Pantex.

Document #: *1048* **Comment #:** *27* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

It is the opinion of the membership of PANAL that this mission requires a site specific environmental impact statement (EIS). It is our belief that an environmental assessment and FONSI is totally inadequate. Dismantling 20,000 warheads and storing plutonium pits at Pantex is a new purpose for Pantex (and a major federal action) which significantly affects the quality of the human environment.

There is plenty of time to study every issue and alternative. A Pantex EIS needs to address all the issues related to Pantex, the alternatives, the capabilities of other facilities, plus any and all environmental effects not only on-site and to workers, but also off-site and to the agricultural economy. An EIS needs to address the entire plutonium management issue. We request a draft document for public participation, comment time and public hearings.

What we're going to do with plutonium pits needs to be ultimately done only after a comprehensive, credible accounting is done by all affected parties, state and federal agencies and technical experts. When will the policy be made for the future use of the pits.

Response #: B.1

Comments on the scope of the Environmental Assessment stated that the proposed action should include long-term storage of plutonium components and/or dismantlement operations at Pantex Plant. The decisions on long-term storage of plutonium components for the Department of Energy are being addressed in the Nuclear Weapons Complex Reconfiguration Programmatic Environmental Impact Statement. In order to achieve initiatives for reduction of the weapons stockpile, the Department determined that a decision on additional interim storage is needed prior to completion of the Programmatic Environmental Impact Statement. In order to evaluate the potential significance of environmental impacts regarding additional interim storage, the Department prepared the Environmental Assessment in accordance with Department's National Environmental Policy Act Implementing Procedures [10 Code of Federal Regulations Part 1021].

As a practical matter, it is necessary to study the environmental considerations of interim storage of plutonium pits resulting from dismantlement operations at the Pantex Plant in the near term. This must be done separately from the current activities of the Programmatic Environmental Impact Statement. Although the Department's ultimate decisions regarding interim storage has features in common with decisions regarding long-term storage to be made under the Reconfiguration Programmatic Environmental Impact Statement and decisions regarding the operation of the Pantex Plant to be made under the site-wide Environmental Impact Statement (see below), the decision on interim storage is neither a "connected action" to, nor a "cumulative action" with these other decisions, within the meaning of the Council on Environmental Quality regulations. Interim storage and long-term storage are not connected actions, because interim storage has independent utility from long-term storage. Therefore, it is a severable action for purposes of the National Environmental Policy Act.

Interim storage is needed to meet immediate weapons dismantlement requirements, and needs to occur regardless of what additional actions are taken to address long-term storage or permanent disposition of plutonium. Furthermore, all options for long-term storage or disposition would remain viable during interim storage and would be available when the later decisions are made.

The Department has also determined that additional National Environmental Policy Act analysis of dismantlement activities at the Pantex Plant is not necessary at this time in order to decide whether to increase the interim storage capacity for pits. This function has historically been part of the Pantex Plant mission and is addressed in the Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983). Weapon dismantlement is conducted in much the same way it has always been conducted, with ongoing improvements to safety and environmental protection in accordance with regulatory requirements. Dismantlement operations are presently within the normal historic range of assembly and disassembly activity at Pantex Plant and does not constitute a new project. The impacts of assembly and disassembly are comparable to each other, and the analysis of combined operations contained in the 1983 impact statement adequately bound the impacts of the proposal action. Past disassembly activity alone at Pantex Plant has nearly reached the planned maximum annual future disassembly rates of 2,000 weapons. (Approximately 1757 weapons were disassembled in 1981, See Figure B.1-1.)

Comments stated that the interim storage of plutonium components constitutes a change in mission for the Pantex Plant and, therefore, an Environmental Impact Statement should be prepared. The mission of the Pantex Plant has historically included staging of sealed plutonium pits prior to assembly (into new weapons) and shipping operations. Prior to 1989, the pits were staged after removal from weapons and transported to the Rocky Flats Plant for recovery and reprocessing. In December 1989, plutonium processing and pit fabrication operations at the Rocky Flats Plant were curtailed by the Department of Energy pending resolution of safety and environmental issues. The Pantex Plant continued to disassemble weapons, but shipments of pits to the Rocky Flats Plant were suspended. The pits from those weapons were staged in Zone 4 for later shipment to the Rocky Flats Plant. The Department anticipated that shipments of pits to the Rocky Flats Plant would be reinitiated when processing activities in support of new weapons programs resumed. Efforts to restart plutonium processing operations at the Rocky Flats Plant continued until January 1992 when they were terminated by the Department of Energy because of reduced requirements for new nuclear weapons production in support of the national defense. Consequently, pits from weapons disassembled at Pantex Plant are now placed in interim storage in Zone 4.

The Department believes that this action is consistent with the historical mission of the Pantex Plant, as it relates to the temporary staging of plutonium components after disassembly of retired weapons and prior to shipping to the Rocky Flats Plant for processing. The proposed action analyzed in the Environmental Assessment is the augmentation of the capability to temporarily store plutonium components in response to the cessation of plutonium operations at the Rocky Flats Plant.

Comments were made on the sufficiency of the Environmental Assessment analysis of the impacts of interim storage. The Environmental Assessment finds that the impacts of the proposed action would be limited to radiation exposure of workers which would be controlled to avoid adverse health effects. The Environmental Assessment was provided to the State of Texas for review and comment prior to the Department's approval in accordance with the Department's National Environmental Policy Act Implementing Procedures [10 Code of Federal Regulations 1021.301(a)]. The Department has carefully considered all of the comments on the Environmental Assessment provided by the State of Texas, including comments by State and local agencies and officials, interest groups, and the public. The Department will meet with the State and public to discuss the comments and the revisions to the Environmental Assessment in response to State and public input. When the Environmental Assessment is finalized, the Department will determine whether to prepare a Finding of No Significant Impact or an Environmental Impact Statement for the proposed action. The Department will prepare a Finding of No Significant Impact only if the Environmental Assessment supports a finding that the proposed action will not have a significant impact on the human environment.

Nevertheless, the Department is aware of concerns that have been raised regarding the cumulative impacts of increased dismantlement activities, and is committed to addressing these concerns by preparing a new Pantex Site-Wide Environmental Impact Statement. The Department has initiated assembly of environmental baseline information in support of this effort. This Environmental Impact Statement will examine aspects of current and foreseeable operations at the Pantex Plant, including dismantlement and storage-related issues. This Environmental Impact Statement will include analyses of measures to further mitigate the effect of Pantex activities. Although the scope of the Environmental Impact Statement cannot be defined until the public scoping process has been completed, the Department now envisions considering alternatives to the continued storage of pits at Pantex. The Department cannot predict how long this review will take but best efforts will be made to complete the Environmental Impact Statement on an expedited basis. The public will be invited to help both scope the appropriate review and comment on the draft Environmental Impact Statement when it is available. When the Nuclear Weapons Complex Programmatic Environmental Impact Statement Record of Decision is issued, aspects specific to the Pantex Plant will be incorporated into the new Site-Wide Environmental Impact Statement.

Some comments raised the issue of public participation. The Department will continue to provide opportunities to involve the public in decisions related to Pantex Plant operations and the nuclear weapons complex as a whole. A public meeting regarding the plans for interim storage at Pantex is planned, which will involve state officials, the local community and other interested parties. The scoping process for the Programmatic Environmental Impact Statement included public hearings in Texas as well as other locations. There have been additional opportunities for public participation as a result of the revised Notice of Intent being issued for the Programmatic Environmental Impact Statement and further opportunities will be provided when the Draft Programmatic Environmental Impact Statement is released for public comment. After the Programmatic Environmental Impact Statement Record of Decision is released, Site-Specific Environmental Impact Statements will be prepared for affected Nuclear Weapon Complex Sites. Public meetings and comment periods throughout the preparation of Site-Specific Environmental Impact Statements will assure opportunity for input and comments from affected stakeholders. (Refer to Response A.1 for further information regarding the Programmatic Environmental Impact Statement process.)

from affected stakeholders. (Refer to Response A.1 for further information regarding the Programmatic Environmental Impact Statement process.)

Additionally, the interagency task force determining the disposition of plutonium surplus to national defense requirements will include public participation. The Department is committed to include in an Environmental Impact Statement, major federal actions it proposes to take in conjunction with the task force on the disposition of surplus plutonium. This will help ensure meaningful public involvement in the examination of alternative means of disposition.

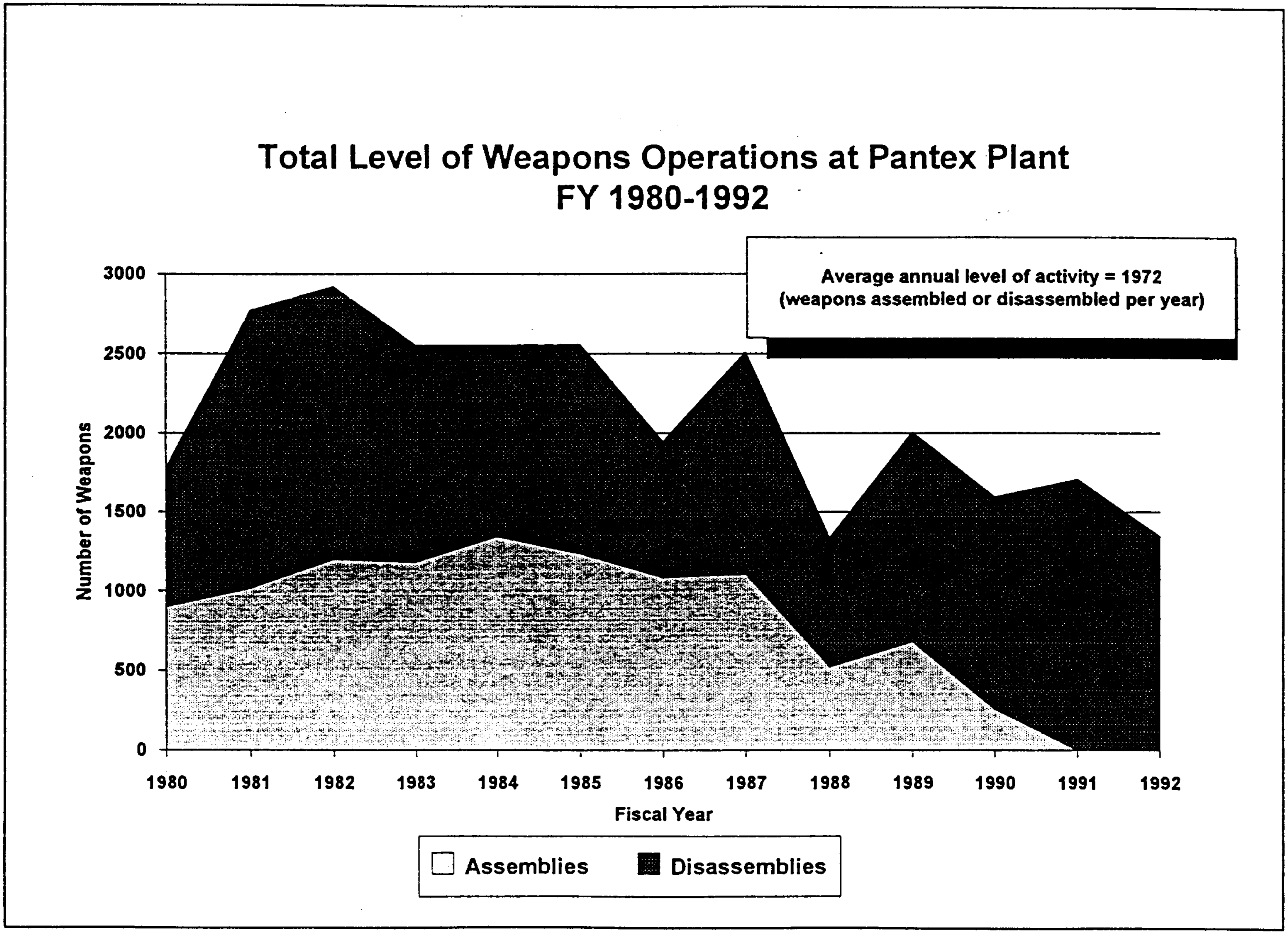


Figure B.1-1 - Total Level of Weapons Operations at Pantex Plant FY 1980-1992

Document #: *1046* **Comment #:** *3* **Date:** *3/22/93*

Dan Morales, Attorney General

State of Texas, Office of the Attorney General

Comment:

II. DOE has improperly segmented the dismantling and storage activities undertaken and to be undertaken at Pantex.

DOE has improperly segmented the analysis of its proposed increased activities at Pantex. While the possible environmental effects of increased interim storage are discussed, the draft EA completely ignores the environmental consequences resulting from the increase in dismantling activities necessitating the increased storage. The draft EA should include, inter alia, a comprehensive analysis of the increase in waste generated at the plant as a result of the increased dismantlement activities.

For example, in past DOE budget requests and in the Pantex Plant's Environmental Restoration and Waste Management Five Year Plan for Fiscal Year 1993, the Department refers to a high explosives incinerator (see page 6-31 of FY 1993 Five Year Plan). Given that the need for this incinerator necessarily relates to the increased dismantlement activities at Pantex, it would appear that the potential environmental impacts from the incinerator should have been discussed in the EA.

We also note that in the DOE budget request for FY 1993 that DOE requested funds for a "Hazardous Waste Treatment and Processing Facility." [footnote 2 (See Attachment B.)] According to DOE's description provided to OMB:

> *This facility will permit the treatment and declassification of low-level radioactive waste (depleted uranium, tritium and thorium), hazardous waste, solvents, mixed waste, and classified metal components generated at Pantex Plant.*

Again, it would appear that the potential environmental impacts from the waste treatment facility, in the event DOE pursues construction of the facility, should have been discussed in the EA.

Furthermore, the cumulative environmental effects associated with the increase in movement of warheads into Pantex, the generation of waste products, and the movement and storage of plutonium pits should have been more adequately analyzed.

Response #: B.2

Additional National Environmental Policy Act analysis of dismantlement activities is not required because dismantling weapons has historically been a part of the Pantex Plant mission and has been addressed in the Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983). (Further discussion on this point is provided in Response B.1.) Dismantlement rates historically at Pantex have nearly reached the 2000 per year anticipated dissemble projection. Since projected dismantlement rates are within the level of past activity (i.e., combined assembly and disassembly) at Pantex, the waste associated with these rates should be bounded.

Discussion of the Hazardous Waste Treatment and Processing Facility is outside the scope of this Environmental Assessment, and considerations and decisions regarding this facility are independent of the proposed action. The proposal for this facility was based solely on the need to consolidate waste management functions at the site. The need for the facility was not prompted in anticipation of increased dismantlement activities, but rather in an effort to provide a more efficient and safer facility with which to better comply with current and future federal and state waste management regulatory requirements. Consideration of alternate waste treatment technologies (both on-site and off-site) is a logical extension of the Department's commitment to use the best available technology for treatment of plant wastes.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (B.3) FOLLOWS.

Document #: *1041* **Comment #:** *7* **Date:** *3/12/93*

Beverly Gattis

Military Production Network

Comment:

DOE should address each of the above stated concerns in the final EA and supporting documents. We also request that if DOE decides to issue a Finding of No Significant Impact (FONSI) for this EA, a public comment period of no less than 45 days should be held, and comments received should be meaningfully considered before a final decision is reached. Also, the EA and all documents referenced by it should be made publicly available at the time the FONSI is published for public comment.

Response #: B.3

The Department has carefully considered all of the comments on the Environmental Assessment provided by the State of Texas, including comments by State and local agencies and officials, interest groups, and the public. The Environmental Assessment was revised to incorporate this State and public input. All documentation cited in the Environmental Assessment (except classified reports) have been made available to the public (in Department of Energy reading rooms located in Amarillo and Panhandle, Texas) and to State of Texas officials.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (B.4) FOLLOWS.

Document #: *1041* **Comment #:** *1* **Date:** *3/12/93*

Beverly Gattis

Military Production Network

Comment:

We have several concerns about issues raised in the above referenced EA, as well as additional concerns about other aspects of the Department of Energy's (DOE) dismantlement program. We very much appreciate your sending us a copy of the EA and your willingness to forward our comments to DOE. However, we hope that in the future DOE will make its preliminary EA's available to the public at the same time they are made available to state governments.

The Military Production Network (MPN) is a national alliance of organizations working to address issues of nuclear weapons production and waste cleanup. The MPN has been very active in DOE's two, ongoing Programmatic Environmental Impact Statements (PEIS) and many other DOE decision making processes. We are committed to full public participation in decisions regarding nuclear warhead dismantlement and to independent regulation and verification of the dismantlement process.

Response #: B.4

The Environmental Assessment was provided to the State of Texas in accordance with the Department of Energy National Environmental Policy Act Implementing Procedures, which require the Department to provide an Environmental Assessment to the host state and host tribe [10 Code of Federal Regulations 1021.301(a)]. Additionally, meetings will be held with the State and the public in order to broaden public involvement on this Environmental Assessment. The Department is also assessing other mechanisms to expand public participation opportunities on future Department of Energy activities.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (B.5) FOLLOWS.

Document #: *1042* **Comment #:** *13* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

Issues that must be specifically discussed include: ...

f. High consequence, low probability accidents -- airplane crash, criticality accident, and major release during disassembly; and

g. On-site storage versus transportation risks and costs for plutonium, highly enriched uranium, and tritium.

Response #: B.5

The Environmental Assessment does address high consequence, low probability accidents for the interim storage proposal. The potential for accidents during disassembly is not addressed because disassembly is not within the scope of the proposed action stated in the Environmental Assessment. The potential for accidents has been addressed in the Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983).

Activities dealing with highly enriched uranium and tritium are not in the scope of this Environmental Assessment since they are processes normal to disassembly and within historic production/disassembly activities (including transportation risks and costs). Transportation issues and cost for plutonium interim storage (on-site versus off-site interim storage) are discussed in relative terms in Section 4.0 of the Environmental Assessment.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (B.6) FOLLOWS.

Document #: *1042* **Comment #:** *26* **Date:** *3/12/93*

Beverly Gattis
Save Texas Agriculture and Resources (STAR)

Comment:
1. List of preparers. Council on Environmental Quality (CEQ) regulations (40 CFR 1502.17) require listing of preparers of an EIS. The final EA should have such a listing even though it is not required by regulation.

Response #: B.6

A list of individuals contributing to the formulation of the Environmental Assessment follows:

DEPARTMENT OF ENERGY

Headquarters
Victor Stello
Daniel Rhoades
Michael Mitchell
David Chaney
Thaddeus Dobry
Tracey Leslie
Sandra Chávez (Sandia National Laboratories - Albuquerque)
Tom Goodwin
Sam Collins
Roy Hedtke
Steve Sohinki
Donna Kostka
Greg Rudy
Henry Garson
Tim Pflaum
Nancy Ranik (Argonne National Laboratory)
Diane Meir (Contractor)
Mike Volpe (Contractor)
Adam Lipinski (Contractor)
Angela Watmore (Contractor)

Albuquerque Operations Office
Steve Guidice
David Rosson
Connie Soden
Wendy Baca
Cliff Jarmin (Contractor)

Amarillo Area Office
Gerald Johnson
David Heim
Anthony Ladino
Vicki Battley
Dean Triebel

MASON & HANGER / BATTELLE - PANTEX

Steve Young
Barbara Nava
Brett Simpkins
Phillip Stewart
Jeff Petraglia
Jerry Martin
Iral Nelson (Pacific Northwest Laboratories)

LOS ALAMOS NATIONAL LABORATORY

Jake Turin
B. Thomas
S. Triay
W. Hansen
W. Wenzel

OGDEN ENVIRONMENTAL AND ENERGY SERVICES / JACOBS ENGINEERING

David Erickson
David Smith
Ray Bennett

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (B.7) FOLLOWS.

Document #: *1009* **Comment #:** *3* **Date:** *2/22/93*

Tom Millwee, Chief

Texas Dept. of Public Safety, Div. of Emergency Management,

Comment:

The probability of an aircraft crashing into an igloo in zone 4 may be an incredible event. However, with respect to the increased dismantlement program, the synergistic impact of every aspect of the dismantlement program must be considered. The potential risk from the increased number of units, their movement, the transportation of these units, the increased disassembly and storage, must be assessed. The overall impact may result in a finding of a credible event.

Response #: B.7

This Environmental Assessment addresses the proposed additional interim storage of plutonium pits at the Pantex Plant with the aircraft crash scenario representing the range of reasonably foreseeable accidents. The effects of accidents outside of Zone 4 have been addressed in the Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983). (Refer to Response B.1 for more information on the scope of the Environmental Assessment.)

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (C.1) FOLLOWS ON PAGE C-6.

Document #: *1007* **Comment #:** *6* **Date:** *2/25/93*

Joseph A. Martillotti

Texas Dept. of Health, Bureau of Radiation Control

Comment:

Page 4-3, Lines 27-33: Beginning with "The nuclear weapons complex mission....", the discussion shows that serious consideration was not given to this option. It would seem that storage of pits, as described in this document, should not aggravate or complicate the massive environmental restoration and remediation efforts required at Hanford. The storage of parts removed from weapons (presumably not ready for insertion into new weapons without some preparation) does not clearly appear to be a defense only mission.

Document #: *1007* **Comment #:** *8* **Date:** *2/25/93*

Joseph A. Martillotti

Texas Dept. of Health, Bureau of Radiation Control

Comment:

Page 4-5, Paragraph 4.4: This report does not indicate that DOD facilities were seriously studied, only that they were "considered" and determined to be "not currently available". It is difficult to visualize what may be different between Pantex SAC and Modified-Richmond facilities and DOD facilities designed to protect and store weapon assemblies. The DOD facilities certainly would provide the physical storage space and the security forces should be comparable to Pantex capabilities. Transportation of components would seem to be less hazardous than assembled weapon delivery, and represents no significant change from previous Rocky Flats components shipments. Table 4-1, Section 4.4 affirms that apparently very little consideration was given to this issue, bsy (sic) the total absence of information. If there is any information available, it should be provided here for scrutiny.

Document #: *1015* **Comment #:** *5* **Date:** *2/20/93*

Addis Charless, Jr.

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

Page 4-3: Hanford, with modifications, could store approximately 10,000 pits. Some knowledgeable persons have suggested that Hanford may become a "national sacrifice zone". Would not Hanford then be a more appropriate storage site? If suitable for no other purpose, why not put the pits there?

Document #: *1015* **Comment #:** *7* **Date:** *2/20/93*

Addis Charless, Jr.

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

Page 4-6: Table 4-1 does not mention Kirtland AFB/Monzano (sic) Mtn. as a possible storage site despite their storage capabilities. Why was the above complex not considered?

Document #: *1016* **Comment #:** *17* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

Section 4.4 c states "decentralization of storage could effect a net increase in the expected radiological worker exposure/over (sic) the proposed action... Ah ha, there is danger to the workers and to the public after all. The entire EA tells us there is no danger of excess exposure at Pantex, but here we learn the same Pu in smaller amounts at other sites creates a danger. Which is it? DOE must do a full EIS to know.

Document #: *1022* **Comment #:** *6* **Date:** *2/11/93*

James Thomas

Hanford Education Action League (HEAL)

Comment:

Moreover, DOE has failed to consider the alternative of the construction of a new DOE facility, or several of them.

Document #: *1026* **Comment #:** *3* **Date:** *2/19/93*

Tamara Snodgrass
Citizen Comments

Comment:
All of the reasonable alternatives were not considered and inadequate attention was given to existing available DOE or DOD facilities. As taxpayers we have spent millions of dollars providing warhead and pit storage facilities at Kirtland Air Force Base (Albuquerque, NM., and the Sierra Army Depot in California (sic).

Document #: *1027* **Comment #:** *3* **Date:** *3/5/93*

Portia Dees
Citizen Comments

Comment:
Are there available sights (sic) for storage of nuclear materials farther from populated areas?

Document #: *1031* **Comment #:** *2* **Date:** *3/1/93*

Louise Daniel
Citizen Comments

Comment:
Alternative storage facilities such as those at Kirkland (sic) Air Force Base and Sierra Army Depot are not mentioned in the Environmental Assessment. These facilities are already constructed and should receive public consideration.

Document #: *1032* **Comment #:** *3* **Date:** *2/19/93*

Betty E. Barnard
Citizen comments

Comment:
All of the reasonable alternatives were not considered and inadequate attention was given to existing available DOE or DOD facilities. As taxpayers we have spent millions of dollars providing warhead and pit storage facilities at Kirtland Air Force Base (Albuquerque, NM., and the Sierra Army Depot in California (sic).

Document #: *1033* **Comment #:** *3* **Date:** *2/19/93*

Norbert Schlegal
Citizen Comments

Comment:
All of the reasonable alternatives were not considered and inadequate attention was given to existing available DOE or DOD facilities. As taxpayers we have spent millions of dollars providing warhead and pit storage facilities at Kirtland Air Force Base (Albuquerque, NM., and the Sierra Army Depot in California (sic).

Document #: *1034* **Comment #:** *3* **Date:** *2/19/93*

48 signatures/form letter
Citizen Comments

Comment:
All of the reasonable alternatives were not considered and inadequate attention was given to existing available DOE or DOD facilities. As taxpayers we have spent millions of dollars providing warhead and pit storage facilities at Kirtland Air Force Base (Albuquerque, NM., and the Sierra Army Depot in California (sic).

Document #: *1035* **Comment #:** *3* **Date:** *2/19/93*

Karen Son
Citizen Comments

Comment:
All of the reasonable alternatives were not considered and inadequate attention was given to existing available DOE or DOD facilities. As taxpayers we have spent millions of dollars providing warhead and pit storage facilities at Kirtland Air Force Base (Albuquerque, NM., and the Sierra Army Depot in California (sic).

Document #: *1037* **Comment #:** *3* **Date:** *3/1/93*

Bishop Leroy T. Matthiesen
Diocese of Amarillo

Comment:
All of the reasonable alternatives were not considered and inadequate attention was given to existing available DOE or DOD facilities.

Document #: *1038* **Comment #:** *3* **Date:** *2/26/93*

Boyd M. Foster, President
Arrowhead Mills

Comment:
All of the reasonable alternatives were not considered and inadequate attention was given to existing available DOE or DOD facilities. As taxpayers we have spent millions of dollars providing warhead and pit storage facilities at Kirtland Air Force Base (Albuquerque, NM, and the Sierra Army Depot in California.)

Document #: *1039* **Comment #:** *3* **Date:** *3/10/93*

Tonya Kleuskens, Chairman
Texas Nuclear Waste Task Force

Comment:
The existing EA does not examine reasonable storage alternatives and we do not believe this issue was given sufficient priority. The potential sites mentioned in the EA are now serving other DOD or DOE missions. Also, they have a limited storage capacity, which would probably not be adequate for the the(sic) considerable quantities of plutonium to be stored at Pantex.

Document #: *1041* **Comment #:** *5* **Date:** *3/12/93*

Beverly Gattis
Military Production Network

Comment:
3) The predecisional EA does not adequately explain why Department of Dofense (DOD) sites cannot store some or all the plutonium components from retired warheads.

The premise in the EA is simply that no DOD facility is "currently available" to DOE for use as an interim storage facility. Consequently, the EA implies that there would be unspecified delays and that needed modifications "would inevitably entail some degree of environmental impacts." (p. 4-5) However, there is no evidence presented for any of these conclusions.

The final EA should indicate which DOD facilities have been considered as possible storage sites and provide a credible rationale for whether they could meet the identified need. Also, the final EA should address the ability of DOD sites to store disabled warheads if delays arise in disassembly operations at Pantex.

Document #: *1042* **Comment #:** *5* **Date:** *3/12/93*

Beverly Gattis
Save Texas Agriculture and Resources (STAR)

Comment:
B.) The draft EA does not discuss all reasonable alternatives, as required by NEPA and the CEQ regulations (40 CFR 1502.14(a)).

The discussion of alternatives is the heart of any NEPA document, yet the draft EA does not adequately analyze the alternatives that it mentions.

Alternative 4.2, combining storage at Pantex and other DOE facilities, is rejected 1) without an adequate discussion of any other facilities at those sites could not be converted to pit storage (just as facilities at Pantex have to be converted) and 2) without adequately describing those "numerous changes" underway at other facilities. Moreover, a more detailed discussion of why other DOE facilities can not store any pits is necessary.

Alternative 4.3, supplementing Pantex storage with other facilities, is not wholly discussed. While supplemental storage at LANL and Hanford is mentioned, the discussion of storage is limited to SRS. As with Alternative 4.2, a much more detailed discussion of the storage capability of all DOE facilities is required.

Document #: *1042* **Comment #:** *6* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

Alternative 4.4, using Department of Defense (DOD) facilities, is wholly inaccurate. The federal government has spent millions of dollars developing pit storage capabilities at Kirtland Air Force Base near Albuquerque, New Mexico. However, there is no specific mention of that facility in the draft EA. Other DOD facilities have significant warhead storage capability. A detailed discussion of why none of those facilities could be used for interim storage is necessary. What will happen with those facilities when they are not used to store warheads?

Document #: *1042* **Comment #:** *43* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

10. Page 4-1. The draft EA states: "For the other alternatives, in each case there were additional costs, transportation requirements, and facility modifications or infrastructure requirements." No evidence is provided to support such a statement. At a minimum, the EA must detail the costs of the preferred alternative and of each proposed alternative, describe the transportation requirements and why procedures used in the past are not adequate, and describe the types and costs of facility modifications.

Document #: *1042* **Comment #:** *45* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

12. Page 4-4. In c), the claim is made that decentralized storage "could effect a net increase in expected radiological worker exposure," but no basis is given for the statement. Specific calculations should be presented and the discussion should differentiate between cumulative exposures to a lesser number of workers versus lower exposures to a larger number of workers.

Document #: *1042* **Comment #:** *46* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

13. Page 4-5. The statement that "no DOD facility is currently available" for pit storage appears to be false, since news reports indicate that pit storage is immediately available at Kirtland Air Force Base, near Albuquerque, New Mexico. In any case, the capabilities of the Kirtland facility must be discussed in detail in the EA.

There is no basis provided for the statement that "the storage of pits at DOD facilities would offer no environmental advantage over the proposed action." To support that statement additional analysis and answers to questions include: do each of the potential DOD facilities have a greater or lesser likelihood of a catastrophic airplane crash than Pantex? Do any of the other facilities sit on an aquifer similarly important as the Ogallala? Would the potential storage facilities at other locations allow for inspections that would require less movement of pits and/or quicker inspections so as to reduce worker exposure?

Document #: *1043* **Comment #:** *2* **Date:** *3/12/93*

Mavis Belisle, Director

the Peace Farm

Comment:

Additionally, the EA proposal for interim storage of all plutonium pits at Pantex has rather summarily dismissed a number of other possibilities, which should be fully explored in the document. These include a dispersed storage, using several Department of Energy sites, utilization of Department of Defense sites, particularly Kirtland AFB.

Document #: *1044* **Comment #:** *5* **Date:** *3/15/93*

Margie K. Hazlett (3)

Citizen Comments

Comment:

As taxpayers we commend the DOE's decision to plan carefully and use suitable places for pit storage which will eliminate problems down through the years ahead. We have financed many facilities for the armes (sic) race. Some of the facilities are: the warhead and pit storage at Kirtland Air Force Base (Albuquerque, New Mexico), the Sierra Army Depot in California, the new unused plant for plutonium reprocessing called the New Special Production Facility at the Savannah River Plant, and a new unused plant built in Rocky Flats in 1983. Arms experts believe plutonium pits would be relatively safer at the Department of Defense's military bases where security is better and the storages (sic) suitable and safe. When Pantex finishes its disassembly work, I respectfully ask you to move the pit storage to a safer site where it will be guarded well and may be be used in the pit reuse experiments, hopefully there will be a good purpose for nuclear components, such as the nuclear hospital equipment we now have.

Document #: *1045* **Comment #:** *4* **Date:** *3/22/93*

Beverly Gattis

Serious Texans Against Nuclear Dumping (STAND)

Comment:

3) The draft EA does not establish a clear sense of DOE's prioritization of the different environmental (as defined by NEPA) impacts.

Worker exposure is acknowledged to be the principal impact (vii). However, discussion of alternatives in the draft EA never clarifies whether or not any of the alternatives might offer more workers protection than another. It is as if, no matter where the storage location is, the rates of exposure will be the same — though this is never substantiated in the text.

Given that approach, one of the justifications for not accepting alternative 4.4, "Interim Storage at a DOE facility," is that, if any modifications were necessary, "these modifications would inevitably entail some degree of environmental impacts of the type generally associated with construction activities." (p.4-5)

The draft EA should establish a general ranking of priorities so that decision-making can distinguish among important differences. Lessening worker exposure could indeed justify other concessions or expenses.

Document #: *1045* **Comment #:** *6* **Date:** *3/22/93*

Beverly Gattis

Serious Texans Against Nuclear Dumping (STAND)

Comment:

5) The draft EA does not present all reasonable alternatives.

As one obvious example: there is no "Supplement No-Action Alternative Storage with Storage at other DOD Sites."

Given both the need for dismantlement to proceed in a timely but safe way, as well as an equally valid and urgent need that any decision protect worker safety and public health to the maximum extent, all reasonable alternatives must be available and evaluated to provide flexibility in decision making.

Document #: *1046* **Comment #:** *2* **Date:** *3/22/93*

Dan Morales, Attorney General

State of Texas, Office of the Attorney General

Comment:

I. DOE has failed to adequately consider viable alternatives to increasing the storage capacity at Pantex.

DOE's analysis of alternatives to the proposed action of expanded interim storage is extremely superficial at best. This failure to seriously analyze the alternatives indicates that DOE has already determined to go forward with increased interim storage at the Pantex plant and that the draft EA was produced simply to pay lip service to the requirements of the National Environmental Policy Act.

Document #: *1048* **Comment #:** *8* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

(2-1, 4-1, 4-3)"...DOE maybe required to cease the disassembly activities..." what is the rush? Under the treaties signed we're not obligated to dismantle immediately, there was no time limit specified. Why not ship warheads or pits to other sites - Pantex is not the only site available for dismantlement or storage, why were other DOE and DOD sites not adequately addressed? To state that no DOD facility is "currently available" must be proved. Not addressing the DOD facilities in full is a false conjecture.

Document #: *1048* **Comment #:** *9* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

To come to the conclusion that "there is no environmental benefit to be gained in packaging and shipping some or all of the pits to any other location for interim storage purposes" (viii) has no credible basis from the information presented in the EA.

Response #: C.1

Several comments alleged as inadequate the Department's discussion of alternatives for interim storage at the Pantex Plant. Several points were consistently made and are as follows:

1. *All possible alternatives were not discussed or were not discussed in sufficient detail.*

   The National Environmental Policy Act requires that alternatives to a proposed action be developed for discussion in an Environmental Assessment. The Environmental Assessment identifies alternatives that are potentially available and considered to be reasonable. Sites mentioned in the comments that are not specifically discussed in the Environmental Assessment are either in use now or slated for future uses other than pit storage. The range of facilities capable of taking on pit interim storage automatically includes sites that will have other missions, storage capabilities, and their own competing requirements for storage. There are no facilities, either within the Department of Energy or the Department of Defense whose mission is limited to storage of special nuclear material.

   While the Department could have listed new construction of an interim storage facility as an alternative, it was considered unlikely to offer an environmental advantage since land disturbance would be unavoidable. Additionally, new construction could not support the preferred schedule for expanding pit storage capacity and would require additional resources.

   The discussion of alternatives in the Environmental Assessment explains that a combination of factors led to the conclusion that none of the other sites considered (those of the Department of Energy and the Department of Defense) are reasonable in that none meet the criteria for the proposed action. The sites considered do not meet programmatic needs for interim storage because of the following factors: 1) increased cost (for facility modification, to augment or reactivate enhanced security, for increased transportation requirements, etc.), 2) untimely implementation of alternative interim storage (time to modify facilities, perform required safety analyses, develop site-specific procedures, train personnel, etc.), and 3) no apparent environmental benefit to interim storage at an alternate site. Under the proposed action, there are no increased transportation requirements, only minor facility enhancements are required, and activities required for implementation are essentially in place.

2. *No basis was presented in the Environmental Assessment to support the Department's conclusion that no environmental advantage would be gained by moving and storing the pits at an alternative site on an interim basis.*

The Environmental Assessment analyzes whether environmental benefit could be derived by storing pits off-site (either at up to four separate Department of Energy facilities or at a Department of Defense facility). The Environmental Assessment analysis indicates that radiation exposure of workers is the principal impact of the proposed action and there is no significant impact to the environment. While impact to the environment would be no different, worker exposure could be increased in the implementation of off-site or decentralized interim storage. Decentralization of interim pit storage (at more than one site) would generate duplication of security, handling, and inventory requirements. Efficiency in handling, monitoring, and inspecting the plutonium components is achieved by conducting interim storage operations at a single site rather than at multiple sites and could result in lower cumulative radiation exposure to workers. Also, additional personnel exposure would be expected due to the additional moving, repackaging, and transporting operations required to ship the pits to sites other than Pantex Plant. This is demonstrated in the process flow diagram (Figure C.1-1) that compares the relative number of handling steps that would be required by the proposed action and storage at another site. Eliminating transportation to alternate sites eliminates some of these processes as well as the total work load and costs involved in pit storage management and is consistent with the Department's goal of reducing worker exposure to "as low as reasonably achievable" levels. Exposures expected from implementing alternatives are not unacceptable from the standpoint of worker safety, instead, worker exposures are expected to be higher relative to the proposed action. This conclusion does not imply that occupational exposure standards for workers would be exceeded for any alternative.

3. *The Department does not discuss specific Department of Defense facilities (as cited in the comments) and, therefore, appears not to have considered them.*

The Department has been working since May 1992 with the Department of Defense concerning potential use of Department of Defense sites for interim pit storage. The Environmental Assessment has been expanded to reflect the most recent results from this interaction. As a matter of Department of Defense policy, the presence of nuclear weapons at specific sites cannot be confirmed or denied for security reasons. Therefore, discussion of specific Department of Defense sites are not presented. However, the Environmental Assessment does include information on the storage of pits at different types of Department of Defense sites. Based on this information, the Department has concluded that Department of Defense sites are not feasible alternatives to the proposed action for the following reasons:

- The Department of Defense is restructuring its forces to reflect troop reductions and base closures. As part of this effort, some Department of Defense bases are being configured to accommodate only conventional forces and their weapons. The remaining active weapon storage facilities are committed to storing both nuclear and conventional weapons, which are being moved from overseas bases and from facilities designated for closure. This restructuring process could take several years. The requirement for additional continental U.S. storage capacity is further strained by the backlog of retired weapons.

- All Department of Defense excess sites are placed on the Base Realignment and Closure List. To store special nuclear material and establish the necessary repository infrastructure (e.g., security, environmental study, training, and negotiation of site-sharing agreements) at an inactive Department of Defense site would require significant new funding and implementation time.

- No environmental benefit is apparent in the use of Department of Defense sites for the interim storage of plutonium components.

Section 4.2 of the Environmental Assessment provides more explicit details regarding impacts, timing and costs associated with implementation of a Department of Defense site for interim storage of pits. Section 4.1 discusses the impact that a decision not to expand the interim storage of pits at Pantex (i.e., the No-Action Alternative) would have on Department of Defense plans for base realignment and closure.

ENVIRONMENTAL ASSESSMENT TEXT CHANGE

Section 4.0 was changed to reflect the comments.

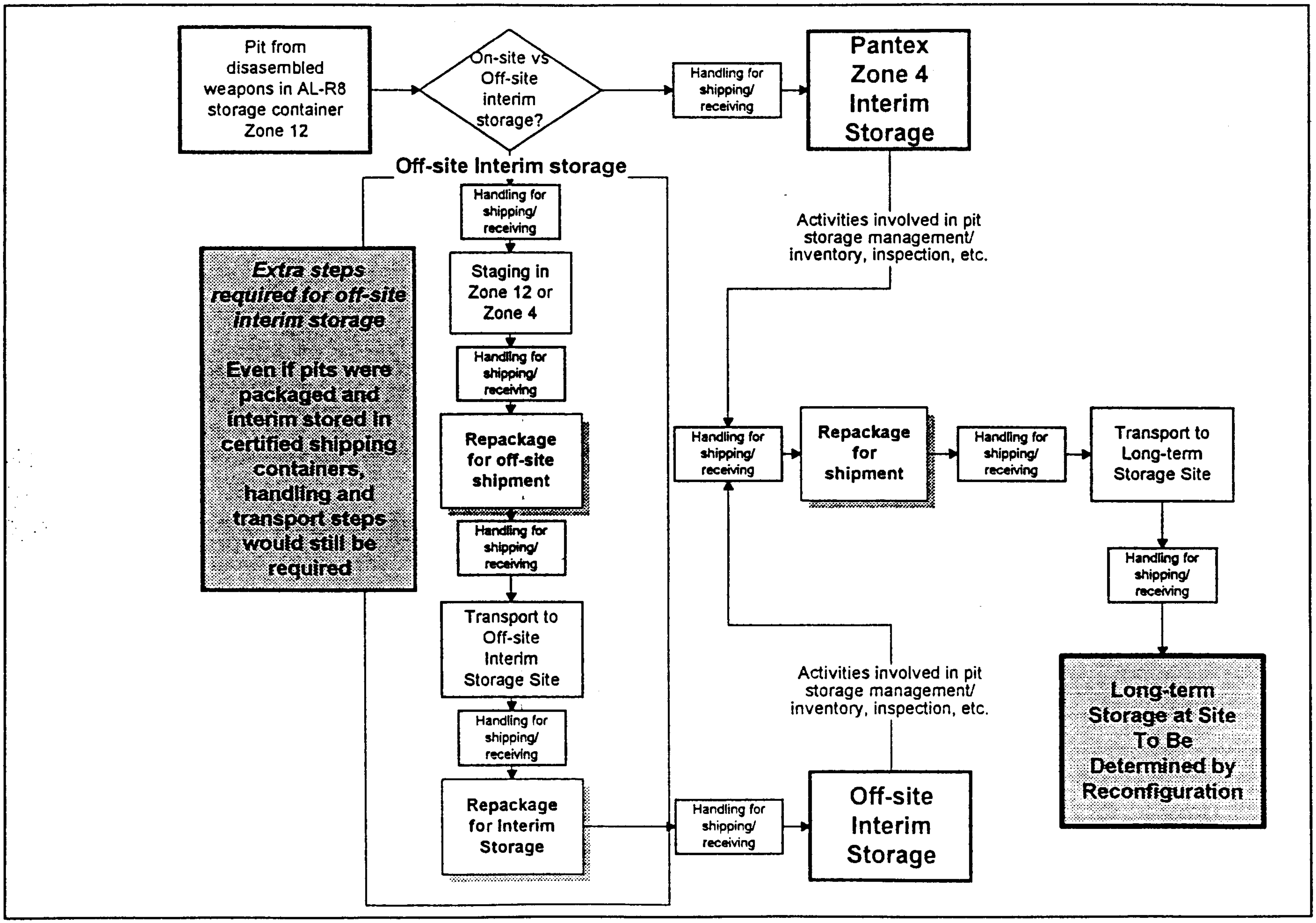


Figure C.1-1 - Comparison of Steps Required For Interim Storage at the Pantex Plant With Any Other Site

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (C.2) FOLLOWS.

Document #: *1045* **Comment #:** *5* **Date:** *3/22/93*

Beverly Gattis

Serious Texans Against Nuclear Dumping (STAND)

Comment:

4) The draft EA does not completely discuss all the alternatives it presents.

As a most obvious example, in the discussion of Los Alamos National Laboratory (LANL) it lists existing pit storage at TA-41 and TA-55. TA-41 is eliminated because "it does not meet current DOE requirements for ES&H, security, and conduct of operations, and programmatic requirements do not justify the costs required to make needed changes." (p. 4-3) Some of the problems with this discussion are:

a) TA-55 is never mentioned again, and remains unevaluated.

b) The extent of modifications needed for TA-41 is not explained.

c) The rationale based on "programmatic requirements do not justify the costs..." is insufficient. Programmatic requirements are only for dismantlement "in an environmentally responsible way that is also timely, cost effective, and uses to the maximum extent practicable, existing facilities and infrastructure." (p. 2-1) Depending on what modifications TA-41 needs, it could be that ES&H benefits might justify the changes when programmatic objectives might not.

Response #: C.2

The comment addresses issues raised in the discussion of Los Alamos National Laboratory as an alternate interim storage site.

a) The Department acknowledges that clarification is needed with respect to this comment. A change was made to the Environmental Assessment to clarify this issue. TA-55 is at approximately 90 percent capacity and overcommitted for the stated pit storage needs at Los Alamos National Laboratory. The total storage capacity is approximately 60 pits.

b) TA-41 and the major ancillary activities associated with this site are shut down and security would have to be reactivated. The TA-41 storage facility is an enclosed, unventilated vault, and major renovation would be required for installation of a ventilation system.

c) Section 2 states that an interim solution (that is, increased interim storage capacity) must meet the programmatic objectives of dismantlement that is also environmentally responsible, timely, cost-effective, etc. The statement made in Section 4.2 "...and programmatic requirements do not justify the costs required to make needed changes." was clarified in the Environmental Assessment to read "... Los Alamos National Laboratory's programmatic requirements did not justify the costs required to make needed changes to maintain TA-41." The modifications (as described in b)), would result in a total (in both TA-55 and TA-41) storage capacity of only 240 pits. The Department cannot justify the expenditure of construction funds and resources in light of the extremely limited increased capacity (180 pits).

ENVIRONMENTAL ASSESSMENT TEXT CHANGE

Section 4.0 was changed to reflect the comments.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (C.3) FOLLOWS.

Document #: *1007* **Comment #:** *5* **Date:** *2/25/93*

Joseph A. Martillotti

Texas Dept. of Health, Bureau of Radiation Control

Comment:

Page 4-3, Lines 3-6: This passage seems to indicate that construction has been halted at the Nuclear Materials Storage Facility due to lack of funding from DOE, and that if construction was resumed, it would take four to five years to complete.

Response #: C.3

The statement made by the comment author regarding the passage in page 4-3, lines 3-6, is correct.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (C.4) FOLLOWS.

Document #: *1021* **Comment #:** *11* **Date:** *1/25/93*

Lawrence D. Egbert, MD

Physicians For Social Responsibility

Comment:

DOE could use other sites as well as Pantex but this would add the hazard of transportation. I find this interesting since they have said this hazard is virtually zero for years. The advantage of storing at multiple sites and doing it visibly, however, would be that numerous communities would then become involved in this dreadful problem. Do you have nightmares thinking of having to trust the Government with the storage of Pu for a half-life of 26,000 years? This risk of trusting our Government is clarified by a marvelous euphemism on page 4.3, "The primary mission of Hanford is environmental restoration."

Document #: *1048* **Comment #:** *10* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

(4-5, 4,4) Why is transportation of pits so much more dangerous than entire warhead or component parts? Is shipping and handling dangerous just for some materials? How dangerous is this stuff - DOE was shipping it before to RF, what is the difference now? If there is danger in transportation, why were these problems not addressed sufficiently? What about the transportation in to Pantex at the present time? Is this not dangerous also?

Response #: C.4

The discussion in Section 4.0 of the draft Environmental Assessment does not imply that the added risk of off-site transportation is a limiting factor in consideration of alternative interim storage sites. From experience and separate analysis of transportation risks discussed in the Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983) and further analyzed in a preliminary Defense Programs transportation study, the Department concludes that the potential risk is acceptable. However, off-site transportation to an alternate interim storage site would introduce a small but finite additional risk that was identified to determine the relative effects of the various alternatives to storing pits only at the Pantex Plant. The issue of transportation of weapons into the Pantex Plant is outside the scope of the proposed action and has been previously addressed in the Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983).

Document #: *1016* **Comment #:** *3* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

Examples of this are "none of the other DOE sites is considered reasonable"Executive (sic) Summary p. vii. Yet section 4 contains several possibilities.

Response #: C.5

The first line in the referenced paragraph in the Executive Summary states "A number of alternatives to increased interim storage at the Pantex Plant were considered." From these alternatives, it was decided which justified additional consideration. The major possibilities considered were included in Section 4.0. The referenced paragraph in the Executive Summary goes on to summarize the key points used to make the statement cited in the comment.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (C.6) FOLLOWS.

Document #: *1022* **Comment #:** *5* **Date:** *2/11/93*

James Thomas

Hanford Education Action League (HEAL)

Comment:

p. 4-1 to 4-7 -- DOE has not presented an adequate examination of the alternatives, especially regarding the possible security risks of having only one interim storage facility.

Response #: C.6

Safeguards and security issues are considered by the Department of Energy during the assessment of any proposed action. The Department would preclude consideration of any option that analysis has shown would compromise or pose an unacceptable risk to national or physical security.

Document #: *1041* **Comment #:** *4* **Date:** *3/12/93*

Beverly Gattis
Military Production Network

Comment:

2) Inadequate information is provided on alternatives for storing plutonium components at other DOE sites. The predecisional EA provides only scant details on why facilities at the Los Alamos National Laboratory (LANL), Savannah River Site (SRS), and Hanford Site would be unable to store some portion of the components. Part of the justification offered for not pursuing plutonium component storage at these facilities is that:

"The nuclear weapons complex is undergoing numerous changes to include environmental restoration and consolidation of its nuclear material to facilitate restoration and to enhance safeguards and security. The complex has limited storage capacity, and each site's capability to store material (pits and SNM in various other forms) must be examined. There are many ongoing programs where the storage capability at the above sites are currently being assessed. Consolidation of material and subsequent inventory reduction at the RFP, reduction of the inventory at LLNL, and clean out of processing canyons at SRS are a few that vie for the existing or potential storage capacity at SRS, LANL, and Hanford." (p. 4-4)

The predecisional EA does not describe, and none of the referenced documents appear to discuss, any of the "many ongoing programs" referred to above. At the very least, the final EA should list these programs and provide ample information on the capacities of existing storage facilities as well as storage needs to allow independent verification of the conclusions presented.

Response #: C.7

Some of the ongoing programs were described in the sentence following the referenced phrase and include: consolidation of material and subsequent inventory reduction at the Rocky Flats Plant; reduction of the inventory at Lawrence Livermore National Laboratory; and clean out of processing canyons at Savannah River Site; and are but a few of the day-to-day issues that are addressed in the operation of these and other Department of Energy Nuclear Weapons Complex facilities. Storage capacity and utilization (of that capacity) are elements of mission and day-to-day operation of the particular facility. The Department has developed and described in the Environmental Assessment several reasonable alternatives to the proposed action. These alternatives were developed taking into account current Department policies and strategies. It would be beyond the scope of this Environmental Assessment to evaluate the need or likelihood of such changes. Reviews of the Department programs mentioned in the Environmental Assessment, resulting from current Department or other government policies and strategies, are being conducted independently pursuant to the National Environmental Policy Act when required. (More detailed discussion of considerations regarding alternatives is presented in Response C.1.)

Document #: *1042* **Comment #:** *7* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

In addition, the draft EA must discuss other reasonable alternatives, including:

a. Storing disarmed warheads;
b. Shipping all plutonium pits to other locations, just as tritium and highly enriched uranium are now transported off site;
c. Providing one or more facilities that are open for international inspection;
d. Establishing one or more disposal facilities;
e. Storing pits at Pantex for a specific time period, with strict enforcement of the time limit and penalties to ensure removal by the end of the time limit;
f. Storing pits in other areas of Pantex in addition to Zone 4; and
g. Others that DOE thinks are reasonable.

Document #: *1043* **Comment #:** *1* **Date:** *3/12/93*

Mavis Belisle, Director

the Peace Farm

Comment:

Interim storage, in so far as it is a necessary part of the process, should be interim -- as defined in the Environmental Assessment -- and limited to the 6-10 year time period referenced in the document.

To assure that this timeframe is met, there should be

- *a strict and open accounting with the State of Texas for the pits*
- *a requirement for quarterly reports to the state for any pits held in interim storage longer than 10 years including their intended disposition and timeline for that disposition*
- *provision for financial penalties for pits held in interim storage longer than 10 years. Otherwise, any pits exceeding the time limit should be reclassified as waste and come under a full review process and environmental impact statement for longterm storage. If the pits are to remain on site as a valuable national resource, their international market value should be determined and that value added to "in lieu of taxes" provisions, paid annually to the State and to Carson County.*

Response #: C.8

With respect to one comment author's call for "a strict and open accounting with the State of Texas for the pits," the Department has a stringent material management policy in place. In addition to the fact that the information contained therein is Restricted Data, it would be inappropriate to create a jurisdictional issue regarding accountability of special nuclear material where one does not now exist.

In addition, two comment authors called for provisions for enforcement of the interim storage time period including penalties, "in lieu of taxes" provisions, or automatic reclassification of the pits as a waste. It is inappropriate to attach the suggested enforcement or "in lieu of taxes" provisions to the proposed action within the document. It is not within the scope of the proposed action to require a determination of long-term disposition.

In addition, the comments assert that other reasonable alternatives should be discussed. A more detailed discussion on alternatives can be found in Response C.1. However, particular alternatives were proposed (Document 1042, Comment 7) that the comment author suggested required further discussion. These are as follows:

a. Storing disarmed warheads - This alternative is discussed in the No-Action Alternative.
b. Shipping <u>all</u> plutonium pits to other locations - This alternative was examined with respect to storage at Department of Defense sites. Alternative Department of Energy sites were not examined because it was recognized in Section 4.2 that sufficient pit storage capacity (at Savannah River Site, Los Alamos National Laboratory, and Hanford) would not provide all the needed capacity in a timely manner.
c. Providing one or more facilities that are open for international inspection - National security policy and treaty obligations will dictate whether the Pantex Plant or any other facility providing interim storage of pits would be open for international inspection, this issue therefore, is outside the scope of the proposed action.
d. Establishing one or more disposal facilities - Issues associated with the ultimate disposition of plutonium are beyond the scope of this document.
e. Storing pits at the Pantex Plant for a specific time period - See discussion above in paragraph 2.
f. Storing pits in other areas of the Pantex Plant in addition to Zone 4 - The Department did not consider other areas of the plant in addition to Zone 4 since the proposed increase in capacity would be more than adequate for the stated need.
g. Others that the Department thinks are reasonable - All alternatives considered reasonable by the Department were discussed.

Document #: *1021* **Comment #:** *6* **Date:** *1/25/93*

Lawrence D. Egbert, MD
Physicians For Social Responsibility

Comment:
We are aware of massive safety problems at various other DOE sites, problems which will take decades to clean up, billions of dollars, and probably a number of injuries to personnel. Knowing that, do we want the DOE to store Pu pits in magazines when Pantex does not have expertise in this? Governor Richards should wonder, why experiment with Texas? Why not experiment at Rocky Flats where the pollution levels are already severe? Or Hanford? Or half a dozen places where the DOE has polluted? Or, why not some place where the military has polluted?

Response #: C.9

Over the years, Pantex Plant personnel have developed more than adequate expertise to implement the proposed action. Staging of weapons and weapons components have historically been part of the Pantex operations. Pit staging operations are well characterized at the Pantex Plant. The personnel, training, procedures, handling fixtures, material accountability, and facilities are all in place and are readily transferrable and directly applicable to the proposed action of interim storage in Zone 4.

Alternative Department of Energy sites and the possibility of using Department of Defense sites were considered, and were not found to be acceptable.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (D.1) FOLLOWS.

Document #: *1011* **Comment #:** *9* **Date:** *2/18/93*

Dana O. Porter

Citizen Comments

Comment:

Even if no environmental contamination occurs, will increased operations at Pantex require excessive water use, thus contributing to depletion (mining) of the Ogallala Aquifer?

Document #: *1015* **Comment #:** *18* **Date:** *2/20/93*

Addis Charless, Jr.

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

Despite claims by director Steve Walton of the AEDC that vast amounats (sic) of water exist for use by industry, such is not the case. Even now, the Canadian River Municipal Water Authority is purchasing Southwestern Public Service Co.'s water rights in Roberts Countey (sic) to provide adequate water for its southernmost customers.

Document #: *1016* **Comment #:** *13* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

Are they planning a reprocessing facility at the Pantex site? The amount of water available will not be sufficient for this.

Document #: *1017* **Comment #:** *21* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

I don't think there is enough water available for reprocessing in this area. Amarillo has drilled at least 7 dry holes in their water field in northern Potter County. The Carson County field where the city is now pumping its water is rapidly declining. Our static level in our wells had dropped four feet this past year and at least one of the Amarillo wells dropped 12 feet.

Response #: D.1

The proposed interim storage activity is not expected to require any additional water use at Pantex Plant. The water used at Pantex Plant is a mixture of water from the Ogallala Aquifer and Lake Meredith. These are the same sources which are used by the City of Amarillo.

Water usage at the Pantex Plant during calendar year 1992 was as follows:

Total pumped	750,121 gpd
Pantex Plant Operations	550,091 gpd
Texas Tech Research Farms	200,030 gpd

Depletion of the Ogallala Aquifer would not be accelerated due to the proposed action covered by the Environmental Assessment.

gpd = gallons per day

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (D.2) FOLLOWS.

Document #: *1011* **Comment #:** *10* **Date:** *2/18/93*

Dana O. Porter
Citizen Comments

Comment:
Has the Texas Water Commission been duly advised of the potential risks to surface water and groundwater resources?

Response #: D.2

Pantex Plant has cooperated fully with the several state regulatory agencies having cognizance over risks to surface water and groundwater resources. These include not only the Texas Water Commission, but also the Bureau of Radiation Control of the Texas Department of Health. Both of these organizations as well as the Texas Air Control Board and the Division of Emergency Management of the Texas Department of Public Safety have been provided the opportunity to review and comment upon the subject Environmental Assessment. In addition, as part of the Agreement in Principle between the State of Texas and the Department of Energy, the Texas Air Control Board is conducting site-wide air dispersion modeling and collecting and analyzing ambient air samples collected from inside Pantex Plant. The Bureau of Radiation Control of the Texas Department of Health has conducted radiological monitoring at both on-site and off-site locations since the early 1980's. None of the measurements performed by the various state regulatory agencies has indicated that emissions in excess of regulatory limits have occurred. These regulatory limits are set at levels several orders of magnitude below those known to present significant health hazards or risks to the environment. Thus the risks have been reviewed and determined to be negligible.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (D.3) FOLLOWS.

Document #: *1012* **Comment #:** *1* **Date:** *1/16/93*

Margie K. Hazlett (1)

Citizen Comments

Comment:

On Thursday, July 25, 1991, The Environmental Protection Agency added the Pantex Weapons Plant to a list of hazardous waste sites posing the greatest threat to human health and our environment. Pantex was one of 22 sites nationwide that the Environmental Protection Agency proposed adding to its Superfund National Priorities List. ... The total number of sites nationwide that were targeted for cleanup were one thousand, two hundred and eleven. Pantex was quickly removed from the list, unjustly so, and remained a hazardous waste site posing a threat to our health and welfare in this area.

Document #: *1015* **Comment #:** *2* **Date:** *2/20/93*

Addis Charless, Jr.

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

Page 1-1: The statement that PX has conducted its activities in a safe and responsible manner belies the facts of ... eligibility for being considered as a Superfund site, and pollutants existing in the soil to a depth of 329 feet-a scant 40 feet above the Ogallala aquifer.

Document #: *1048* **Comment #:** *4* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

"The Pantex Plant has conducted these activities in a safe and reasonable fashion for more than 40 years" (1-1) the SAR's, the GAO Report, the Tiger Team, the Adhearn (sic) Committee Report - are all these reports in error? Pantex has been nominated for a Superfund site, Is this because the activities have been conducted safely and reasonable? Why is ER/WM now being addressed at Pantex if the above statement is true.

Document #: *1048* **Comment #:** *5* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

In a statement made by Lowell F. Cranfill, President/Chief Steward, Metal Trades Council, Mason & Hanger, May 17, 1989, before the Subcommittee on Health and Safety, Committee on Education & Labor, U.S. House of Representatives, he states "I am very seriously concerned with the health and welfare of my friends and members of my union working at the Plant. I am also concerned with the Panhandle of Texas and the potential problems they may have in that area due to the toxic waste (sic) that are accumulating because of the spills and dumps from Pantex. I know that the Energy Department estimate last June was in excess of 700 million dollars to clear up the Pantex Plant. I do not know what the spills and dumps consist of. I solicit your aid in trying to find that out and help us clear up the plant. It is a serious and dangerous hazardous waste dump if that amount of money is to be spent in trying to clear it up. I would like to be involved in stopping the things that Pantex is doing that is causing the need for such expenditure."

Response #: D.3

The statement made by the Department regarding the activities conducted at Pantex Plant in safe and reasonable manner for over 40 years refers to the overall health and safety record of the plant. Since nuclear weapons operations have begun at Pantex Plant, there have been no accidents involving nuclear weapons which have caused impacts off-site. Some accidents involving the processing of high explosives and radiological contamination of some work areas have occurred, however.

Environmental restoration activities are currently underway at the Pantex Plant. The Department is working with the Texas Water Commission under the Resource Conservation and Recovery Act to develop plans for investigation and remediation of contaminated sites. These sites include construction landfills, locations which contained leaking underground storage tanks, and an old sewage treatment plant and contain common industrial contaminants such as lead, chromium, dioxin, and gasoline by-products that are now more stringently regulated by state and federal government than in the past. In addition, the Environmental Restoration program at Pantex Plant has funding set aside for interim corrective action measures. If it is found through the investigation portion of the program that there is an imminent danger to the environment, this funding would be used to start remediation actions immediately to prevent further contamination of the environment.

The consideration of Pantex Plant as a Superfund site is in accordance with the requirement of the Comprehensive Environmental Response, Compensation and Liability Act, Section 120(a). Under this Act, all Federal facilities are subject to consideration as Superfund sites. The Environmental Protection Agency proposed Pantex Plant for placement on the National Priority List on July 24, 1991 based upon the hazard ranking scores. In September 1991, the Department submitted comments to the Environmental Protection Agency regarding the methods and calculations used to derive the hazards ranking score. The Department's comments are still under review by the Environmental Protection Agency and no final determination has been made regarding the final listing of Pantex Plant on the National Priority List.

Document #: *1015* **Comment #:** *6* **Date:** *2/20/93*

Addis Charless, Jr.

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

Pg 4-5: Storage capacity at PX would be reached by the 4th quarter of '93 to the 2nd quarter of '94. The AEDC has offered $5.5 million for additional land purchases to be deeded to the DOE-how (sic) many families might this affect? This has come about after it was stated that no additional land would be needed for PX expansion.

Response #: D.4

The purchase of additional land for $5.5 million does not pertain to the pit storage in Zone 4. The Department of Energy and the Amarillo Economic Development Committee submitted the joint proposal referenced in the comment. This land, currently leased from Texas Tech University by the Department of Energy, is used as an additional security buffer zone along the southwest boundary of the site. It will not involve the purchase of land from the public. This land may be used to provide additional space between public lands and Pantex Plant, support present or future needs for expansion, relocate support facilities, and allow security to better isolate personnel traffic from the highly secured areas of Pantex Plant.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (D.5) FOLLOWS.

Document #: *1016* **Comment #:** *19* **Date:** *2/16/93*

Jeri Osborne
Citizen Comments

Comment:
Also, section 5.1 states that surface runoff flows into several playa lakes on the site. Runoff also comes out of the plant on the north into the barrow ditches that drain into the Pratt lake one-half mile to the north of the plant. Pratt lake also catches lots of water running down the draw by the old sewage plant. Debris is often caught on the barbed wire fence in the draw.

Response #: D.5

The Environmental Assessment describes the usual surface hydrology at Pantex Plant. The individual is correct in noting that unusual conditions (i.e., mechanical failure coupled with intense precipitation events) have resulted in storm water runoff from the extreme northeast section of Pantex Plant toward the playa lake located north of the site. In any event, storm water flows from Zone 4 are not involved and are contained onsite in Playa One.

Pantex Plant has developed drainage systems to divert the rainwater runoff onto playas located on-site. This collection system includes a collection pit and return pumping system located in the northeast corner of Pantex Plant.

This location is regularly sampled by Pantex Plant Environmental Monitoring personnel to monitor water quality and to identify any problems should they exist. Additional water samples are collected and analyzed to ensure water quality and protection of the public. Automatic sampling devices are assigned to collect samples at this location in the event of a storm. Environmental sampling data from this location, as well as others, are reported to the Texas Water Commission and become public records.

ENVIRONMENTAL ASSESSMENT TEXT CHANGE

Section 5.1 on page 5-1 has been changed to reflect the comments.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (D.6) FOLLOWS.

Document #: *1042* **Comment #:** *47* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

14. Page 6-1. The statement that "routine operations of the No-Action Alternative are similar to those for the proposed action" would appear to be false and is at odds with other statements in the draft EA about worker exposure impacts. Even for non-radiological impacts, common warehouse/industrial accidents and injuries will be higher with the proposed action than with no action.

Response #: D.6

The complete statement in the Environmental Assessment is "Routine operations of the No-Action Alternative are similar to those for the proposed action, differing only in the quantity of materials held and number of magazines authorized for pit storage". This statement addresses the type of operations, which are essentially the same in either case (the storing and inspecting of pits). The referenced statement does not address, nor is it intended to address, the resulting impacts from the number of pits stored and the storage configurations. Radiological exposure to workers associated with the proposed action is discussed in Section 6.1.1.1 of the Environmental Assessment, while exposure to workers associated with the No-Action alternative is discussed in Section 6.1.1.2.

Increased radiation exposure was found to be the only potential impact to workers as a result of the proposed action. It is expected that common industrial accidents will be reduced due to the use of Automated Guided Vehicles and the decrease in the frequency of inspections.

Document #: *1011* **Comment #:** *8* **Date:** *2/18/93*

Dana O. Porter
Citizen Comments

Comment:
The groundwater risk assessment does not address any organic solvents, heavy metals, or other potential groundwater hazards. If I recall correctly, the United States Environmental Protection Agency reported several years ago that they had found evidence of heavy metal and organic chemical contamination of the soil and water environment associated with previous Pantex operations.

Response #: D.7

The interim storage activity does not require the use of organic solvents in the storage site. The pits that are the subject of the proposed action contain plutonium, a heavy metal. The risks associated with the release of plutonium were evaluated in the Environmental Assessment and were found to be negligible.

Investigations of heavy metal and organic chemical contamination at other parts of Pantex Plant are currently under way. The investigations are conducted in accordance with a Permit for Industrial Solid Waste Management Site (No. HW-50284) issued by the Texas Water Commission. The proposed interim storage activity is not expected to contribute any contamination to the other sites currently under investigation.

Document #: *1035* **Comment #:** *11* **Date:** *2/19/93*

Karen Son
Citizen Comments

Comment:
#3 Pantex - Amarillo ...
b. burns 300,000 pounds of nuclear explosives every year which we breathe.

Response #: D.8

The burning of high explosives is not within the scope of the proposed pit storage activity. Neither the plutonium components (pits) that are the subject of this Environmental Assessment nor nuclear explosive devices are burned at Pantex Plant. Pantex Plant does conduct open burning of high explosives under a written grant of authority from the Texas Air Control Board.

The quantities of explosives burned at the Pantex Plant High Explosives Burning Grounds during the last five years is as follows:

1988	226,000 lb (estimated)
1989	226,000 lb
1990	100,000 lb
1991	112,000 lb
1992	74,000 lb

The downward trend in the amount of high explosives burned each year can be attributed to two reasons. First, the stoppage in production of nuclear weapons has eliminated the scrap high explosives that were produced as a result of machining operations. In addition, the high explosives removed during dismantlement operations are being recycled.

lb = pounds

Document #: *1044* **Comment #:** *6* **Date:** *3/15/93*

Margie K. Hazlett (3)

Citizen Comments

Comment:

From 1981 to 1986, Pantex had a burning pit in which solvents and uranium were found and were present at 329 below the surface in soils underlying the pit, while the Ogallala Aquifer occurs at a depth of 390 to 420 beneath the site. These years when the Department of Energy did not tell us about these dangerous pollutants coming from the burn pits has had a great impact on the Panhandle of Texas. I will enclose a summary of "Texas Background Radiation Levels determined by Thermoluminescent Dosimeter (TLD) Monitoring" in the "1990 Environmental Monitoring Results". The 1988-89 surveillance program already showed considerable contamination of the soil, surface water, vegetation, sediment, and crops such as sorghum and winter wheat. Also a passive integration of gamma radiation was obvious in this report. In the 1988-1989 Environmental Surveillance Program, Gamma scan, (suspected radionuclides: U3238 (sic)); gross alpha; gross beta; H-3 were present in the soil, surface water, vegetation, sorghum and winter wheat. Surface water showed all of the above analysis types with Pu-239 included. I am enclosing the 1990 "Summary of Texas Background Radiation Levels" as determined by Thermluminescent (sic) dosimeter (TLD) Monitoring.

Response #: D.9

The burn pit is out of the scope of the proposed action. The environmental impacts of increased plutonium storage have been analyzed in the Environmental Assessment. The only possible accident scenario that would release plutonium to the environment involved the forklifts used for movement of the pit containers in Zone 4, as discussed in Appendix D of the Environmental Assessment. The potential impacts on the environment due to a plutonium release were found to be negligible.

The State of Texas and the Pantex Plant Environmental Monitoring Section both use thermoluminescent dosimeters as well as other monitoring media to monitor the Pantex Plant site and ensure that no release of radiation to the public takes place. Soil, air, groundwater, and vegetation are regularly monitored by the State of Texas and Pantex Plant Environmental Monitoring Section. These results, which are published in annual reports that are available to the public, show that the levels of radiation are consistent with background levels. The results also indicate that releases in excess of state and federal standards for protection of the public from radiation and/or other contaminants have not occurred at Pantex Plant.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (D.10) FOLLOWS ON PAGE D-13.

Document #: *1016* **Comment #:** *8* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

The EA only addresses storage in Zone 4 magazines. Are there other places on the site to store Pu? If so, why aren't they being addressed?

Document #: *1017* **Comment #:** *17* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

Storing Pits in Assembly Bay #8 -- Electrical power for lights, air conditioning and heating is present in the work bays.

Document #: *1042* **Comment #:** *30* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

3. Page 1-1. The draft EA states that Pantex workload requirements "is (sic) expected to be similar to that experienced in the past for all assembly/disassembly operations." Questions that should be answered include: What were the historic peak years for disassembly, and for assembly/disassembly? What types of disassembly accidents have occurred with what exposures to workers and releases into the environment?

Footnote 1 states that 50,000 nuclear weapons have been dismantled in the last 40 years. How many were done at Pantex? How many were done at other facilities? What other facilities were used? Can those facilities be used for at least some of the proposed dismantlement?

Footnote 2 describes staging. What is the maximum time that pits have been stored at Pantex? Where were they stored? With what results? What types of accidents have occurred during transportation, with what exposures to individuals, with what releases into the environment?

4. Page 1-2. The implication is that pits have been stored at Pantex since December 1989. How many pits? What kind of inspections have been done? What measured exposures have workers received? What accidents have occurred?

Document #: *1042* **Comment #:** *35* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

6. Page 2-2. Figure 2.1 indicates that in the three years since RFP stopped processing pits (December 1989 to 4th Quarter 1992), Pantex has accumulated between 3,300 and 3,800 pits. How many are actually stored at Pantex? Have any pits been shipped off-site since December 1989? If so, how many and to what location(s)? (See also: issues raised in comments about page 1-2.)

Document #: *1045* **Comment #:** *7* **Date:** *3/22/93*

Beverly Gattis

Serious Texans Against Nuclear Dumping (STAND)

Comment:

6) The draft EA does not discuss all the plutonium storage locations at the Pantex Plant itself.

The title of the draft EA seems to encompass the entire Plant (Interim Storage of Plutonium Components at Pantex) yet only Zone 4 is ever discussed. In reality there are at least two other locations at Pantex which store plutonium for various lengths of time: Cell 8 and 12-26 Vault, both in Zone 12.

In addition, there is another facility currently under construction in Zone 12, referred to as Special Nuclear Material Staging Facility, which might be capable of holding as many as 4,880 pits. (see attached document 2, "DOE Plutonium Strategy Task Force, Steering Committee Meeting, January 30, 1992 (Predecisional), p. 26)

None of this storage is taken into account in the Draft EA discussion. Nor has there ever, to STAND's knowledge, been any mention of an intended EA process evaluating the new Zone 12 SNM facility, yet that facility could store more pits than Zone 4 is currently allowed to do.

Though Cell 8 and 12-26 might be used only to briefly stage pits until they are transferred to a storage area, this should be discussed in the text of the draft EA.

The SNM Staging Facility, however, must undoubtedly be considered as relevant to the draft EA's proposed action. It will provide such a significant amount of storage that it changes the entire picture of pit storage time frames, options and capacity as portrayed in the draft EA.

Such a significant facility also deserves at least the same amount of careful evaluation process as is being applied to Zone 4 igloos.

Document #: *1045* **Comment #:** *8* **Date:** *3/22/93*

Beverly Gattis

Serious Texans Against Nuclear Dumping (STAND)

Comment:

7) The draft EA must accurately portray the history of dismantlement and pit storage at Pantex. There are many instances where this is not the case, but the following two examples are particularly pertinent:

a) In the Executive Summary DOE consistently uses the term storage. The purpose of the EA is even stated as, "to evaluate the environmental impacts of additional interim storage of pits at Pantex..." (p. vii)

As previously discussed in comment 1d, pit storage is new to Pantex. If "additional interim storage" is true in any sense, it is only because it has become unavoidable given the current condition of the complex and the change in the world situation. To portray it as merely more of the same, a usual part of Pantex's work, is inaccurate. Pit storage has transpired because it has been unavoidable. Being unavoidable does not mean that it is not a significant change from either past practice or past mission which must be evaluated as such.

In addition, because it is a NEPA process, the final version of this draft EA will become a public document. As such, it is logical that most people will have access to and read the Executive Summary. The summary must be scrupulously written and accurately reflect the significant points of the whole. Section 1.1, Introduction and Background, makes the distinction between staging and storage."

b) The text of the draft EA gives a false impression of the number of dismantlements conducted in the past at Pantex when it uses a footnote within the statement "The primary mission of the DOE Pantex Plant is the assembly and disassembly of nuclear weapons." (p. 1-1) The footnote to the word "disassembly" reads: "Over 50,000 nuclear weapons have been dismantled in the last forty years."

Clearly the impression is that all 50,000 dismantlements took place at Pantex. However, during the August 20, 1992 public meeting of the Defense Nuclear Facility Safety Board, when a Board member pursued this same statement, the Pantex official admitted that of the 50,000 dismantlements only an estimated 10,000 to 15,000 had been done at Pantex.

Document #: *1048* **Comment #:** *19* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

Is Zone 4 the only place the DOE intends to 'hold pits'? This is the only area discussed in the EA. What about the other structures, bays, etc.?

Document #: *1048* **Comment #:** *21* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

DOE assumes there will be no problems, either human or mechanical at any time during storage. All potential problems associated with storage need to be addressed.

Document #: *1048* **Comment #:** *22* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

For the EA to state that the proposed action would not result in additional generation or management of wastes (vii) - evades the original issue being - dismantlement - which is increasing so the pits can be stored at Pantex and there is additional waste being generated. The issue of waste management was not addressed in the EA. This is a major issue and needs to be fully explored.

Response #: D.10

The Environmental Assessment addresses the hazards associated with the interim storage of no more than 20,000 pit containers. The analysis for 20,000 pits will bound the actual number of pits stored at Pantex Plant. Approximately 5,200 pits (as of 11/1/93) are currently stored at Pantex Plant. The purpose of the Environmental Assessment is to evaluate the environmental impacts for Zone 4, the only area of Pantex Plant that is being considered for additional interim storage of pits. Some pits have been stored at Pantex Plant since the closure of Rocky Flats Plant in 1989. For further information refer to the National Environmental Policy Act issue discussion (Response B.1).

Other locations in the production areas of Pantex Plant provide staging of pits to support assembly as well as dismantlement activities. Pits that have been staged at Pantex Plant since December 1989 have been handled in accordance with the Pantex Site-Wide Environmental Impact Statement and the Final Safety Analysis Report Magazines for the particular staging location. Two of these locations, Building 12-44 Cell 8 and the Building 12-26 Pit Vault, are staging facilities and are not used for storage. Pits are moved in and out of these facilities periodically. The capacity of Cell 8 is 288 pits, and the capacity of the Pit Vault is 152 pits. There are no plans to increase the staging capacities of either of these facilities. Since only Zone 4 will be used for interim storage, only Zone 4 is addressed in this Environmental Assessment.

A new building for the staging of weapon components under construction is the Special Nuclear Materials Staging Facility (Building 12-116). National Environmental Policy Act documentation for this facility was completed in the form of a Memo To File, which was appropriate under the Department of Energy National Environmental Policy Act implementation requirements at the time. This facility will be used as a staging facility for weapon components resulting from the disassembly of nuclear weapons. Components in transport containers will be moved to Building 12-116 where they are readied for staging. The facility will have two vaults (Rooms 120 and 121) with the capability of staging 834 pits (Building 12-116 Preliminary Safety Analysis Report, Section 1.0). Other types of special nuclear material will also be staged there. Since the purpose of the Special Nuclear Material Staging Facility will be staging of pits and other special nuclear material, and the purpose of the Environmental Assessment is the interim storage of pits, it would not be appropriate to include both facilities in the same document.

The introduction and background sections of the Environmental Assessment are intended to provide the reader with some current and historical facts of Pantex Plant. The historic peak years for disassembly/assembly, types of disassembly accidents, exposure to workers, and releases into the environment are not within the scope of the Environmental Assessment. The footnote on Page 1-1 of the Environmental Assessment, that states "Over 50,000 weapons have been dismantled in the last forty years," covers all Department of Energy Nuclear Weapons Complex sites, including Pantex Plant. From January 1, 1967 through May 31, 1993, the total number of weapons that have been dismantled at Pantex Plant is 23,463. Prior to 1967, the records for dismantlements are not computerized and are not readily available.

Final Safety Analysis Reports are written for the pit staging locations in Zone 12 of Pantex Plant. Aspects of a safety analysis report are to provide a formal evaluation to systematically identify the hazards of an operation and to analyze and evaluate potential accidents and their associated risks. The Pantex Plant Final Safety Analysis Report for Zone 4 Magazines has recently been updated to include the new proposed interim storage configurations. The Pantex Plant Final Safety Analysis Report for Zone 4 Magazines performed a systematic identification of the hazards for the storage of the pits in Zone 4. The presence of electrical power for security purposes does not pose any credible accident that could release plutonium; therefore, no unacceptable risk is associated with the presence of electrical power in Zone 4.

Waste generated in the dismantlement process is generated prior to the storage of pits in Zone 4 and is not therefore within the scope of the Environmental Assessment. Pits are considered a resource, not a waste; therefore Zone 4 is not a waste storage facility.

Appendix A of the Environmental Assessment is a summary of the 38 potential accident initiating events. These analyses and a more complete description of the potential accident initiating events are contained in the Pantex Plant Final Safety Analysis Report for Zone 4 Magazines. A quantitative analysis was performed for the accidents with the highest potential to cause a release of plutonium. These accidents included aircraft impacts, earthquakes, external explosions, forklift accidents, tornados, and tornado-generated missiles. The consequences from these potential accidents are contained in Appendices B, C, D, and E of the Environmental Assessment. To date no accidents have occurred because of pit storage operations.

In addition to the accident analysis, a formal process is now being implemented to perform an 18 month surveillance of containers for corrosion and other attributes. Corrosion inspections have been conducted on a periodic basis, with approximately 1.7 rem cumulative yearly radiation exposure to workers associated with the inspection. Pits and containers will be surveyed through a statistical sampling program whereby a percentage will be removed from Zone 4 to a production area. The purpose of the program is to verify the integrity of the pits and containers and to return them to Zone 4. Currently the same process is used to occasionally ship pits from Pantex Plant to one of the national laboratories for additional testing and surveillance. For additional information on the inspection of pits, refer to the configuration, inspection, stability and dose rates discussion (Response D.23).

ENVIRONMENTAL ASSESSMENT TEXT CHANGE

Section 1 has been revised to reflect the comments.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (D.11) FOLLOWS.

Document #: *1017* **Comment #:** *18* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

Work Bay #1 -- Still not cleaned up since the tritium leak in 1989. I understand that they have tried to clean it up, but it still will not meet specs and they are talking about tearing it down.

Response #: D.11

Actions related to the decontamination or decommissioning of Cell 1 are not the subject of the proposed action. An assessment to determine the extent of the contamination was performed and an evaluation of clean-up options is currently under review.

Document #: *1042* **Comment #:** *21* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

Unanswered in the draft EA are basic questions, including: ...

- What is the actual accident history and exposure rates for inspections under storage configurations;

Response #: D.12

No accidents with radiological consequences have occurred as a result of Zone 4 operations.

Historical exposure rates for inspections are discussed in Section 6.1.1 of the Environmental Assessment. Current dosimetry records for both 1991 and 1992 indicate that the collective dose rate for personnel associated with all Zone 4 operations is less than 10 person-rem/yr. Estimates for the proposed configuration are detailed in Appendix F of the Environmental Assessment.

yr = year

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (D.13) FOLLOWS.

Document #: *1011* **Comment #:** *2* **Date:** *2/18/93*

Dana O. Porter

Citizen Comments

Comment:

Do the designers of the storage configurations know that it is safe to store these quantities of plutonium in such a small area? Is there danger of nuclear reaction due to "critical mass"?

Document #: *1015* **Comment #:** *4* **Date:** *2/20/93*

Addis Charless, Jr.

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

Pg 3-2: Some proposed multiple stacking configurations have in mathematical formulas approached 80%-90% of criticality.

Response #: D.13

The statement made by the individual regarding the neutron multiplication factors for the proposed storage configurations is true. The proposed storage configurations for the pits in the Zone 4 magazines were prepared to prevent criticality. Criticality is determined by calculating the number of neutrons that will be present for subsequent chain reactions to occur. The number of neutrons is referred to as the neutron multiplication factor. The neutron multiplication factor is strongly dependent upon two items: geometry (surface to volume ratio) and material characteristics.

Geometry is a strong factor because of the increased chance for neutrons given off by the radioactive material to interact with more radioactive material. More interactions are possible if the same amount of radioactive material is shaped in the form of a sphere (large surface to volume ratio) versus a thin rectangular slab (small surface to volume ratio). The quantity of material present (mass) does not significantly influence the calculation of criticality for finite arrays and is not an influence in calculating neutron multiplication factors for infinite arrays.

The AL-R8 containers that store the pits have been designed to prevent criticality by providing fixed separation of the pits. Administrative controls are in place to ensure that only one pit is placed into each container and that the correct packaging procedures are performed. Since the geometric configuration of the pit inside of the container is constant, the arrangement of the containers within the magazines could alter the neutron multiplication factor. The proposed storage configurations of the pits within the magazines were examined to determine if criticality could occur. In each of the proposed storage configurations, criticality was not obtained. Various accident scenarios that could alter the geometric arrangement of the pits in the magazines were also examined and the possibility of obtaining criticality was found to be not credible.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (D.14) FOLLOWS ON PAGE D-19.

Document #: *1011* **Comment #:** *18* **Date:** *2/18/93*

Dana O. Porter
Citizen Comments

Comment:
The health effects of long-term, low-level radiation exposure are not known.

Document #: *1015* **Comment #:** *9* **Date:** *2/20/93*

Addis Charless, Jr.
Panhandle Area Neighbors and Landowners (PANAL)

Comment:
Pg 5-2: Scientists are continually lowering the levels that are deemed to be safe, and arguments abound that in the long run, no levels of radiation are truly safe. Witness the current concerns being voiced about naturally occurring radon accumulations in our area's basements.

Document #: *1015* **Comment #:** *10* **Date:** *2/20/93*

Addis Charless, Jr.
Panhandle Area Neighbors and Landowners (PANAL)

Comment:
Pg 6-4: If annual collective worker radiation doses increase but Federal individual worker exposure limits are not exceeded, it logically follows that even more workers will be at risk for radiation-induced cancer.

Document #: *1042* **Comment #:** *25* **Date:** *3/12/93*

Beverly Gattis
Save Texas Agriculture and Resources (STAR)

Comment:
Further, basic information about the DOE approach to worker safety is not included in the draft EA. Will a few workers be charged with doing all inspections, thereby increasing doses to a few workers, or will many workers conduct inspections, thereby increasing the number of workers receiving some exposures but limiting exposures to individuals? Related questions are whether having a few highly trained workers make inspections quicker and more efficient, thereby reducing exposures, or whether having teams of more than two workers would reduce the time and resulting exposures from inspections. Other questions are: Are the same workers responsible for moving pits from the disassembly bays to the storage facilities and then doing inspections? If so, what are the cumulative exposures?

Document #: *1048* **Comment #:** *2* **Date:** *2/28/93*

Doris & Phillip Smith
Panhandle Area Neighbors and Landowners (PANAL)

Comment:
"Environmental impacts would be limited to radiation exposure of workers which would be controlled to insure that ALARA objectives are achieved" (vii), (3-2), (4-1); to assume no adverse health effects among workers is ludicrous. Workers will receive increased radiation doses in taking pits from Assembly Bay to Zone 4 - will these be the same workers? If there are fewer workers there will be higher doses, but if there are more workers there is less exposure, but more people are involved.

In inventorying the pits, the estimates for worker radiation exposure are based on current inventory operations - these in no way are a guide for determining full worker exposure for the future operations. "Impacts of the proposed action were assessed and found to be limited to worker exposures to radiation" (viii, 4-4, 8-1) - we demand for the workers that this proposed action be further examined - no one person's life is expendable.

Document #: *1048* **Comment #:** *3* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

For the workers who handle the pits the radiation risks are not fully analyzed. The EA has failed to adequately address radiation exposure to workers. "The workload requirements for increased weapons disassembly is expected to be similar ... in the past" (1-1) how can this be when the workload is increased?

Response #: D.14

Although the long term effects of low-level radiation exposure are not known, it is standard practice within the Department on Energy to limit both individual and collective exposures to minimal levels. This is outlined in the Department's As Low As Reasonable Achievable Program. In this program, Pantex Plant has established an administrative limit on individual dose to 1 rem/yr. This limit is below the current federal radiation limit of 5 rem/yr. Additionally, pursuant to the Department of Energy Radiological Control Manual (July 1992), the As Low As Reasonably Achievable goal to further reduce exposure to 500 mrem/yr is planned to be implemented by the end of 1993.

Frequently, the practice of trying to reduce both types of radiation exposure (individual and collective) requires a balanced approach that may include compromise. Situations do arise where the use of a limited number of highly efficient workers will result in higher individual doses but lower collective doses. Other considerations, such as safety, security, job efficiency, and contingency planning will also determine the number of trained personnel required. To determine the ideal number of personnel to perform a given activity requires assessments by radiation safety and operations professionals. These assessments are performed at Pantex Plant on an activity-by-activity basis.

Workers responsible for transporting pits from the disassembly bays and cells are not the same workers performing inspection operations. Exposures associated with the preparation of the pits for shipment will be essentially the same regardless of the location where stored (provided a similar number of units are disassembled). Further, doses associated with the receipt and emplacement of pits at Zone 4 are included in the dose calculations (see Appendix F of the Environmental Assessment). Worker radiation exposures received in the disassembly areas and during transport of the containers will continue to be limited to the Pantex Plant Administrative Dose Limit of 1 rem/yr.

As stated by an individual, increasing the number of workers exposed to the same level of radiation will increase the number of workers at risk of radiation-induced cancer. Based on the latest studies on the effect of continuous exposure to low-level radiation, a dose of 1 rem is estimated to result in an increase of cancer risk of 0.08 percent ("National Research Council, Health Effects of Exposure to Low Levels of Ionizing Radiation; BEIR V," Committee of the Biological Effects of Ionizing Radiation, National Academy Press, Washington, DC, December, 1989). (This risk is based on projections from observations at high doses.) Based on this finding, the health effects of long term, low-level radiation exposures are very small and comparable to the health effects from natural background radiation.

The mortality rates for radiation workers have been studied by scientific groups. At least one study has concluded that radiation workers tend to live longer than members of the general public. This conclusion is attributed to the fact that radiation workers receive more frequent examinations than the general public and illnesses can be diagnosed and treated in the early phases. (For more information, refer to "Mortality Among Workers at Pantex Weapons Facility," Journal of Health Physics 48 (1985): 735-746.)

Department of Energy Orders (5480 series) contain directives regarding worker safety. In addition, Secretary of Energy, Hazel O'Leary has outlined a new program to enhance and improve worker radiological health and safety. This safety and health initiative will establish clear roles for independent oversight, empower employees to assure safety and health, develop a shared strategy for continuous improvement, and clearly articulate expectations for safety and health. This policy was published in 48 Federal Register 33804 on June 21, 1993.

mrem = millirem
yr = year

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (D.15) FOLLOWS.

Document #: *1017* **Comment #:** *11* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

Missiles -- How about missiles from a test firing or from an HE press accident? We know these kinds of accidents have happened in the past. We know of at least three.

Document #: *1017* **Comment #:** *19* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

I know one breech block from a 16 inch naval gun has been blown up. I have heard that at least three high explosive presses were also blown up over the years. These accidents could provide missiles for penetration of the igloos and possible fires.

Response #: D.15

Appendices C and D of the Environmental Assessment discuss potential accident initiating scenarios as a result of blast pressure, fragments, and missiles generated from accidental explosions in adjacent structures. The maximum credible explosion found was the result of an explosion of a Richmond magazine in Zone 4 east which contained high explosives. Since this is the maximum credible accident scenario involving explosion-generated missiles, explosions from more distant areas of the plant are considered to be not credible.

In addition, administrative controls have been implemented at the Plant firing sites to control fragments from explosives tests that have the potential for producing fragments off-site. Quantity-distance separation requirements, as specified in applicable Department of Energy Standards, are provided from operations such as test firing to the Plant boundary as well as to other Plant operations. These separation distances are monitored and routinely evaluated by internal and external groups from the Department of Energy and the Department of Defense.

Document #: *1036* **Comment #:** *7* **Date:** *3/1/93*

Arjun Makhijani, Ph.D.
Institute for Energy & Environmental Research

Comment:

V. Accident Scenarios - Calculations of the effects of an accidental explosion of high explosives on the Modified Richmond and SAC magazines are based on the assumption that the blast can be represented as a triangular wave distributed load on the roof of the structure in quesions (sic). These calculations indicate that the combination of blast and dead load on the roof of the Modified Richmond magazine would be about 65% of the estimated yield strength of the beam.

Since the results of the stress calculations are dependent on pressure waveform and on the distribution of the load, the DOE should do a sensitivity analysis that includes waveforms with sharper rise profiles (such as exponential or parabolic) and non-uniform load distributions across the roof. Similar sensitivity analyses should also be done for other aspects of calculating the consequences of an accidental explosion. This is critically needed for the doors of the SAC magazine, since the calculated ductility ratio with the assumed waveform and load distribution indicates significant deformations may occur with the assumed waveforms.

Response #: D.16

The structural response of the roof, in the event of an adjacent detonation, has been addressed using standard Department of Energy and Department of Defense design methods. The pressure event used in the accident scenario is a result of a detonation a great distance away (480 ft, 435 ft).

The positive phase impulse is the area under the pressure-time event back to the first point of ambient pressure, t_o ("Structures to Resist the Effects of Accidental Explosions", TM 5-1300, NAVFAC P-397, AFR 88-22, Figure 2-90, Page 2-232). The equivalent pressure history is represented by the idealized positive phase curve. The modified pressure time history appears as an immediate over-pressure coincident to the actual over-pressure, P_{so}, then decays linearly to the original environmental pressure after the equivalent load duration is met, t_{of}. As a result, the equivalent triangular event conserves the original magnitude of the over-pressure and the actual incident impulse on the structure. The simplified load duration, t_{of}, is the only assumption used in the pressure history. Both histories still represent the original real impulse. The figure cited above is not to scale, and the negative phase pressure is overstated. The time history of the pressure pulse, as stated in the Environmental Assessment, has a relatively low original pressure component along with a relatively longer applied duration.

Because of the combination of the strength of the structure and the resulting pressure time history from the detonation, the design falls into the design category of a pressure sensitive structure. Since this structure is pressure sensitive, the design approach undertaken is the acceptable method to use. The applied pressure used in the analysis is the pressure at the wall closest to the point of detonation. In addition, this pressure time history is applied to the entire length of the roof to ensure the bounding case loading history has been examined. Therefore, a sensitivity analysis is not needed because a bounding case event has been used in the original analysis.

ft = feet

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (D.17) FOLLOWS ON PAGE D-25.

Document #: *1007* **Comment #:** *3* **Date:** *2/25/93*

Joseph A. Martillotti

Texas Dept. of Health, Bureau of Radiation Control

Comment:

Page 3-2, Line 23-29: The discussion of the shielded forklift with passive guidance system is written in the present tense, as though it exists and is in use today.

Document #: *1015* **Comment #:** *13* **Date:** *2/20/93*

Addis Charless, Jr.

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

Pg A-2: Table A-1 states the possibility of internal fire as being "not possible or plausible at this site or facility". However, an earlier statement in this EA document considered a forklift accident scenario in which Pu escaped its confinement. Since Pu is pyrophoric (burns on contact with air), a very real internal fire possibility exists.

Document #: *1016* **Comment #:** *22* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

A-5 does not mention any possibly (sic) of an explosion caused by a forklift penetrating a container causing great heat by friction or the possibly (sic) of an exploding battery or other electrically (sic) short.

Document #: *1017* **Comment #:** *6* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

Internal Explosions -- Plutonium pits implode; not explode. Forklift batteries may explode.

Document #: *1017* **Comment #:** *7* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

Internal Fires -- Plutonium is combustible in the presence of oxygen. How about electrical fires from an electric forklift? How about heating and or air conditioning in Work area Bay #8 where storage is now being done? How about wooden pallets? They burn.

Document #: *1017* **Comment #:** *8* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

Lightning Strikes -- How about static electricity from nearby lighening (sic) strikes and static electricity from wind?

Document #: *1017* **Comment #:** *9* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

Loss of Power -- Would gasoline or deisel (sic) powered generators be used to light the storage area if power is lost from commercial supplies?

Document #: *1017* **Comment #:** *12* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

Sand storms and Dust storms -- How about static electricity? How about missiles from high winds? The day before Labor Day (Sept. 3, 1968 or 1969) we had a wind storm that took a four mile wide swath of high voltage electrical lines and poles and roofs from homes and machine sheds and barns. One Pantex employee at that time told me that the wind speed indicator at the plant registered 113 mph before it broke. Also there were reports of as many as 7 funnel clouds reported in that storm. He said after he saw a 55 gallon drum go over the administration building that it was time to go to the basement.

Document #: *1017* **Comment #:** *13* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

Transportation Accident: -- Electric fork lifts may catch fire -- Batteries may explode from either fire or overload. Trucks could be involved incollisions (sic), catch fire or be turned over by high winds.

Document #: *1017* **Comment #:** *16* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

Fork Lift Accident -- If, as the EA suggests, the container is punctured and the pit crushed, plutonium would be exposed to air. Friction from the fork lift tine penetration of the pit could cause spontaneous combustion. The workers would be exposed to fire and smoke as well as plutonium dusts. Presuming that the door of the magaxine (sic) was open, the surrounding area and people could also be exposed.

Document #: *1042* **Comment #:** *24* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

Unanswered in the draft EA are basic questions, including: ...

- If storage containers are punctured, what amount of plutonium dust could be released, with what effect on workers, what emergency response measures will be put into place to treat workers so exposed?

Document #: *1042* **Comment #:** *39* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

The draft EA discusses the shielded electric forklift, but does not provide important information, including:

- *how many of those forklifts are currently in use,*
- *what are measured reduced exposures to workers,*
- *what is the accident history of those forklifts compared to unshielded forklifts?*

The draft EA mentions the AGVs, but does not describe:

- *when such vehicles could be available,*
- *the calculated reductions in time for inspections or reduced worker exposures,*
- *what kind of testing has been done with prototype vehicles and with what results,*
- *how the barcodes would be placed on pits already stored.*

Document #: *1042* **Comment #:** *50* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

17. Page 6-5. The discussion of a forklift accident does not use the most conservative assumptions, including for the amount of plutonium dust available and the actual inhalation by a worker. Thus, the statements that there would be no health effect to the worker and no consequences to the public are not adequately supported.

Document #: *1048* Comment #: *13* Date: *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

5.0... any serious dispersal of plutonium was not carefully examined, 5.2 ...does not talk about risks to the general off-site population. Off-site ionizing radiation was not even considered. No Emergency Preparedness plans were presented for off-site communities in the event of a hazardous or toxic release.

Response #: D.17

Forklifts Puncturing Containers

The Zone 4 operations were carefully examined for the possibility of operational accidents. The most limiting accident involves a forklift puncturing an AL-R8 container. A forklift penetration might cause a breach of the container, but since there is no explosive material in the container (only the pit and packing material), an explosion is not possible. The analysis provided in Section 6.2.4 of the Environmental Assessment is consistent with the analysis documented in the Pantex Plant Final Safety Analysis Report for Zone 4 Magazines. The forklift analysis described in the Pantex Plant Final Safety Analysis Report for Zone 4 Magazines is very conservative.

A forklift accident has been evaluated and the potential for a spontaneous combustion was found to be not possible. A more likely event is that the crushing of the pit would cause the expulsion of respirable plutonium dust. Using conservative assumptions, it is estimated that 0.57 mg (92 μCi of 45 year old weapons grade plutonium) of this dust could be expelled from the container. A worker who is exposed to this quantity of plutonium dust could receive a committed effective dose equivalent of 6.6 rem to the whole body over the next 50 years. The committed effective dose equivalent to an individual at 2.1 km is 0.00013 rem to the whole body over the next 50 years. In both instances, less than one-half of the 50-year committed effective dose equivalent would be received during the first year, and smaller amounts would be received during all ensuing years. Therefore, the maximum dose to the worker would be 3.3 rem and to the general public would be 0.000065 rem during the first year after a release of this magnitude. Thus, neither the 5.0 rem Federal radiation limit for the dose to the whole body that each radiation worker at nuclear facilities is allowed to receive each year, nor the 0.010 rem/yr standard developed by the Environmental Protection Agency in 40 Code of Federal Regulations 61, Subpart H, to limit risk to the general public and the environment would be exceeded in any one year. These regulatory limits are established at levels significantly lower than those that have been known to cause any public health hazard. The shielded forklift will reduce the possibility of puncturing a container due to electrical and mechanical interlocks not accounted for in this conservative analysis.

Battery Explosion, Transportation, Fire, and Other Vehicle Accidents

A pit in its storage configuration does not contain explosive material and cannot explode. An exploding battery, an electrical short, or a forklift penetration cannot cause a pit to explode. Battery explosions usually occur during the charging cycle, which is done at a different location than Zone 4.

Several vehicles may be near the magazines, including Safe, Secure Trailers, diesel-powered forklifts, electric forklifts, and various transport and security vehicles. Only electric forklifts are allowed inside the magazines. Due to the structure of the magazines, transportation activities outside the magazines do not pose an internal threat. The pits are transferred to and from Zone 4 in either the AL-R8, an approved storage container, or a certified Type B transportation container. The AL-R8 container has been reviewed for the bounding transportation accident in the "Rocky Flats Container, Model AL-R8 Safety Analysis Report for Packaging". The Type B transportation container has been rigorously tested to prove compliance with requirements.

Only a minimal amount of exposed combustible material is allowed in the magazines (principally in the form of shipping/identification tags). In an effort to reduce the threat of internal fires, the pallets used for stacking are made of metal and are not combustible. The minimum level of exposed combustibles associated with these items was evaluated in the Pantex Plant Final Safety Analysis Report for Zone 4 Magazines. The likelihood of an internal fire scenario was examined in Appendix D of the Pantex Plant Final Safety Analysis Report for Zone 4 Magazines. The initiating event for a fire (a hydraulic fluid leak from an electric forklift) is an implausible event. Based on the frequency of this initiating event and the probability of other events that are necessary for an uncontrolled fire to occur, the likelihood of a fire initiated inside a magazine leading to the release of radioactive material is 2.7×10^{-7} per year. No damage to the structures or their contents are expected because there is insufficient material to sustain an internal fire. Consequently, no effects on the general public, the Pantex Plant workers, or the environment are expected, although damage to the forklift may occur.

Plutonium Dispersion Accidents

Pits cannot spontaneously implode. For weapons to function, a high explosive shell around the pit is detonated that implodes the pit. The configuration evaluated in the Environmental Assessment is for single pits with no explosive material present. Neither explosion nor implosion of a pit is possible in this configuration.

Plutonium metal in large pieces (such as present inside plutonium-containing pits) does not burn on exposure to air. Plutonium metal can be handled in air and is often processed and stored in normal air in environmental glove boxes. Spontaneous ignition only occurs when plutonium is present as particles less than 0.2 mm thick and then only on exposure to temperatures in excess of 150° C. Larger samples must be exposed to temperatures in excess of 500° C before ignition. Formation of such small particles is difficult. Plutonium subjected to considerable mechanical stress does not form such small particles. Analysis of plutonium pits subjected to mechanical deformation or stress shows plutonium does not burn or spread as a result of chemical reaction with air. Plutonium oxide forms when plutonium metal or a compound of plutonium reacts with oxygen. The oxide forms an adherent layer on the metal surface and acts as a barrier that slows the rate at which additional oxygen can react. The oxide is the most stable compound of plutonium in an oxygen-containing environment, and, once formed, it does not react further upon continued exposure to the air. Controlled chemical processing is necessary to convert the oxide back to the metal or to another plutonium compound.

Shielded Forklifts and Automated Guided Vehicles

Shielded forklifts are not yet in use at Pantex Plant, and no historical information is available on shielded forklift accidents. However, the shielded forklift has been delivered to Pantex Plant, and operators are being thoroughly trained prior to operating it. Sensors have been installed to assist in the operation by providing position of the forklift and height indication of the boom used for pallet retrieval. In addition, electrical and mechanical interlocks will further reduce the probability of a forklift puncture accident. The expected reduction in radiation exposure to personnel using the shielded forklift is anticipated to be a factor of 20.

The implementation date of the Automated Guided Vehicles delivery is unknown at this time because the contract is currently in the procurement phase, and it has not been awarded. Since the Automated Guided Vehicles are currently in the procurement phase, no testing has been performed to date. Once the Automated Guided Vehicles are delivered (expected in the fall of 1994), both Pantex Plant and Sandia National Laboratory will perform prototype testing. The goal for the Automated Guided Vehicle project is to eliminate the need for personnel to enter the magazines for inventory and inspection. The inventory and inspection requirements will be satisfied by using a bar code reader and cameras. By eliminating the need to enter the magazines, radiation exposure will be drastically reduced.

Confusion was generated because on Page 3-2 (of the December 1992 Draft Environmental Assessment) the third paragraph starts with "An electric shielded forklift with shielding for radiation purposes would be used for storage, retrieval, and inventory operations for palletized stacking configurations or individual container handling". The paragraph then continues in the present tense as if the forklift was already in use. The shielded forklift was not constructed when the draft Environmental Assessment was written but has now been delivered. The unit has been tested and workers are being trained in its use. The forklift is shielded to maintain worker radiation exposure "As Low As Reasonably Achievable", which is less than 1 rem/yr. This is another system that Pantex Plant has planned for protection of its workers.

Lighting in the Magazines

Neither the Modified-Richmond nor Steel Arch Construction magazines has lighting inside. The electrical system is used for security purposes, is supported by two redundant sources, and has a backup generator that is not in Zone 4. A complete loss of electrical power to the magazines would not lead to safety-related consequences.

ENVIRONMENTAL ASSESSMENT TEXT CHANGE

Sections 3.0 and 6.0 have been changed to reflect comments.

mg = milligram
km = kilometers
yr = year
μCi = microCuries
mm = millimeters
C = Celsius

Document #: *1015* **Comment #:** *11* **Date:** *2/20/93*

Addis Charless, Jr.

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

Pg 6-5: If a forklift accident occurs, conservative calculations show .57 mg of Pu escaping to the atmosphere. A lethal inhaled dose of Pu is a scant one-billionth of a gram.

Response #: D.18

If 0.57 mg of 45 year old weapon grade plutonium was released into the air, a fraction of this dispersed material could be inhaled by personnel in the immediate area of the accident. An analysis of such an event is discussed in the Pantex Plant Final Safety Analysis Report for Zone 4 Magazines in Appendix D. These results are:

1) The worker would be expected to receive 0.02 μCi through breathing;

2) The resultant 50 year committed effective dose equivalent for lungs would be 24 rem; and

3) The resultant 50 year committed effective dose equivalent for whole body dose would be 6.6 rem.

One billionth of a gram of weapon grade plutonium is equivalent to 0.06 nCi (6×10^{-11} Ci) of activity. This amounts to 0.3 percent of the activity calculated by the event discussed above, and would result in a 50-year committed effective dose equivalent for lungs and whole body in direct ratio to the doses reported in Appendix D of the Pantex Plant Final Safety Analysis Report for Zone 4 Magazines, or about 72 mrem to the lungs and 20 mrem to the whole body over 50 years. Consider these exposure levels when compared to the annual effective dose equivalent for inhalation of naturally occurring radon gas (200 mrem/yr) as stated on page 15 of the National Council of Radiation Protection 1993 Report.

mg = milligram
μCi = microCuries
nCi = nanoCuries
Ci = Curies
mrem = millirem
yr = year

Document #: *1015* **Comment #:** *16* **Date:** *2/20/93*

Addis Charless, Jr.

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

Pu is in this EA addressed as 45 years or more old, as if by this advanced age it is relatively innocous (sic). However, 45-year-old Pu has spent but 1/5,333rd of its total life before it is an inert substance.

Breakdown/decay/sister products of Pu have half-lives of up to 28 billion years.

Since we do not know the long term chemical form of Pu in this ecosystem, we've absolutely no idea of its effects on the ecosystem. To assume the initial form of Pu to be an oxide might be correct, or it may be a gross fallacy with a horrible unthought of effect.

Response #: D.19

The age of the plutonium (Pu) refers to the time that has lapsed since it was manufactured into weapons grade material. Rather than describing the plutonium as relatively innocuous at 45 years, the Environmental Assessment describes it in a state where it emits more penetrating radiation than when it is newly manufactured. Older manufactured plutonium emits more penetrating radiation because of a natural isotopic contaminant, Pu-241. This type of plutonium has a much shorter half-life than Pu-239 and it decays to americium (Am-241). The Am-241 emits penetrating radiation similar to an X-ray, which is the primary contributor to dose rates present outside of the pit storage containers. Therefore, assuming that the plutonium is 45 years old describes a conservative case when predicting dose rates near pit storage areas.

If the sealed pit is compromised by external forces, the plutonium will oxidize as do other metals. Plutonium oxides are insoluble and move very slowly through the ecosystem. The effects of plutonium as well as other radioisotopes in the ecosystem have been extensively studied and are discussed in such documents as <u>Radiological Assessment: Predicting the Transport, Bioaccumulation and Uptake by Man of Radionuclides released to the Environment (NCRP Report No. 76)</u>, National Council on Radiation Protection and Measurements, Bethesda, Maryland, 1984; and <u>Radiological Assessment, A Textbook on Environmental Dose Analysis (NUREG/CR-3332, ORNL-5968)</u>, Till, John E. and Meyer, H. Robert, editors, U.S. Nuclear Regulatory Commission, Washington, D.C., 1983; as well as in other scientific literature.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (D.20) FOLLOWS ON PAGE D-31.

Document #: *1010* **Comment #:** *1* **Date:** *2/8/93*

Walt Kelley

City of Amarillo, Emergency Management

Comment:

1. The maximum tornado winds shown in the assessment are 220 mph. This wind speed falls in the range of a category F4 tornado (wind range 207-260 mph). This past year an F4 level tornado struck Fritch, Texas, a community approximately 20 miles NE of the plant. During recent years we have spotted and tracked several tornados near the plant. More emphasis needs to be placed on the effects of the maximum winds of an F4 level tornado (260 mph) and consideration needs to be given to an F5 level (winds 261-318 mph) tornado. A new engineering study needs to be completed on the older storage areas in sector 4. The threat is listed in the assessment as extremely unlikely yet the plant has very extensive tornado plans and elaborate spotting techniques and equipment.

Document #: *1016* **Comment #:** *18* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

As Dana O. Porter soil and water conservation engineering specialist at Mississippi State University says, the EA is lacking in basic information that the DOE needs to accurately determine the safety of the proposed storage of Pu at Pantex. The scope is too narrow. Extremes of the weather are very conservative. Section 5-1 states the prevailing wind direction is from the south-southwest with an average wind speed of 14 mph with occasional gusts of up to 70 mph. The weather bureau at National Weather Service says th (sic) annual average is 13.1 mph at a 230 degree true direction. Wind gusts have been recorded in excess of 100 mph. On September 3, 1968, a wind guage (sic) on the Pantex site registered 113 mph before it broke. We have observed numerous tornadoes, funnel clouds, and massive wall clouds both near and over the plant. In June, 1992, a tornado crossed from our tail water pit into the plant before lifting near Firing Site 4. Two very large wall clouds were seen over the plant and our home the same week. In May, 1991, a tornado moved from just west of Panhandle directly toward the east gate of Pantex before lifting just before it got there.

Document #: *1024* **Comment #:** *4* **Date:** *3/10/93*

Jay R. Roselius, County Judge

Carson County

Comment:

... request that authorities from these different agencies be assembled together in their area of expertise and address and formulate the best possible response to the following areas which seem to me to be the areas of most concern when considering all of the various comments...

4. What impact would tornadic winds have on a bunker/magazine or other strategic location.

Document #: *1030* **Comment #:** *1* **Date:** *3/2/93*

Judy Osborne

Citizen Comments

Comment:

One can be sure that if the city of Panhandle has the potential of being hit by a tornado, the Pantex plant is also vulnerable to a hit.

Numerous very devastating tornadoes have struck near the plant. In late June, 1992, the city of Fritch, about 15 miles to the north of the plant was very hard hit. The city of Amarillo has been hit. White Deer has had three hits. A farm was destroyed 4 miles to the north of the plant. Tornadoes have been spotted on all sides of the plant. In September, 1968, a rather large storm with numerous tornadoes and funnel clouds moved from the north onto the plant site. A wind guage (sic) on the site broke at 114 mph. in (sic) 1991, a large tornado headed directly toward the east gate from Panhandle, lifting just before it reached the plant. In June, 1993(sic), at least three tornadoes were spotted on the north side of the plant. One moved onto the site, lifted at Firing site 5.

We believe the possibility of a devastating tornado striking the Pantex plant is too great (sic) threat for Pantex to be considered as an intrium(sic) storage site for plutonium. Missiles hurled by the very high winds of a tornado are capable of penetrating the storage areas. There would not have to be a direct strike for massive destruction.

Response #: D.20

From the Pantex Plant Final Safety Analysis Report for Zone 4 Magazines, the analysis of the magazines indicates the structure will not fail as a result of a 132 mph Design Basis Tornado or a 200 mph Maximum Credible Tornado. Since the maximum credible tornados was calculated to be 200 mph, tornados with winds speeds in excess of that amount were considered to be not credible and thus not examined. There are considerable safety margins associated with the magazine roof/steel arch and earth overburden, walls, doors, and security barriers to resist the forces produced by both levels of tornados. It is important to note that the magazine structures have been analyzed under the condition that the doors are closed. Operating procedures require that the magazines be secured during the onset of severe weather. In this secured configuration, the Pantex Plant Final Safety Analysis Report for Zone 4 Magazines identifies the large concrete blocks protecting the steel doors as the only vulnerable component to the effects of a tornado.

Another design configuration for tornado analysis includes atmosphere pressure change. The maximum pressure difference applied to the concrete blocks during the Maximum Credible Tornado is approximately 100 psf. Since the pressure required to topple the concrete blocks is 140 psf, the magazines are considered invulnerable to the wind effects of both the Design Basis Tornado and the Maximum Credible Tornado. In addition, the statement that winds average 14 mph from the south-southwest is consistent to the given statement that the annual average is 13.1 mph at 230 degrees true direction.

The analysis in the Pantex Plant Final Safety Analysis Report for Zone 4 Magazines also concluded that the most credible generated missile is a tornado-driven, 75 lb., 3 in. diameter pipe traveling at 50 mph will penetrate the concrete structure approximately 8 in. Since the magazine structure is earthen-covered and at its thinnest point is 24 in. thick, the magazine structures are considered invulnerable to the effects of the tornado-generated missiles.

mph = miles per hour
psf = pounds per square foot
lb = pound
in = inch

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (D.21) FOLLOWS.

Document #: *1012* **Comment #:** *5* **Date:** *1/16/93*

Margie K. Hazlett (1)

Citizen Comments

Comment:

Our climate is not suitable for plutonium storage such as that at Pantex. During a 24 hour period, usually in the Spring or Fall, we can have an extreme temperature of hot weather and then extremely cold, and vice versa. This process could cause any container to rust after condensation, or cause a lot of moisture in your plutonium storage places. Our climate can be fine some days, but then we have violent tornadoes with hail, straight winds and strong thunder storms. During high winds, we prefer not to have grass fires.

Response #: D.21

The climate has been recognized as a source of accident conditions, specifically high winds and tornados. The facilities have been evaluated in the Pantex Plant Final Safety Analysis Report for Zone 4 Magazines for earthquakes, tornados, fires, flooding, explosions, and missiles (generated by explosions or tornados). These analyses have concluded that natural phenomena do not pose a threat to the plutonium storage facilities. The containers have been designed and approved for the storage of plutonium to avoid corrosion and other accident conditions.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (D.22) FOLLOWS.

Document #: *1011* **Comment #:** *4* **Date:** *2/18/93*

Dana O. Porter

Citizen Comments

Comment:

I question the accuracy of the average annual wind rose, located on page 5-10, Figure 5.8, in the report. I found no reference cited for the data in the figure. An error or misrepresentation of such data can result in inappropriately placed air quality samplers, and consequently, errors in air quality measurements.

Response #: D.22

Figure 5.8, which appears on Page 3-3 of the 1983 Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098), represents the average annual wind rose for 1955 through 1964, based on data obtained from the National Weather Service Station located at the Amarillo International Airport in Amarillo, Texas. This 10 year wind rose is similar to wind roses from recent years and is considered to be accurate.

Placement of air quality sampling equipment is based on numerous factors including the prominent wind direction(s), but also on input from various regulatory agencies (Environmental Protection Agency, Texas Air Control Board) and on permit requirements.

ENVIRONMENTAL ASSESSMENT TEXT CHANGE

Section 6.0 has been changed to reflect the comments.

Document #: *1007* **Comment #:** *2* **Date:** *2/25/93*

Joseph A. Martillotti

Texas Dept. of Health, Bureau of Radiation Control

Comment:

"Page 3-1, Lines 35-36: The statement "DOE Orders and procedures for insuring safe and secure storage of pits would continue to be followed rigorously." is misleading and is contradicted by Paragraph 6.1.1.1, which states that "... inspections and inventories would (bolded) occur a minimum of once every 18 months..." (emphasis added). During a DOE briefing conducted on January 14, 1993, this was verified as a departure from the current bi-monthly minimum physical inventory requirement."

Document #: *1007* **Comment #:** *9* **Date:** *2/25/93*

Joseph A. Martillotti

Texas Dept. of Health, Bureau of Radiation Control

Comment:

Page 6-1, Paragraph 6.1.1.1: This passage reflects a diversion from previous DOE Security and Safeguards requirements to mitigate substantial increase in worker radiological exposures. The statement on Page 3-1, Lines 36-37, "The DOE Orders and procedures for ensuring safe and secure storage of the pits would continue to be followed rigorously." needs to be reconciled here. It should also be noted that the "approval" contained in DOE/SA-124 Memorandum, Dated January 12, 1993, Subject, "Request for Exception of the Bimonthly Minimum Physical Inventory Frequency Requirement at the Pantex Facility" relates only to 18 Igloos. It is interesting to note that the "effective date" is not a date certain, but rather a "floating" date starting (or re-starting) within 30 days after a physical inventory of the contents of each igloo has been accomplished.

Document #: *1007* **Comment #:** *10* **Date:** *2/25/93*

Joseph A. Martillotti

Texas Dept. of Health, Bureau of Radiation Control

Comment:

Page 6-2, Chart: This gives the appearance that corrosion inspections are not required for containers in the horizontal palletized stacking configuration.

Document #: *1008* **Comment #:** *1* **Date:** *2/1/93*

Boyd Deaver

Texas Water Commission

Comment:

Comment: Executive Summary: page vii fourth paragraph. -- Reference is made to capacities of the magazine, the statement of "up to 20,000 pits" appears to be an inference rather than a declaration... Capacities of magazines mentioned well exceeds 20,000 pits.

Question: What is the maximum capacity of Storage?

Document #: *1008* **Comment #:** *4* **Date:** *2/1/93*

Boyd Deaver

Texas Water Commission

Comment:

Comment: 3.0 PROPOSED ACTION: p. 3-1, Third Paragraph. - "...hold up to 384 or 392 pits, in the single-layer vertical or horizontal palletized multiple stacking configurations respectively.

Question: Figure 3.4 exhibits 460 pit capacity for horizontal palletized multiple stacking. Which number is the capacity to be used?

Document #: *1008* **Comment #:** *5* **Date:** *2/1/93*

Boyd Deaver

Texas Water Commission

Comment:

Comment: 3.0 PROPOSED ACTION: p. 3-2, Second paragraph. - "Variations and/or a combination of these arrangements may be used.

Question: Is this a "disclaimer" or "loophole" that can be used to deviate from arrangements previously proposed in this document?

Document #: *1011* **Comment #:** *6* **Date:** *2/18/93*

Dana O. Porter

Citizen Comments

Comment:

The report indicates that the containerized plutonium pits will be inspected on an 18-month schedule. There is a comment on page 6-1 of the report that some minor releases of air pollutants (sic) during these inspections.

Inventory and inspection operations described by the report have allowed one minute per container. Does this include locating and moving the containers to an area where they can be visually inspected? From the stacking configurations described in the report, I was not able to visualize how the inspectors could locate and inspect the individual pits at a rate of one per minute, especially if the pits must be moved with a forklift. If inspection time and handling requirements are underestimated, are the associated risks also underestimated?

Document #: *1015* **Comment #:** *8* **Date:** *2/20/93*

Addis Charless, Jr.

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

Pg 5-1: PX storage magazines employ natural ventilation. Any accidental leakages would be vented to the atmosphere for dispersal by the winds to who-knows-where: the Canadian river, Lake Meredith, the assorted playa lakes of the area, and by subsequent percolation/infiltration, most likely into the Ogallala aquifer.

Document #: *1016* **Comment #:** *9* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

Radiation is not adequately addressed. The exposure of workers will be much greater with realistic time frames for inspection. There Is no way workers can make a full visual inspection of storage containers in one minute, especially taking into account the removing and replacement of the container (F-1.3.). The long term exposure of low levels of radiation to workers and/are (sic) peoples living nearby are are (sic) not addressed. A one time exposure is a lot different than an exposure of low levels 24 hours a day for months and years. What are the cumulative effects? DOE must answer.

Document #: *1016* **Comment #:** *15* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

At what point will natural deterioration of the containers, Pu, and storage area occure (sic)? How will radiation effect the containers and the storage area? Will radiation cause more rapid deterioration of the concrete, the steel, or even the gravel and dirt of the magazines?

Document #: *1016* **Comment #:** *20* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

Section 6.1.2. states that "the expected level of penetrating radiation would result in no measurable effect or exposure to an individual occupying a position for an entire year at the nearest Pantex site boundary. Such a level would be indistinguishable from natural background radiation." Since this "individual" is either me or a member of my family, I question if the Pantex operations and storage of Pu and other radioactive activities may be adding to the background radiation. How does long term exposure to low levels affect us?

Document #: *1017* **Comment #:** *1* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

After reading the EA, I visited with a former Pantex employee who also read the EA. He told me that at the time he worked there, they were only allowed to store 32 or 40 pits per igloo instead of the 270 to 400 04 (sic) 440 pits they are proposing to store or stage now.

Document #: *1017* **Comment #:** *2* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

After reading the EA, I visited with a former Pantex employee who also read the EA. ... He said he felt that monitoring on an 18 month basis is not nearly often enough and that the number of containers proposed to be monitored is not nearly enough.

Document #: *1017* **Comment #:** *3* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

After reading the EA, I visited with a former Pantex employee who also read the EA. ... He also wants to know if the pits are to be segregated according to type for storage or will they be stored randomly?

Document #: *1017* **Comment #:** *4* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

After reading the EA, I visited with a former Pantex employee who also read the EA. ... He said there is not (sic) way that workmen can remove, inspect and restore a container per minute. He said it would take hours and hours to remove all the containers to get to one near the rear of an igloo and that worker exposure would be too great.

Document #: *1019* **Comment #:** *3* **Date:** *1/20/93*

W. H. O'Brien

Operation Commonsense

Comment:

There also remains a critical need for detailed analysis of the comparitive (sic) stability of the 18 Modified-Richmond magazines vs. the 42 Steel Arch Construction (SAC) magazines and the overall adequacy of magazines built 50 years ago to hold conventional bombs.

Document #: *1019* **Comment #:** *4* **Date:** *1/20/93*

W. H. O'Brien

Operation Commonsense

Comment:

Moreover, differences in the density of storage [number of pits] in each magazine could impact the degree of risk as well as the ease and safety for inspection tasks.

Document #: *1021* **Comment #:** *8* **Date:** *1/25/93*

Lawrence D. Egbert, MD
Physicians For Social Responsibility

Comment:
The DOE points out that using the safer method of storage will fill up the present storage areas this year while the less safe method will fill it up by the summer of 1994. That horizontal, palletized multiple stacking has not been used before in either the Modified Richmond or the steel arch constructed magazines rather implies that the DOE has not previously thought about storage of Pu pits, does it not?

Document #: *1022* **Comment #:** *2* **Date:** *2/11/93*

James Thomas
Hanford Education Action League (HEAL)

Comment:
p. 2-1 -- Both here and elsewhere in the EA (e.g. compare number on p. vii with those on p.3-1), there are numerous inconsistencies in the number of pits to be stored at Pantex. In addition, this same problem of inconsistency involves the storage capacity of Pantex and DOE's proposed storage levels at Pantex.

Document #: *1026* **Comment #:** *5* **Date:** *2/19/93*

Tamara Snodgrass
Citizen Comments

Comment:
There is no discussion on the stability of plutonium pits during interim or long-term storage.

Document #: *1026* **Comment #:** *6* **Date:** *2/19/93*

Tamara Snodgrass
Citizen Comments

Comment:
The effect on the workers is not adequately addressed in this draft document. It does not explicitly analyze doses to workers who handle the pits in the disassembly areas and those transporting them from disassembly areas to Zone 4.

Document #: *1026* **Comment #:** *7* **Date:** *2/19/93*

Tamara Snodgrass
Citizen Comments

Comment:
It does not calculate the doses for the maximally exposed worker, or the doses to workers if inspections are required more frequently pthan (sic) every 18 months. Not discussed is the increased worker exposures compared with the current operations, yet it appears those exposures will be several times current levels.

Document #: *1031* **Comment #:** *3* **Date:** *3/1/93*

Louise Daniel
Citizen Comments

Comment:
Deterioration of the pits and storage containers over the long term should receive intensive study.

Document #: *1032* **Comment #:** *5* **Date:** *2/19/93*

Betty E. Barnard
Citizen comments

Comment:
There is no discussion on the stability of plutonium pits during interim or long-term storage.

Document #: *1032* **Comment #:** *6* **Date:** *2/19/93*

Betty E. Barnard
Citizen comments

Comment;
The effect on the workers is not adequately addressed in this draft document. It does not explicitly analyze doses to workers who handle the pits in the disassembly areas and those transporting them from disassembly areas to Zone 4.

Document #: *1032* **Comment #:** *7* **Date:** *2/19/93*

Betty E. Barnard
Citizen comments

Comment;
It does not calculate the doses for the maximally exposed worker, or the doses to workers if inspections are required more frequently pthan (sic) every 18 months. Not discussed is the increased worker exposures compared with the current operations, yet it appears those exposures will be several times current levels.

Document #: *1033* **Comment #:** *5* **Date:** *2/19/93*

Norbert Schlegal
Citizen Comments

Comment;
There is no discussion on the stability of plutonium pits during interim or long-term storage.

Document #: *1033* **Comment #:** *6* **Date:** *2/19/93*

Norbert Schlegal
Citizen Comments

Comment;
The effect on the workers is not adequately addressed in this draft document. It does not explicitly analyze doses to workers who handle the pits in the disassembly areas and those transporting them from disassembly areas to Zone 4.

Document #: *1033* **Comment #:** *7* **Date:** *2/19/93*

Norbert Schlegal
Citizen Comments

Comment;
It does not calculate the doses for the maximally exposed worker, or the doses to workers if inspections are required more frequently pthan (sic) every 18 months. Not discussed is the increased worker exposures compared with the current operations, yet it appears those exposures will be several times current levels.

Document #: *1034* **Comment #:** *5* **Date:** *2/19/93*

48 signatures/form letter
Citizen Comments

Comment;
There is no discussion on the stability of plutonium pits during interim or long-term storage.

Document #: *1034* **Comment #:** *6* **Date:** *2/19/93*

48 signatures/form letter
Citizen Comments

Comment;
The effect on the workers is not adequately addressed in this draft document. It does not explicitly analyze doses to workers who handle the pits in the disassembly areas and those transporting them from disassembly areas to Zone 4.

Document #: *1034* **Comment #:** *7* **Date:** *2/19/93*

48 signatures/form letter

Citizen Comments

Comment:

It does not calculate the doses for the maximally exposed worker, or the doses to workers if inspections are required more frequently than every 18 months. Not discussed is the increased worker exposures compared with the current operations, yet it appears those exposures will be several times current levels.

Document #: *1035* **Comment #:** *5* **Date:** *2/19/93*

Karen Son

Citizen Comments

Comment:

There is no discussion on the stability of plutonium pits during interim or long-term storage.

Document #: *1035* **Comment #:** *6* **Date:** *2/19/93*

Karen Son

Citizen Comments

Comment:

The effect on the workers is not adequately addressed in this draft document. It does not explicitly analyze doses to workers who handle the pits in the disassembly areas and those transporting them from disassembly areas to Zone 4.

Document #: *1035* **Comment #:** *7* **Date:** *2/19/93*

Karen Son

Citizen Comments

Comment:

It does not calculate the doses for the maximally exposed worker or the doses to workers if inspections are required more frequently pthan (sic) every 18 months. Not discussed is the increased worker exposures compared with the current operations, yet it appears those exposures will be several times current levels.

Document #: *1036* **Comment #:** *5* **Date:** *3/1/93*

Arjun Makhijani, Ph.D.

Institute for Energy & Environmental Research

Comment:

III. Container Types - The EA mentions two different types of containers: carbon steel and stainless steel. It provides no discussion of the relative merits of these containers, how many of each will be used, and what the effects of various essumptions about the use of these containers (sic) be on the dismantlement rates and on worker health and safety. In addition, the EA does not discuss the relative merits of each type of container with respect to a number of crucial issues, such as corrosion rates, inspection frequency, verification issues, and severity of some accidents, notably those involving possible rupture of containers. The EA also does not provide the information necessary for an independent evaluation of the containers using such criteria. The EA should also discuss the experience of corrosion and worker doses with these two types of containers, as well as the maximum length of time that a pit has been stored in each type.

Document #: *1036* **Comment #:** *6* **Date:** *3/1/93*

Arjun Makhijani, Ph.D.

Institute for Energy & Environmental Research

Comment:

IV. Inspections and Inventory-Taking Procedures - The EA claims that a 100 percent inspection of the single-layer vertical configuration will take one minute per container, including removal, inspection and returning containers to the magazines. It does not provide any basis for this estimate, nor the variation in the amounts of time for containers in different parts of the magazine. This information is essential since both the soundness of the inspection and the doses to workers depend directly on this time estimate.

Further, aisle space would have to be cleared in order to inspect the containers in the rear of the magazine. This would require taking the containers to other magazines and stacking them appropriately, finishing the inspections and then retrieving and restacking the containers. Indeed, it would appear that all rows from front to back but one would have to be cleared and the containers stored elsewhere in order to inspect the containers in the last rows (parallel to the sides and stretching back from the door.)

It strains the imagination that all these operations, including thorough inspections, could be carried out at the rate of one minute per container. Further, such procedures raise verification questions, since the moving and stacking of containers rapidly from one magazine to another increases the opportunities for possible diversion.

The EA should provide detailed descriptions of all inspection procedures and the evidence from actual operating records that such inspection times are realistic for magazines that are full. It is also necessary for the EA to specify how much experience there is with inspections with full igloos in vertical configurations. Careful verification of DOE's inspection procedures is necessary to calculate compliance with dose limits, since workers will be in a highly radioactive environment, with neutron dose rates in the tens of millirems per hour and gamma dose rates in the hundreds of millirems per hour.

Finally, taking inventories of pits also raises similar questions. Since the magazines do not have lighting, physical verification of all of the inventory in a full, vertically stacked magazine would be quite time consuming. Yet the estimated time for such an inventory is not much greater than the estimated time to inventory a horizontally-stacked, modified Richmond magazine, where all the containers would be in relatively easily view (90 minutes for the horizontally-stacked versus 140 minutes for the vertically stacked.)

The rates of inspection and inventory-taking are critical to estimating worker doses. They are also central to estimating whether Pantex can meet the worker dose limits without compromising other goals, such as thoroughness of inspections. In this context, it is also important for the EA to include further information on other radiation to which the inspection and inventory workers would be subjected under normal or non-routine circumstances.

Document #: *1037* **Comment #:** *5* **Date:** *3/1/93*

Bishop Leroy T. Matthiesen

Diocese of Amarillo

Comment:

There is no discussion on the stability of plutonium pits during interim or long-term storage.

Document #: *1037* **Comment #:** *6* **Date:** *3/1/93*

Bishop Leroy T. Matthiesen

Diocese of Amarillo

Comment:

The effect on the workers is not adeuately(sic) addressed in this draft document. It does not explicitly analyze doses to workers who handle the pits in the disassembly areas and those transporting them from disassembly areas to Zone 4.

Document #: *1037* **Comment #:** *7* **Date:** *3/1/93*

Bishop Leroy T. Matthiesen

Diocese of Amarillo

Comment:

It does not calculate the doses for the maximally exposed worker, or the doses to workers if inspections are required more frequently than every 18 months. Not discussed is the increased worker exposure compared with the current operations, yet it appears those exposures will be several times current levels.

Document #: *1038* **Comment #:** *5* **Date:** *2/26/93*

Boyd M. Foster, President
Arrowhead Mills

Comment:
There is no discussion on the stability of plutonium pits during interim or long-term storage.

Document #: *1038* **Comment #:** *6* **Date:** *2/26/93*

Boyd M. Foster, President
Arrowhead Mills

Comment:
The effect on the workers is not adequately addressed in this draft document. It does not explicitly analyze doses to workers who handle the pits in the disassembly areas and those transporting them from disassembly areas to Zone 4.

Document #: *1038* **Comment #:** *7* **Date:** *2/26/93*

Boyd M. Foster, President
Arrowhead Mills

Comment:
It does not calculate the doses for the maximally exposed worker, or the doses to workers if inspections are required more frequently than every 18 months. Not discussed is the increased worker exposures compared with the current operations, yet it appears those exposures will be several times current levels.

Document #: *1039* **Comment #:** *5* **Date:** *3/10/93*

Tonya Kleuskens, Chairman
Texas Nuclear Waste Task Force

Comment:
DOE's draft EA does not adequately address the effect on Pantex workers. It does not explicitly consider doses of radiation to workers who handle the pits in the disassembly area and those transporting pits from disassembly to Zone 4.

Document #: *1039* **Comment #:** *6* **Date:** *3/10/93*

Tonya Kleuskens, Chairman
Texas Nuclear Waste Task Force

Comment:
Specifically, the EA does not calculate the doses for the maximally exposed worker, or the doses to workers if inspections are required more frequently than every 18 months. Also not discussed is the increased worker exposures compared with the current operations, yet it appears those exposures will be several times current levels.

Document #: *1040* **Comment #:** *3* **Date:** *3/9/93*

Carl L. King, President
Texas Corn Growers Assn.

Comment:
They do not even bother to discuss the stability of plutonium pits during interim or long-term storage.

Document #: *1042* **Comment #:** *12* **Date:** *3/12/93*

Beverly Gattis
Save Texas Agriculture and Resources (STAR)

Comment:
Issues that must be specifically discussed include: ,,,
e. Expected lifetime of Modified-Richmond and SAC facilities, including effects of increased radiation, and their expected performance from the two new proposed storage configurations and "maximum packing;"

Document #: *1042* **Comment #:** *16* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

Worker exposure information in Appendix F is based on one inspection in each magazine every 18 months. No basis is given for why that is the appropriate frequency of inspection. The EA must present a detailed discussion of why more frequent inspections are not necessary. It must also discuss why more frequent inspections would not be required in later years, when radiation exposure could result in container or building deterioration.

Document #: *1042* **Comment #:** *17* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

Further, the EA should present comparative data as to the level of exposures if inspections are required every month or every six months.

The basic information about the length of worker exposure is highly suspect. The draft EA states that for the Modified-Richmond magazines (single-layer vertical configuraton) each inspection would require 70 minutes and for the horizontal palletized stacking 45 minutes for each side, and for the SAC each inspection would require 140 minutes for single-layer configuration and 90 minutes for the horizontal palletized configuration.

Document #: *1042* **Comment #:** *18* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

Unanswered in the draft EA are basic questions, including:

- What kind of lighting will be provided for the inspections since the magazines apparently have no lighting;

Document #: *1042* **Comment #:** *19* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

Unanswered in the draft EA are basic questions, including: ...

- If each container will be removed from the magazines in case of single-layer veritcal stacking (as stated on p. F-2), what kind of accidents could occur, what exposures will occur, and how long would such moving actually take (certainly longer than the few seconds estimated);

Document #: *1042* **Comment #:** *20* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

Unanswered in the draft EA are basic questions, Including: ...

- During removal how many pits would be outside at any one time, what types of accidents could occur (including from weather related events), how many times would a pit actually be handled -- i.e., moving pits to allow aisle space to reach the rear of the magazine; how could just two workers properly keep track of and log the pits to ensure that they are each returned to their assigned storage location -- if additional workers are required, additional exposures will result;

Document #: *1042* **Comment #:** *22* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

Unanswered in the draft EA are basic questions, including: ...

- If the pits will not be handled or moved during inspections as is implied for horizontal palletized stacking, how will corrosion or leaks in "hidden" areas be identified;

Document #: *1042* **Comment #:** *29* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

The 18 Modified-Richmond magazines capacity would increase from 370 to a maximum of 440 pits and the SAC magazines could hold up to 384 pits. However, page 3-1 states that the Modified-Richmond would increase from 378 to 440 pits and the SAC could hold 384 or 392 or 406 pits (according to footnote 2). Which numbers are correct? Using the maximum figures shows that more than 24,000 pits (not 20,000 pits) could be stored. The EA should discuss if storage for more than 20,000 pits is eventually necessary, how could Pantex accommodate such an increase?

Document #: *1042* **Comment #:** *36* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

7. Page 3-1. Footnote 1 states that using the 18 Modified-Richmond magazines for up to 6,800 pits (or 378 each) "is not currently the operationally preferred configuration" but does not explain why that is so.

Footnote 2 states that the 406 pits/magazine single-layer vertical configuration "will not be considered for use" but does not provide any basis for that statement.

Document #: *1042* **Comment #:** *38* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

Variations or combinations of potential storage configurations are mentioned. What are the costs and risks of such variations? Why are aisles not required? How can inventories be done without aisles unless virtually the entire magazine is taken outside?

Document #: *1042* **Comment #:** *40* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

"Individual pit containers could rest on casters rather than on the concrete floor of magazines," but Figure 3.2 (page 3-4) says that having six rows of pits on casters is "operationally preferred." The EA must provide an analysis of why such a configuration is operationally preferred. For each configuration, the EA must provide an analysis of how inspections would be done, including how much movement of pit containers would be necessary, how two workers could ensure that each container was returned to its assigned location, how much time the configuration takes to load and unload and the calculated exposures. For containers on casters, the EA must describe the operational experience with casters, how frequently casters break or containers fall off.

Document #: *1042* **Comment #:** *49* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

15. Page 6-2. Some of the specific assumptions for the proposed action alternative do not appear to be conservative:

- inventory inspections should be calculated on a more frequent basis than once every 18 months; to be consistent with assumptions used for the no-action alternative and to make reasonable comparisons, inventory inspections should be each month (see page 6-3).

- since the maximum Modified-Richmond capacity is 440 pits (page 3-1), 220 pits per side could not be inspected in 70 minutes. Unless better information about actual inspection rates is available, a conservative assumption should be that the time required is at least twice that specified;

- inspecting 392 pits in a SAC (maximum capacity specified on page 3-1) is assumed to take 140 minutes, the same amount of time given for inspecting 440 pits in a two-sided Modified-Richmond magazine. Inspecting more than ten percent more pits should take at least more than ten percent more time.

- horizontal palletized stacking is assumed to take about one-third less time than for single-layer stacking. Justification and actual calculations are needed to justify that difference;

- corrosion inspections are specified only for single-layer vertical configuration. However, container and pallet integrity inspections are necessary for palletized storage and must be assumed in calculations.

- two hours for storage facilities to be open is not conservative based on 140 minutes each (which itself is not conservative). In terms of number of workers to be affected, more than two workers per inspection should be used and two workers should be assumed to inspect only one magazine per day.

- capacities assumed are not consistent with those stated in other places in the draft EA. Consistent number should be used throughout.

- radiation dose rates are not adequately supported; actual historically measured rates and calculations, and conservative extrapolations from those data, should be used.

The statement that shielded forklifts and AGVs "would further reduce worker exposure" should be supported by actual calculations and analysis. If such vehicles do have that effect, the EA should specifically describe the health effects and justification for storing pits without using such vehicles.

16. Page 6-3. Some assumptions used for the no-action alternative do not appear to be conservative:

- 70 minutes inventory inspection time is not well supported (see comments about page 6-2);

- corrosion inspections only once in 18 months;

- see also comments about page 6-2 for other assumptions.

Document #: *1045* **Comment #:** *10* **Date:** *3/22/93*

Beverly Gattis

Serious Texans Against Nuclear Dumping (STAND)

Comment:

9) Finally, but of extreme importance, the draft EA fails to make clear the implications for worker exposure if the change from current pit storage to intensified pit storage begins to occur before automated systems are developed. Nor does the draft EA clearly commit to Best Management Practices if the decision is delayed. In fact, it does not clearly commit to best management practices even if the intensified storage is approved.

In Section 3.0 describing the proposed action, it states that proposed action storage in either type of magazine would be, "in one of two configurations: multiple stacking...and/or a single layer..." It then continues, "These two configurations represent the bounding cases for the number of pits that would be held in a single Modified-Richmond or SAC magazine." (p. 3-2)

No where in the draft EA does DOE commit to not using the single-layer configurations depicted in Figures 3.5 and 3.6, both described as "(Bounding)," yet both depicting and adding up to the maximum packing arrangement. However, on page 4-1 the discussion warns of maximum packing, and states: "Actual best management practice to facilitate required safeguards and security activities and reduce worker exposure to radiation could dictate use of other storage configurations that would provide less pit storage capacity."

In addition, the proposed action which would seem to allow DOE ample room for storage, still hedges. "Individual pit containers could rest on casters rather than on the concrete floor of the magazines, and aisles may also be used. This would facilitate inventory operations, ensure worker safety, and accommodate operational needs." (p. 3-2)

Wording such as "could" and "may" for procedures which ensure worker safety and benefit other needs is unacceptable in this document -- particularly when outlining the proposed storage option.

Document #: *1048* **Comment #:** *12* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

Pits change over time, what happens to containers that change over time? With pits and containers changing over time, what are we looking at for the future? Do you have any idea how these will react, either individually or collectively, over time?

Document #: *1048* **Comment #:** *17* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

The Executive Summary, vii, and 3-1 states "SAC magazines have not been used previously for holding pits, and the multiple stacking configuration has not been used previously in SAC or Modified-Richmond magazines." Our question is then why are you going to store plutonium, with a half life of 24,000 years in a structure which is not proven to be 100% safe for 'holding pits'?

Response #: D.23

The proposed action is consistent with storage activities currently conducted at Pantex Plant. Magazines will continue to be used to stage weapons, and pits and weapons will not be placed in the same magazine. Operational changes, such as automated inventory, shielded forklift, or potentially modified inventory schedules, have been investigated to support the magazines for interim storage of pits.

Individual Magazine Capacities

Pits in each magazine type can be stacked in the single-layer vertical or the horizontal palletized multiple stacking configuration. For the Modified-Richmond magazine, the horizontal palletized multiple stacking configuration is 440 (Figure 3.3) and the single-layer vertical configuration is 378 (Figure 3.5). For the Steel Arch Construction magazine, the horizontal palletized multiple stacking configuration is 392 (Figure 3.4) and the single-layer vertical configuration is 384 (Figure 3.6). Figure 3.4 in the Environmental Assessment exhibits a center section that consists of two rows of nine sets stacked three high with four pits in each set for a total of 216 pits. There is also a left and a right row of 11 sets stacked two high with four pits in each set for a total of 176 pits. The combined total for Figure 3.4 is 392 pits. The Steel Arch Construction magazine shown in Figure 3.6 is capable of having 406 containers but the operational limits is set to 384 containers, which will allow for some space in the room for movement of the containers.

The close pack vertical configuration shown in Figure 3.5 of the Environmental Assessment is for 378 containers in a solid arrangement. If all 18 Modified-Richmond magazines were configured like this, the total capacity would be 6,804 (the 6,800 maximum packing configuration). The operationally preferred configuration shown in Figure 3.2 of the Environmental Assessment is for 336 containers in a solid arrangement with an aisle on each side of the magazine. If all 18 Modified-Richmond magazines were configured like this, the total capacity would be 6048 (the nominal 6000 pits). The operational preferred configuration in Figure 3.2 facilitates required safeguards and security activities and reduces worker exposure to radiation by providing an aisle down each side of the magazine.

Total Magazines Capacity

The maximum interim storage capacity is based on the number of magazines intended to be used and the type of configuration used.

The maximum interim storage possible with the single-layer vertical configuration in both the Modified-Richmond and Steel Arch Construction magazines would be approximately 22,932 pit containers.

Using the preferred horizontal palletized multiple configuration, the 18 Modified-Richmond magazines would contain 7,920 pits and the 42 Steel Arch Construction magazines would contain 16,464 pits for a total of 24,384 pits.

These capacities are based on the Modified-Richmond and Steel Arch Construction magazines being completely dedicated to interim storage. This situation is not practical because some magazines would have to be used for weapons staging to support the weapons dismantlement process. Staged weapons and stored pits will not be together in the same magazine.

The paragraph in Section 3.0 states "It should be noted that some Steel Arch Construction magazines would be reserved for assembled weapons and component staging activities that have historically taken place, and will continue to take place, in these facilities." If 20,000 pits were stored with the maximum capacity in the 18 Modified-Richmond and the remainder in the Steel Arch Construction magazines, about 11 magazines, would be left for other activities. Therefore, the 20,000 pit containers to be stored in Zone 4 is a realistic approximation for future needs, not storage capacity.

Storage Configuration Bounding Analysis

The storage configuration described is the bounding case for the number of pits that would be held in a single magazine. Variations and/or combinations of these arrangements would not exceed the boundary assumed in the analysis for the Environmental Assessment. The words "could" and "may" are used in the Environmental Assessment to indicate possible options for pit storage. All possible storage configurations considered are within the bounding analysis presented in Section 6.0 and the appendices.

The magazines have been analyzed in the Pantex Plant Final Safety Analysis Report for Zone 4 Magazines for the maximum density of material that can be stored in each magazine type. The risk associated for each magazine assumes that the magazine has the maximum number of pits. Designation of which stacking options will be used in each magazine is done in the Environmental Assessment to "allow operational flexibility and facilitate security and safeguards." The inspection process was developed with the maximum number of pits possible for the magazine. The risks are bounded by the consequence analyses performed as a result of the Pantex Plant, Final Safety Analysis Report for Zone 4 Magazines. The dose rate calculations are also based on the maximum number of pits in a magazine.

The variations or combinations of potential storage configurations are for the horizontal palletized multiple stacking configuration or the single-layer vertical configuration. Aisles are not required in the single-layer vertical configuration because absence of the aisles does not reduce the safety of the magazine. The inventory of the single-layer vertical configuration can be performed without an aisle by rotating the containers in and out as needed, and therefore, not having to unload the entire magazine. The single-layer vertical configuration (full with no aisles) is not the preferred option because the horizontal palletized multiple stacking configuration provides greater capacity, better access, and an opportunity to reduce long term exposure. However, the single-layer vertical configuration may be necessary during the transition to the horizontal palletized multiple stacking configuration.

Comparison Between the Vertical and Horizontal Configurations

For the single-layer vertical configuration, the individual pit containers may rest on casters rather than on the concrete floor for ease in rolling the container. This scheme is a transition before implementation of the horizontal palletized multiple stacking configuration. The pit containers can withstand a drop considerably more severe than would occur if a container drops due to a broken caster.

The horizontal palletized multiple stacking configuration is preferable because it will minimize personnel time inside the magazines (therefore minimize radiation exposures) and maximize the interim storage space for pit containers. With this configuration, the pit containers will be transported from the truck into the magazines on precision pallets (four or six horizontally oriented pit containers semi-permanently affixed to the pallet) secured to a specially equipped shielded forklift. The shielded forklift is designed to minimize the possibility of operational accidents leading to a release of radioactive material. A number of electronic and mechanical interlocks have been designed into the forklift to reduce the possibility of puncturing a container. Efforts are under way to develop Automated Guided Vehicles that could be used to assist in taking inventories using bar code readers. This would further reduce worker exposure for inventory activities.

Similar types of pits will be placed on a pallet of either four or six units for the horizontal palletized multiple stacking configuration. Therefore the pits will be segregated by type in that each pallet will typically have only one kind of pits on it. There will not be segregation of the pits for each magazine. Since the pits are in geometrically safe containers, there is no criticality benefit from the segregating of pits. An automated storage and retrieval system is being developed so that it will be possible to retrieve any particular pallet.

Doses and Dose Rates for Inspections

The estimates presented in Appendix F of the Environmental Assessment assume a very conservative pit source term with the maximum americium (Am-241) buildup and a smaller floor space (one half of the magazine). This maximizes the dose rates and minimizes the distance between the source and the exposed worker. Section F.3.3 points out that the actual dose rates measured during worker exposure for these types of operations with vertical configured containers were about 30-60 mrem/hr, whereas the calculated dose rates were 250 mrem/hr for palletized and 522 mrem/hr for the single-layer vertical configuration (see Section F.3.2). Even with the bounding calculation assumptions, the collective doses given in Section F.5 indicate that implementing the proposed action would give 100-200 person-rem/yr for single-layer vertical configuration and 50-100 person-rem/yr for the horizontal palletized multiple stacking configuration. The no-action proposal (continuing storage as vertical stacking configuration and stopping dismantlement when magazines are full) gave a calculated collective dose at 50-100 person-rem/yr. However, the field survey dose rates are much less (60 mrem/hr versus 522 mrem/hr), which indicates that actual exposures could be much less (about a factor of nine) than the calculated exposures for each configuration.

Appendix F of the Environmental Assessment summarizes the conservative dose calculations used to make the estimates of the exposures for the radiation workers for the vertical and horizontal palletized multiple stacking and inventory operations. Implementing the proposed action (storing the pit containers in vertical or horizontal configurations) would only give a calculated maximum of about a factor of three increased collective dose (see F.5, Conclusions). Since the calculated doses are about nine times greater than the actual averaged survey doses, it is not likely that the collective doses will increase for the Zone 4 activities implemented.

The preferred alternative, the horizontal palletized multiple stacking configuration, gives a factor of two to four decrease in collective doses and allows expanded interim storage for the containerized pits without an increase in collective dose above the current operations. The horizontal palletized multiple stacking option actually decreases the calculated collective doses over the single-layer vertical configuration. The horizontal palletized multiple stacking configuration gives a dose reduction factor of about two to four due to the remote handling and increased distance factors when compared to the single-layer vertical configuration. The expected reduction in radiation exposure to personnel with the shielded forklift is anticipated to be a factor of twenty.

Individual radiation worker exposures are controlled by the Pantex Plant Administrative Control Limit of 1 rem/yr which is significantly lower than the Federal radiation limit of 5 rem/yr. The proposed automation and the horizontal stacking will allow increased storage capacity without increasing the collective dose and with no change in the individual exposures above the current operations. Even with the proposed greater number of pit containers the collective dose and individual worker doses are not expected to increase over previous annual doses. Using the shielded forklift (and later the Automated Guided Vehicles) with the horizontal palletized multiple stacking configuration, and by only doing inventories on an 18 month basis, individual and collective doses are expected to decrease. Appendix F, Worker Radiation Exposure, presents the detailed work activities that are compared between the vertical and horizontal stacking configurations.

Eighteen-Month Inventory Schedule

Inventories have been performed on the magazines bimonthly. During the transition to the horizontal palletized multiple stacking configuration, the inventory cycle has been increased because adequate security and safeguard controls are in place and the magazines will be secured for long periods of time. Once a magazine is secured, it is anticipated that it will not be opened until the next scheduled inventory. The longer inventory cycle will be used for the single-layer vertical configuration and will result in a lower worker dose since the occupancy time will be considerably less. When the Automated Guided Vehicles are operational and available to take inventories for the horizontal palletized multiple stacking configuration, the inventory cycle will be re-evaluated. The Automated Guided Vehicles will allow a more frequent inventory cycle but still maintain a reduced worker dose.

An exception was requested and granted by the Department of Energy (Office of Security Affairs) for the vertical single-layer vertical configuration. The exception allowes the physical inventory of 18 magazines to be extended from bimonthly to 18 months. The exception to the bimonthly physical inventory, as required by the Department of Energy Order 5633.3, only applies to the 18 magazines because only 18 magazines are currently approved for interim storage of pits.

The exception was based on inventory credits determined using the July 1992 Office of Security Affairs guidance on extending physical inventory periods and additional detection capabilities within Zone 4. With the approved exception, the extended cycle for physical inventory is still in rigorous compliance with the Department of Energy Orders and procedures for ensuring safe and secure storage of pits. Providing all conditions of the original approval are adhered to, the intent of the original exception was that it would permanently extend the physical inventory periods to 18 months. In accordance with Department guidance on physical inventory requirements and the provisions of Department of Energy Order 5630.11A, the current Pantex exception on inventory frequency for the Zone 4 igloos would be converted to a variance. The variance would be approved for an indefinite period of time consistent with the previously approved exception by the Office of Security Affairs (SA-10). A recertification will continue to be necessary every 18 months based on the original terms and conditions of the exception. The Department of Energy Office of Field Security Oversight and the Albuquerque Operations Office will be jointly responsible for assuring that the recertification will be conducted. This is considered consistent with the original approval of the exception, and the applicable provisions of Department of Energy Order 5630.11A, for both deviations and approvals. In addition, this process will continue to assure that adequate safeguards are employed for the security of Special Nuclear Material and will provide for a greater measure of safety for Plant personnel responsible for conducting inventories at the igloos.

Magazine Stability with Age

The Modified-Richmond and Steel Arch Construction magazines have some similarities. Both types of magazines have at least 3 feet of earth overburden and natural circulation ventilation. Each magazine type is evaluated to determine its increased usage by a systematic process to identify hazards within a given operation; to describe and analyze the adequacy of measures taken to eliminate, control, or mitigate identified hazards (e.g., stability of construction); and to analyze and evaluate potential accidents and their associated risks. An analysis predicting the consequences of an aircraft impact, tornado, external fire, explosion, and other accidents has been documented in the Pantex Plant Final Safety Analysis Report for Zone 4 Magazines. The expected lifetime of the magazines is dependent upon the ability of Pantex Plant to maintain the magazines within the conditions specified by the Pantex Plant Final Safety Analysis Report for Zone 4 Magazines. These conditions are periodically assessed to verify operational reliability of the magazines.

Pit and Container Stability with Age

Pits have been under careful scrutiny for many years through various the Department of Energy programs, particularly the weapons Quality Assurance Testing Program, that includes the Pit Surveillance Program and an accelerated aging program, to ensure that aging-related defects do not develop in pits. The same pits have already spent several decades under the surveillance of the Department of Energy, the national laboratories, and the military in the field. A routine stockpile surveillance has been performed on the pits for 20 to 30 years in more hostile environments of Zone 4. All data indicates that pits and containers will not degrade over the interim storage period. A pit surveillance program will continue in effect throughout the entire storage time frame.

Although the half life of plutonium is 24,000 years, the proposed action is to provide additional storage for an interim time period. The overall conclusion drawn from the accident analysis is that the potential for adverse impacts to the plant workers, the public, or the environment is low.

Inspection of Pits and Containers

The Sandia National Laboratory Stockpile Evaluation Department has defined a sampling and inspection plan to verify the integrity of the pits and containers during interim storage. In this plan, coincident with the 18 month physical inventory, 10-20 containers of the total site population per year would be statistically selected for 100 percent visual inspection of the pits and the container and individual container parts. In addition to visual inspection for rust and corrosion, inspection of the insulation, weld integrities, and plastic parts will be conducted. The statistical sampling inspection program will be conducted for both the single-layer vertical and horizontal palletized multiple stacking configurations. The single-layer vertical configuration will be performed on an 18 month period. The inspection period for the horizontal palletized multiple stacking configuration has not yet been determined.

The 100 percent corrosion inspection cited in Section F.1.3, is for the bounding radiation exposure analysis and does not mandate that 100 percent corrosion inspection inside the magazine will be performed. It is planned that a visual inspection of magazine conditions and of exposed pit container surface followed by removal of surveillance samples would take place. A corrosion inspection of the pits, pit containers, and the individual parts will be performed on the 10-20 containers selected from the total site population as surveillance program samples. After the results are reviewed and it is determined if additional corrosion inspection is needed, the dose rates in Appendix F will bound the expected worker dose even if a 100 percent corrosion inspection is performed.

For the single-layer vertical configuration in the Modified-Richmond magazines, containers may be on casters for ease in rolling the container. Containers will be moved to the entrance of the magazine (to reduce dose to personnel from other containers), a visual inspection performed for corrosion (rust and paint bulging). The container will then be moved back into the magazine. The number of pit containers allowed out of the magazines (on the apron) is not specified. Only the minimum number necessary for operational continuity will be moved; even then, the maximum number allowed will be based on environment, safety and health and security considerations. This operation will be performed by two people and is anticipated to take one minute for each container. This estimate is based on current inventory operations and knowledge of what is proposed for this future inventory activity for interim storage configuration. The one minute for each container is based on dividing the time expected to perform the inspection for an entire magazine by the number of containers in the magazine. In all cases, estimates are considered conservative in comparison to current inventory time requirements.

Under normal circumstances, it would be expected that no corrosive media other than moisture resulting from changes in relative humidity would come in contact with the interior surfaces of the magazine. In the absence of a highly corrosive media, there is no mechanism to cause corrosion that would lead to the degradation of the pit containers. It should be noted that minor rusting of the carbon steel container is expected but in no way impacts containment of Special Nuclear Material or the ability of the AL-R8 to serve as a suitable storage container.

Plutonium Release Conditions

Several conditions preclude an accidental release of plutonium. The first is the absence of a credible initiating event. The second is that the metal is encapsulated in a metal shell of material to prevent direct exposure to the atmosphere. The third is that the encapsulated pit is packaged in a container to ensure that the contents will remain stationary. Additionally, an environmental monitoring program encompassing sampling of the atmosphere, soil, vegetation, and surface water for radionuclides used at Pantex Plant exists, and would detect releases of the radionuclides should such releases occur in the storage area.

The accident analysis in Appendix A of the Environmental Assessment is applicable if the containers are either inside or outside of the magazine. Accidents due to weather-related events are not applicable to containers outside the magazine because work is suspended; the containers are placed in the magazine; and the doors are secured if there is a tornado watch, static electricity alert, or any other inclement weather.

The statement in Section 6.1 of the Environmental Assessment that "routine operations of the No-Action Alternative are similar to those for the proposed action" is in regard to the subject of the paragraph - minor releases of air pollutants and a minor increase in particulate (dust).

<u>Dose During the Inventory Process</u>

As indicated in Section 6.1.1.2 and Appendix F the current collective dose for Zone 4 operations is less than 10 person-rem/yr. Measured dose rates in Modified-Richmond magazines currently used for pit storage are on the order of 30 mrem/hr.

As discussed in Sections 6.1, 6.1.1.1, and the summary, no radiation exposures (acute or chronic) to the public are anticipated for the proposed action. The estimated worker exposures provided in Sections 6.1.1.1 and 6.1.1.2 and Appendix F are based on a year of routine operation. The dose is not assumed to be provided by a one time exposure but by a series of exposures occurring over the work year. The health effects discussed (i.e., the increased cancer risk) are based on the long-term accumulation of chronic low-level exposures. Detailed and current information of the effects of low-level chronic radiation exposure can be found in the National Research Council, Health Effects of Exposure to Low Levels of Ionizing Radiation; (BEIR V), and Committee of the Biological Effects of Ionizing Radiation, National Academy Press, Washington, DC, December 1989 (UNSCEAR 1988) reports.

Pantex Plant performs measurements of penetrating radiation at several off-site locations near the facility and at a background location near the Bushland Agricultural Research Center, approximately 30 miles southwest of the facility. The results of the measurements, which have been confirmed by independent measurements made by the Bureau of Radiation Control of the Texas Department of Health, do not indicate levels in excess of expected background levels. Therefore, personnel who reside near Pantex Plant receive no additional low-level radiation exposure as a result of Pantex Plant operations.

The average annual background exposure from natural radiation received by people living in the United States is approximately 300 mrem ("Exposure of the Population in the United States and Canada from Natural Background Radiation", Report #94 of the National Council on Radiation Protection and Measurements, Table 9.6). There are parts of the earth where average annual background exposure is in the range of 1,000 to 3,000 mrem ("Environmental Aspects of Nuclear Power", Jeffrey G. Eichholz, Page 110). No adverse effects on human populations living in these regions of elevated background radiation exposure have been observed.

The impact to worker exposure if inspections are performed at higher frequencies of once every month or six months, as opposed to the proposed schedule of once every 18 months, is an increased dose to workers. As can be seen in Section 6.1.1.1 and more fully explained in Appendix F, the radiation doses to workers resulting from inspections are directly proportional to the frequency at which these inspections are performed. Thus, if inspections are performed every 6 months rather than every 18 months, resulting doses from these operations would increase threefold.

The reason for the decreased inspection time required for the horizontal palletized multiple stacking configuration versus the single-layer vertical configuration is not fully discussed in the Environmental Assessment. The horizontal palletized multiple stacking configuration allows inspections to be performed in less than 60 percent of the time required for the single-layer vertical configuration. The horizontal palletized multiple stacking configuration allows the use of a forklift to lift and manipulate a group of containers in a way that facilitates and speeds inspections. In the single-layer vertical configuration the containers must be individually handled for the inspection process and therefore have a longer inspection time and a larger worker dose.

ENVIRONMENTAL ASSESSMENT TEXT CHANGE

Section 6.0 has been changed to reflect the comments.

mrem = millirem
hr = hour
yr = year

Document #: *1015* **Comment #:** *14* **Date:** *2/20/93*

Addis Charless, Jr.

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

Additionally, chemical/toxic gas releases have occurred, the incidents having not been made public until well after the fact, if at all.

Response #: D.24

Any unusual releases are reported to the 24 hour Emergency Operations Center at Pantex Plant. The operations center reports any incident to the regulatory authorities as required in Section V.D of the Resource Conservation Recovery Act permit for Pantex Plant. The permit requires any release which endangers the public to be reported orally within 24 hours pursuant to Title 31 Texas Administrative Code, Section 305.123(9). It is still the responsibility of the civil authorities to control public announcements. In any emergency situation where the general public is endangered, civil authorities would make a public announcement and information centers would be quickly established by the Department of Energy to inform the public concerning the nature of the hazard and how to respond.

The only unusual release of chemical/toxic gases at Pantex Plant was the tritium release incident that occurred in 1989. The incident was immediately reported to State and local authorities in accordance with the requirement of the Department of Energy Order 5300.3B and with the Pantex Plant Emergency Plans. State and local authorities had responsibility for making public announcements. The release was controlled on-site and did not represent any hazard to the general public. No additional chemical/toxic gases have been released in the past that were considered abnormal at the time, such as disposing of solvent chemicals by burning. All Department of Energy occurrences become public documents and can be found in reading rooms located in Amarillo and Panhandle, Texas.

Document #: *1042* **Comment #:** *15* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

The draft EA contains no discussion of worker exposures during dismantlement and at any other time prior to the inspections in the interim storage facilities. In fact, significant exposures could occur during dismantlement, during storage prior to arrival at Zone 4, during transport of the pits from the disassembly facilities to Zone 4, and in loading the pits into the Modified-Richmond and SAC buildings.

Questions that must be addressed in the EA include:

- *How many workers are involved in those operations;*
- *What is the duration of exposures;*
- *What are the potential maximum exposures;*
- *What kind of accidents can occur during disassembly, storage, and shipment to Zone 4,*
- *What kind of accidents could occur during loading pits into the Modified-Richmond and SAC magazines;*
- *Will the differing storage configurations in the two types of storage buildings require different training for workers to avoid accidents;*
- *What kind of cumulative exposures can workers receive for participating in various activities, or will each operation have its own specialized work force?*

Response #: D.25

Dismantlement activities other than interim pit storage are not within the scope of this Environmental Assessment. The dismantlement of nuclear weapons has always been part of the mission of the Pantex Plant, and all potential accident scenarios have been addressed in the 1983 Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098).

The radiation worker operations concerned with interim storage are addressed in Appendix F of the Environmental Assessment and include inventory, container corrosion inspection, and miscellaneous operations. Assumptions about the number of workers and projected exposure rates can be found in this discussion. The radiation worker exposures in Zone 4 as well as the rest of the site will be routinely monitored to ensure that they will not exceed the Pantex Plant Administrative Limit of 1 rem/yr. The As Low As Reasonably Achievable Program Coordinator reviews the radiation doses monthly. If any adverse trends are found, these are investigated to determine what corrective actions are appropriate. Workers in Zone 4 do not participate in the disassembly and transport operations outside of Zone 4. Zone 4 workers are not expected to receive greater than 200 mrem/yr from any of these operations.

Potential accidents that could occur as a result of operations in Zone 4 were analyzed in Section 6.2 and Appendices A, B, C, D, and E of the Environmental Assessment. Additional information on potential accidents during Zone 4 operations can be found in the Pantex Plant Final Safety Analysis Report for Zone 4 Magazines. Also, improvements to operations to reduce accident potential such as systems to prevent a forklift from crushing a containerized pit, technology upgrades such as the shielded forklift and the Automated Guided Vehicle are identified in the Pantex Plant Final Safety Analysis Report for Zone 4 Magazines.

Training of radiation workers at Pantex Plant, including Zone 4 workers, involves classroom as well as on-the-job training (Specialized Training, the Department of Energy Radiological Control Manual Article 634). The differing storage configurations do not require different training using the written standard operating procedures for vertical and horizontal stacking configurations to ensure the operations are done to limit radiation exposure.

yr = year
mrem = millirem

Document #: *1012* **Comment #:** *2* **Date:** *1/16/93*

Margie K. Hazlett (1)
Citizen Comments

Comment:
The General Accounting Office, the investigating arm of Congress, early in 1991 said Pantex had one of the worst occupational safety records in the Department of Defense (sic) Weapons complex.

Document #: *1021* **Comment #:** *14* **Date:** *1/25/93*

Lawrence D. Egbert, MD
Physicians For Social Responsibility

Comment:
There is no reference to Coy Overstreat who has been collecting cases of atomic radiation victims for years. The search for potential problems seems thoughtful but there is no mention of previous complications. I would recommend the Governor insist upon a careful evaluation of all previous accidents, injuries and environmental abuses which have occured at Pantex and other DOE plants before permitting even one Pu pit to be stored in Texas.

Response #: D.26

Pantex Plant operations experienced an average of 120 recordable injuries per year from 1990-1992. Approximately 41 percent of those injuries resulted in lost time, with an average of 592 lost days and 915 restricted workdays reported by Pantex Plant each year. Compared to other Department of Energy production contractors, Mason & Hanger ranks 11 out of 14 relative to the number of recordable injuries. No fatalities were reported at Pantex Plant from 1990–1992 (no fatalities have been experienced since 1977). The resultant 1990-1992 average total recordable case and lost workday case rates for Pantex Plant were significantly lower, 5.03 and 2.05 respectively, than the Bureau of Labor Statistics average rates of 8.5 and 3.9.

Table 1 provides Pantex Plant statistics for 1990-1992 and a three-year average for Pantex Plant. The table illustrates the decline in total recordable cases, lost workday cases, and lost workdays Pantex Plant has experienced since 1990. This is significant considering that each year the number of employees and hours worked have increased. Table 2 provides a direct comparison of the Pantex Plant three-year average rates with the Bureau of Labor Statistics rates for all industrial workers.

The data provided do not go back past 1990 because on January 1, 1990, the Department of Energy changed the reporting requirements and adopted 29 Code of Federal Registrations 1904, for recording and reporting occupational injuries and illnesses. Field Offices were advised to use Department of Labor publication, "Record Keeping Guidelines for Occupational Injuries and Illnesses," for determining the recordability of injuries and illnesses. Prior to that time, Pantex Plant reported injuries and illnesses in accordance with the DOE-76-45/7A, SSDC-7B, "Department of Energy Guide to the Classification of Recordable Accidents." The intent in adopting Department of Labor regulations was to ensure that the Department captures all data for the types of cases being reported by the rest of the nation, and to establish a record keeping and reporting system at the Department of Energy comparable to the very stringent Department of Labor system.

Pantex Plant is continuing efforts to reduce the number of work-related injuries by increasing employee awareness. Monthly injury reports, electronic message boards, incentive programs, and training courses are a few ways that Pantex Plant is getting the message out to inform and educate employees on how to prevent work-related injuries.

Table D.26-1 - Pantex Plant Composite Statistical Summary

	1990	1991	1992	Avg.
Equivalent Full-time Employees	2274	2468	2728	2490
Work Hours (per 1000)	4321	4691	5289	4767
Total Recordable Cases (TRC)	138	103	118	120
TRC Rate	6.39	4.39	4.46	5.03
Number Illness Cases	10	11	7	9
Illness Rate	0.46	0.47	0.26	.38
Number Lost Work Cases (LWC)	82	28	38	49
LWC Rate	3.8	1.19	1.44	2.05
Lost Workdays:Away	1017	384	374	592
Restricted	2237	123	385	915
Total	3254	507	759	1507
Lost Work Day Rate	150.63	21.62	28.70	63.23
Number Fatalities	0	0	0	0

Table D.26-2 - Average Injury Rates Comparison for 1990-1992

	Total Recordable Cases	Lost Workday Cases	Lost Work Days
Pantex Plant Composite	5.03	2.05	63.23
Bureau of Labor Statistics	8.5	3.9	75.2

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (D.27) FOLLOWS ON PAGE D-59.

Document #: *1007* **Comment #:** *4* **Date:** *2/25/93*

Joseph A. Martillotti

Texas Dept. of Health, Bureau of Radiation Control

Comment:

Page 4-2, Lines 6-10: The "Note" in italics is misleading. It suggests that any alternative involving shipment will require repackaging into a shipping container at Pantex and repackaging into a suitable storage container at the alternate site. Page 3-2, lines 3-7 indicate that pits may be stored in Type B shipping containers. It would appear that in any case, the radiological exposure to workers would be approximately the same as when pits were routinely returned to Rocky Flats Plant.

Document #: *1007* **Comment #:** *7* **Date:** *2/25/93*

Joseph A. Martillotti

Texas Dept. of Health, Bureau of Radiation Control

Comment:

Page 4-4, Lines 29-38: Concerns expressed in this passage would not necessarily be valid if the pits were packaged and shipped to an alternate location in suitable transportation/storage containers, as is suggested on Page 3-2.

Document #: *1016* **Comment #:** *11* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

Is there independent quality control on the containers? What are "other approved containers"? The EA must address these questions.

Document #: *1016* **Comment #:** *16* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

If the Pu would have to be repackaged into Type B shipping containers for shipping (4.1), why can they not be stored in the Type B containers as stated by 3-2.

Document #: *1017* **Comment #:** *5* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

After reading the EA, I visited with a former Pantex employee who also read the EA. ... He also said that the new stainless steel containers shown to the media are apparently brand new and most pits are stored in the od (sic) style carbon steel containers that will rust and deteriate (sic) faster. He said the packing material shown to the media is all new to him and apparently both the stainless steel containers and the packing material are new since the EA was written.

Document #: *1019* **Comment #:** *2* **Date:** *1/20/93*

W. H. O'Brien

Operation Commonsense

Comment:

There appear to be differences in the relative degrees of protection provided by the two types of storage containers for the plutonium pits.

Document #: *1042* Comment #: *23* Date: *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

Unanswered in the draft EA are basic questions, including: ...
- What types and levels of gas buildup can occur inside the pit storage containers;

Document #: *1042* Comment #: *28* Date: *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

The stated purpose of the EA is to evaluate environmental impacts of additional pit storage. However, there is no discussion of some storage related activities, including transporting pits from disassembly bays to Zone IV and the actual loading of pits into the magazines.

Document #: *1042* Comment #: *37* Date: *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

8. Page 3-2. "The majority of the stored components in Zone 4 would be packaged in AL-R8 containers... but other approved containers" may be used. The EA should provide much more information about the AL-R8 containers, including:

- *description, including size, weight, compostion (compare with page 6-1 description of "carbon or stainless steel drum")*
- *how many currently exist,*
- *how old they are,*
- *how many new containers will be built,*
- *what kind of independent certification will be required,*
- *what the demonstrated optimum lifetime has been,*
- *what kind of deterioration/corrosion has occurred with the existing inventory?*

Similarly, much more information about "other approved containers" is necessary, including:

- *detailed information on the specific containers to be used,*
- *what kind of independent certification will be required,*
- *whether combined storage/transportation containers can be used,*
- *the time frame within which such containers will be available?*

Document #: *1042* Comment #: *41* Date: *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

For palletized multiple stacking, the EA must describe how frequently the pallets would be changed, the history of damage and breaking of the pallets, accident scenarios including possible releases when pallets break and containers are dropped. It must describe the structural integrity of each pit container, its design specifications including weight-bearing ability, actual history of containers supporting triple stacking (as shown in Figure 3.4).

Document #: *1042* Comment #: *44* Date: *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

11. Page 4-2. The Note stating that additional repackaging would be required for off-site shipment must be explained. What differences are required for repacking now as compared to when pits were being shipped to Rocky Flats? Are the "Type B shipping containers" going to be certified by the Nuclear Regulatory Commission? Why could pits not be shipped in the AL-R8 containers?

Document #: *1042* **Comment #:** *48* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

The few sentences in Section 6.1.1 are the most detailed description of the pit and storage container, but do not provide adequate or complete information (see also: comments about page 3-2).

Document #: *1044* **Comment #:** *4* **Date:** *3/15/93*

Margie K. Hazlett (3)

Citizen Comments

Comment:

Why were the majority of the pits stored in ALR8 containers? You commented that Type B containers were less dangerous and are certified for off-site transportation of pits under the Department of Energy's performance criteria adopted from Section 10 of the Federal Regulations Part 71 (10 CFR 71).

Document #: *1048* **Comment #:** *11* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

(3-2, 4-2, A-3) "The majority...packaged in AL-R8 containers, but other approved containers may be used." What is the history of these containers? What are the "other approved containers"? A thorough discussion of containers is imperative. Can these containers be used for shipping and/or storage? What are the test results on any of these containers?

Response #: D.27

The AL-R8 is currently not approved for off-site transport of pits. The procedures and the radiological exposure would be approximately the same (for shipment of pits to an off-site interim storage site) as when pits are routinely returned to Rocky Flats Plant. However, pit shipping containers returned to Rocky Flats Plant from Pantex Plant were removed from the certified shipping container and staged for the next process step. The shipping container was then returned to Pantex Plant, either empty or with a pit slated for new production. The certified shipping container was then used to return pits awaiting shipment back to Rocky Flats Plant. This allowed the Department of Energy to continue pit shipment operations with a minimal number of certified containers. The Department of Energy, not the Nuclear Regulatory Commission, certifies shipping containers. The Department of Energy uses criteria consistent with Department of Transportation guidelines for the transport of radioactive materials.

The age of the containers varies from approximately 30 years to newly built. The majority of the first containers built approximately 30 years ago are still in service. When the AL-R8 containers were being fabricated, all components for the containers were purchased from approved fabricators and vendors, inspected, and then assembled for service or stocked as spare parts. Using a combination of physical measurements, visual determinations, and nondestructive tests, requirements given on the engineering drawing are confirmed. Acceptable product is certified for use, defective material is identified, segregated, and returned to the supplier for repair or replacement. These acceptance tests fulfill the quality assurance provisions of 10 Code of Federal Regulations 71. There are no limited life components that must be periodically replaced or periodic tests that must be performed on the container, fiberboard, or clamping fixture other than corrosion inspections.

AL-R8 and Type B Container Description

AL-R8 outer containers are "Specification 17H Steel Drums," that have a 1-inch vent plug in the top lid. The model AL-R8 container is typical of the drum type containers used for transporting fissile material within the Department of Energy weapons complex. The design specifications for the pit container are contained in a classified document; therefore, it is not available for publication, but the AL-R8 containers were designed and tested to the requirements of the Department of Energy Order 5610.1; 10 Code of Federal Regulations 71; and 49 Code of Federal Regulations Parts, 100-178. The AL-R8 container utilizes the pit structure for containment, whereas a shipping container, such as the Type B, has two independent seals for containment. This results in a substantial cost increase. There are four sizes of AL-R8 containers: Models 2030, 2040, 2050, and 2060. The model number refers to the 20-inch diameter of the drum and its 30-, 40-, 50-, or 60-inch. height. All AL-R8 containers are constructed of 18-gauge carbon steel. The container is internally lined with Celotex® fiberboard to provide impact and thermal protection. The pit is suspended within the fiberboard using a steel clamping device.

Pits may also be stored in Type B containers, which are double-containment stainless steel drums categorized as Type B shipping packages. The outer containment of a Type B shipping package has a 22.5-inch diameter and a 50-inch height. The drum is 16-gauge stainless steel. The inner containment drum (within which the pit is located) is constructed of 12-gauge stainless steel and has a 13.8-inch diameter and a 38-inch height. Celotex® packaging material is used between the inner and outer containment drums and also around the pit inside the inner containment drum.

Comparison of the Two Containers

Statements are made in Section 3.0 that "the majority of the stored components in Zone 4 would be packaged in AL-R8 containers but other approved containers, such as Type B containers, may be used. Type B containers are certified for off-site transportation of pits under the Department of Energy performance criteria". This does not imply that Type B containers are "less dangerous", but that Type B containers are certified for transportation to Pantex Plant. Both the AL-R8 and the Type B are approved for the use of interim storage of pits.

The Type B containers are primarily used for shipping. The plutonium pits could be stored in Type B containers, but due to the limited number of Type B containers available, and time and cost to build more, the plutonium pits are being stored in AL-R8 containers. The AL-R8 containers have been in service for approximately 30 years, and with this 30-year history the AL-R8 container has proven itself to be a durable container for pits. Both container types adequately meet the design safety requirements necessary for interim storage of pits; thus, it makes sense to avoid storing pits in the much more costly shipping containers.

Analysis of Possible Hazards

An analysis of credible hazards associated with the horizontal palletized multiple stacking configuration is contained in the Zone 4 Pantex Plant Final Safety Analysis Report for Zone 4 Magazines. In an effort to reduce the threat of internal fires, the pallets used for stacking are made of metal and are not combustible. Since this is a relatively new storage configuration there is currently no historical data associated with damaging and breaking of pallets. The consequences from the event of a pallet breaking and the containers dropping to the floor are bounded by the safety analysis. In addition, the container and packaging provide additional protection to the pit that would preclude a potential release using this scenario. Therefore, no additional analysis is required. No historical data are associated with triple stacking, but the pallet has been formally analyzed and will be subjected to rigorous testing prior to implementation.

As to the potential gas buildup within the containers, the pit does not release a gas; therefore, no gas buildup from the pit will occur. The AL-R8 containers have been fitted with a 1-inch vent plug in the top lid. This vent plug is to relieve over-pressurization in the containers due to heated air generated from an external fire.

<u>Transportation to and from Zone 4</u>

Most of the activity associated with the magazines is a result of movements to and from the production areas in Zone 12 (Building 12-26, Pit Vault and Building 12-44, Cell 8 staging areas). Weapons assemblies and weapons components transferred between Zone 4 and Zone 12 are moved by Safe-Secure Trailers or hardened trailers. The pits are transferred in either the AL-R8, an approved storage container, or a container certified for transportation. The AL-R8 has been reviewed for the bounding transportation accident in the AL-R8 Safety Analysis Report for Packaging. This analysis and the supporting documentation are used as the basis for transporting material to and from Zone 4.

The stated purpose of the Environmental Assessment is to evaluate environmental impacts of additional pit storage. The transportation of the pits to Zone 4 and loading the pits into the magazines will continue to be the same for Zone 4 as they have been in previous years. The only exception is that when the horizontal palletized multiple stacking configuration is approved, Automated Guided Vehicles will be developed and used to place the pits in the magazines and to assist in taking inventories using bar code readers. This would reduce worker exposures for inventory activities. The Automated Guided Vehicles are discussed in Section 3.0 of the Environmental Assessment.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (D.28) FOLLOWS.

Document #: *1011* **Comment #:** *3* **Date:** *2/18/93*

Dana O. Porter

Citizen Comments

Comment:

The report does not address the hazards of air-borne dusts and gases. Dusts are only mentioned in reference to their potential to contribute to groundwater contamination. What about the public health risks associated with ingestion or inhalation of radioactive or chemical dusts and/or gases? Has the Texas Air Control Board been appropriately consulted with respect to these dangers?

Response #: D.28

The interim storage of pits is not expected to generate emissions other than extremely minor amounts associated with internal combustion engines used to transport materials and personnel to and through the area. The Texas Air Control Board has conducted ambient air measurements of chemical dust and/or gases at several discrete locations on site. These measurements do not indicate concentrations of the pollutants greater than regulatory limits. Since the regulatory limits restrict off-site releases and are set at fractions of those levels known to cause health effects, there are no anticipated public health effects from releases of chemical dust and/or gases.

Since the storage of plutonium components does not represent an air emission source, the public health hazard related to releases of radioactive dust and or gases from the facility would be bounded by the analysis in the Pantex Plant Final Safety Analysis Report for Zone 4 Magazines.

Pantex Plant has appropriately consulted and cooperated fully with the several state regulatory agencies having cognizance over releases of radioactive/chemical dust and/or gases. These include not only the Texas Air Control Board, but also the Bureau of Radiation Control of the Texas Department of Health and the Texas Water Commission. All of these organizations as well as the Division of Emergency Management of the Texas Department of Public Safety have been provided the opportunity to review and comment upon the subject Environmental Assessment. In addition, as part of the Agreement in Principle between the State of Texas and the Department of Energy, the Texas Air Control Board is conducting site-wide air dispersion modeling and collecting and analyzing ambient air samples collected from inside Pantex Plant. The Bureau of Radiation Control of the Texas Department of Health has conducted radiological monitoring at both on-site and off-site locations since the early 1980's. None of the measurements performed by the various state regulatory agencies has indicated that emissions in excess of regulatory limits have occurred.

Document #: *1001* **Comment #:** *1* **Date:** *2/25/93*

Ann W. Richards, Governor
State of Texas

Comment:
In addition, state officials believe that the methodologies used in the report addressing the potential impact of a plutonium release to the Ogallala Aquifer, ... are so fundamentally flawed that they must be revisted. In their current form, it is impossible to determine whether the resulting conclusions are, in fact, valid.

Response #: E.1

In an analysis prepared at the Department of Energy's request, the Los Alamos National Laboratory Earth and Environmental Sciences Division analyzed potential consequences to the Ogallala Aquifer of a hypothetical plutonium release (Appendix L of "Response to Comments"). Standard scientific and engineering methodologies were used to complete the analysis. Many of the comments from individuals questioned the assumptions, data, and subsequent result of calculations. The specific comments are addressed in the following responses.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (E.2) FOLLOWS.

Document #: *1006* **Comment #:** *1* **Date:** *2/25/93*

Auburn L. Mitchell

Univ. of Texas, Austin, Bureau Economic Geology

Comment:

I. Cleanup to the Level of 0.2 uCi/m2 Following the Hypothetical Accident

The first assumption (listed on page 7-1 of the EA report and on page 1 of Turin and others, 1992) is that "Surface soils would be decontaminated to levels no greater than 0.2 uCi/m2 following the hypothetical accident. (Previous experience indicates that this level is achievable)." Neither the EA nor Turin and others (1992) provide support for this critical assumption, and numerous questions about it can be raised. First, the potential for soil and ground-water contamination at initial post-accident levels during the cleanup period cannot be summarily excluded. Accordingly, documentation should be provided on the anticipated range of initial contamination levels at the surface prior to decontamination. Further, the basis for concluding that a maximum post-cleanup radiation level of 0.2 uCi/m2 is achievable should be provided. If this assumption is based on previous remediation efforts, the report should discuss such prior cleanups and show that they are applicable to the Pantex Plant area.

Second, the length of time taken for cleanup is important to assessing plutonium concentrations in soils, and in particular playas, during this period (reference Footnote on Page 2 of letter from The University of Texas at Austin, dated February 25, 1993). The inference that cleanup will be performed in a timely fashion using methods based on past experience for released plutonium needs explanation. Will soil removal be required? If so, this task could be substantial. For example, if the accident occurred as described but with contamination spread over only (underlined) 1/5 of 1 percent of the 50-mi- (80-km-) radius, then the following volumes of contaminated soil would result. If only the top 4 inches (10 cm) of soil had to be removed during decontamination of this 15.7 mi2 (40 km2) area, the volume of soil would equal approximately 5,000,000 yd3 (4,500,000 m3). If 250 trucks with a carrying capacity of 10 yd3 (7.6 m3) were used, and each truck could make 12 round trips per day to a temporary disposal facility, then the total cleanup time required would be 160 days.

Because of the time likely required to achieve decontamination to the desired level throughout the affected area, it appears unrealistic to assume that no plutonium concentration above 0.2 uCi/m2 will occur in soils prior to decontamination or during cleanup. For example, if the cleanup period extends as long as one year, a rainfall event with a 5-year return interval would have a 20% chance of being equaled or exceeded in that one-year period. According to Becker and Purtymun (1982) in a previous study of the Pantex Plant region, there is a recurrence interval of 5 years for a 2.9-in (7.36 cm) rainfall event in a 6-hour period and a 3.7-in (9.40 cm) rainfall event in a 24-hour period. Any precipitation event that produced significant surface runoff, such as a 5-year return-interval storm, would result in concentration of plutonium contamination because of the closed drainage typical of the region. In sum, the cleanup effort could require some time, during which contaminated soil would be exposed to rainfall/recharge events. Runoff could possibly concentrate contaminants in playas, and contamination could extend to the subsurface. Thus, the conceptual model described for this hypothetical accident is presently unsubstantiated with regard to the implication that cleanup could be completed prior to movement of plutonium into the subsurface and with regard to the initial concentration of 0.2 uCi/m2 of plutonium.

Response #: E.2

The 0.2 $\mu Ci/m^2$ post-cleanup contamination level was proposed in 1977 in a draft Environmental Protection Agency Guideline (42 Federal Register 60956) as an acceptable level of residual plutonium surface contamination (see Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983), Section 4.2.7 and the Environmental Assessment, Section 7.0). This level would result in dose rates less than the guidance recommendations for acceptably low risks from alpha radiation exposure (about 1 mrad/yr to lung tissue). This guideline was never adopted by the Environmental Protection Agency; however, it is a level believed to be achievable using current technology. This technology has been demonstrated at such cleanups as those performed at Johnston Atoll, Eniwetok, and current research and development activities at the Nevada Test Site.

If required, surface soil cleanup may be both expensive and time-consuming. However, a delay on the order of a few years would not significantly change the analysis stated in the Environmental Assessment concerning the potential effects of a plutonium-dispersal accident on the Ogallala Aquifer. Although there is uncertainty concerning the long-term rate of plutonium transport, soil scientists generally agree that it is relatively immobile and that it will not migrate beyond remediable depths within the few years that could be needed to complete a cleanup.

An exception might be the short-circuit paths described in the Los Alamos National Laboratory report entitled "Potential Ogallala Aquifer Impacts of a Hypothetical Plutonium Dispersal Accident in Zone 4 of the Pantex Plant" (Turin et al. (1992)). In the extremely unlikely event of a plutonium-dispersal accident, these areas would receive priority for decontamination and steps taken to eliminate the short-circuit path to groundwater. The Department has initiated steps to identify and document preferential pathways that may exist within the postulated area of contamination.

μCi = microCurie
m = meter
mrad = millirad
yr = year

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (E.3) FOLLOWS.

Document #: *1006* **Comment #:** *2* **Date:** *2/25/93*

Auburn L. Mitchell

Univ. of Texas, Austin, Bureau Economic Geology

Comment:

II. Plutonium Concentrations in Soils

The second assumption (listed on page 7-1 of the EA report and on page 1 of Turin and others, 1992) is "Surface transport processes may increase soil concentrations ten-fold to 2.0 uCi/M2, before infiltration takes place." The assumption that only a tenfold increase in contaminant levels for playa basins in the area of the Pantex Plant is questionable. Data from an investigation by Becker and Purtymun (1982) of the 10 playa basins on or immediately adjacent to the Pantex Plant indicate a significantly higher concentration factor. Becker and Purtymun's method for determining concentration potential is based on the ratio of surface area of the playa (drainage) basin to the surface area of the playa floor (collection point for the basin). They reported measured areas for 10 basins (Turin's Basin No. 7 had zero acres recorded for the playa floor and is thus ignored in the following statistics). The minimum basin-to-playa ratio reported, and therefore the minimum concentration factor, was 12 (for their Basin No. 10). Thus, the concentration ratio of 10 is neither conservative nor equivalent to the actual minimum measured ratio. The maximum ratio was 29 (for their Basin No. 3). The mean ratio for the nine basins is 21, with a standard deviation of 8. Therefore, if a "conservative" value is used for the potential concentration of contaminants, a minimum factor of 25 to 30 should be selected, assuming an antecedent moisture concentration of saturation and no infiltration of precipitation.

To accurately determine a more statistically defensible "conservative" concentration factor, an effort could be made to compute the ratio of playa-basin surface area to playa-floor surface area for all of the basins in the 80-km radius of the hypothetical accident area. This could be done by comparing the area of Randall Clay soils (playa floors) to the area of upland soil. Soil data are availabe in county soil surveys published by the USDA Soil Conservation Service.

Response #: E.3

This comment concerns the assumption in Turin et al. (1992) that surface transport processes may increase plutonium concentrations ten-fold. The comment cites a 1982 investigation by Becker and Purtymun which compared playa lake drainage basin areas to playa floor areas and found that basin-to-playa ratios range from 12 to 29. The comment suggests that the Los Alamos National Laboratory should have used this ratio as the plutonium concentration factor. The Los Alamos National Laboratory chose not to use the assumption suggested by the individual, and the following discussion presents their rationale.

Stating that the basin-to-playa ratio is equivalent to the plutonium concentration factor implies acceptance of an assumption that surface transport processes are 100 percent effective at moving all forms of plutonium (including dissolved, sorbed, and colloidal) from the upland soil surface into the playa lakes. This assumption is clearly not reasonable. Previous research and the laboratory studies for Turin et al. (1992) indicate that most plutonium will be sorbed to soil particles of various sizes. Direct observation illustrates that 100 percent of upland surface soil is not transported into playa lakes during any given rainfall event.

The Los Alamos National Laboratory intentionally chose not to use extreme assumptions in predicting the groundwater effects of an extremely unlikely event that would disperse plutonium over the area around the Pantex Plant. Rather, conservative yet reasonable assumptions were made. To identify reasonable assumptions about an appropriate concentration factor, actual field data on surface transport concentration from the Trinity Site was used. These data showed concentration factors of 1.5 to 2. Because of potential differences between the Trinity Site and the Pantex Plant, the Los Alamos National Laboratory conservatively increased the concentration factor to ten.

Document #: *1006* **Comment #:** *3* **Date:** *2/25/93*

Auburn L. Mitchell

Univ. of Texas, Austin, Bureau Economic Geology

Comment:

III. Flow and Contaminant Transport Through Playas

The third assumption (listed on page 7-1 of the EA report and on page 1 of Turin and others, 1992) states that "Recharge to the Ogallala Aquifer is focused at playa lake beds. Playa lake recharge rates are approximately 3 cm/yr, ten times the High Plains average." The assumption that recharge to the Ogallala aquifer is focused in playa lake beds is probably valid (reference Footnote 2, Page 4 of letter from The University of Texas at Austin, dated February 25, 1993). However, in our view, the 3 cm/yr playa lake recharge rate, which is reported to be 10 times the High Plains' average recharge rate, is probably invalid for this contaminant transport analysis.

A. In Contaminant Transport Analysis, a "Site Specific" Recharge Rate Should be Used Rather Than Regionally Averaged Recharge Values

Turin and others (1992) point out that local variability in recharge rates may be quite high, but these values may be averaged over larger areas to provide a representative recharge rate for the entire landscape. This approach is suitable for estimating regional ground-water resources, but it is not valid for evaluation of site-specific ground-water contamination. In contaminant transport analyses it is important to know not only the rate at which water is recharged to an aquifer but also the rate and concentration at which contaminants move down to the aquifer. Gee and Hillel (1988) discuss the fallacy of averaging, and Gee and others (1991) discuss the importance of preferred pathways that may bypass much of the vadose zone and transport contaminants directly to an underlying aquifer. If most of a region's recharge occurs beneath only 3 to 4 percent of the land surface, then the much higher focused recharge rate actually would transport a greater mass of contaminants at greater velocities than would be predicted from regionally averaged recharge values.

The methodologies and recharge values listed in the Turin report are not appropriate for several reasons. For example, most of the recharge rates reported in Turin and others (1992) are based on very little quantitative data (Wood and Petraitis, 1984), or on a ground-water flow model calibration (Knowles, 1984; Luckey, 1984), (reference Footnote 3 on Page 5 from The University of Texas at Austin letter dated February 25, 1993). Recharge rates based on the chloride mass balance approach (Stone and McGurk, 1985) are subject to the assumptions of one-dimensional piston-type flow and of precipitation as the only source of chloride (Scanlon, 1991). Because surface runoff into the playas provides another source of chloride such as irrigation return waters, recharge estimates based on the chloride mass balance approach in playa settings are minimum estimates. Therefore, the recharge values provided by Stone and McGurk (1985) should be used only as minimum estimates and not as absolute values, as in the EA. In addition, the potential existence of preferential flow pathways beneath playas may invalidate the application of the chloride mass balance approach beyond estimating minimum recharge rates.

The method used by Nativ (1988) and Nativ and Riggio (1990) in calculating recharge rates, which ranged from 1.3 to 8 cm/yr, is probably the most applicable for this study. This range in recharge rate is based on "bomb" tritium (reference Footnote 4, Page 5 of letter from The University of Texas at Austin, dated February 25, 1993) found in shallow Ogallala aquifer wells in Lubbock County. Turin and others (1992) accept the methods used and recharge rates reported in Nativ (1988) and Nativ and Riggio (1990) but point out that the higher rates were recognized in areas far south of the Pantex Plant. However, as discussed next, Nativ (1988) also reports elevated tritium in a well near the Pantex Plant.

Response #: E.4

This comment consists of three main points shown in three paragraphs beneath the sentence labelled "A." The following is offered in response:

Paragraph 1: The Los Alamos National Laboratory made a concerted effort to estimate local playa lake recharge rates because local, rather than regional, recharge rates are the key to predicting how much plutonium might appear in the groundwater.

Paragraph 2: In Turin et al. (1992), the Los Alamos National Laboratory compiled and presented available estimates of recharge rates from open literature sources. While each individual method is vulnerable to technical criticism, the overall agreement of the results suggests that the true recharge rate is close to those presented. This was further supported by information reported in Nativ (1988), an unpublished report which was not available to the Los Alamos National Laboratory at the time Turin et al. (1992) was prepared. Nativ (1988) compiled a list of literature recharge estimates for the Southern High Plains, which includes four references not listed by the Los Alamos National Laboratory in Table 3-1 of Turin et al. (1992) (these include United States Bureau of Reclamation (1982), Klemt (1981), Knowles et al. (1984), and Barnes et al. (1949)). These references provide recharge estimates ranging from 0.15-2.54 cm/yr, all within the range of values presented in Turin et al. (1992).

Paragraph 3: The comment states that "Turin et al. (1992) accept the methods used and recharge rates reported in Nativ (1988) and Nativ and Riggio (1990)...." Los Alamos National Laboratory did not have access to Nativ (1988) while preparing Turin et al. (1992), and, therefore, did not cite it. Furthermore, by listing Nativ and Riggio's (1990) recharge estimate in Table 3-1, the Los Alamos National Laboratory did not intend to endorse or accept either the estimate, or the method by which it was derived. Since publishing Turin et al. (1992), the Los Alamos National Laboratory has carefully reviewed the recharge estimates in Nativ (1988), and has concerns about both the method and results. These concerns are described in detail in Response E.5.

cm = centimeter
yr = year

Document #: *1006* **Comment #:** *4* **Date:** *2/25/93*

Auburn L. Mitchell
Univ. of Texas, Austin, Bureau Economic Geology

Comment:

B. A Proposed "Site Specific" Recharge Rate Based On Known Tritium Levels In Wells On or Near Pantex Plant

Nativ (1988) reports elevated tritium in a well in Carson County, immediately north of the Pantex Plant in the Amarillo Well Field (Well No. 627, TWC No. 06-44-207) and in a well in northern Armstrong County. Therefore, on the basis of these data alone, there is clearly some recharge in progress at rates capable of transporting tritium to the water table at depths of at least 200 to 500 ft (161 to 152 m), and this recharge has been occurring within the last 40 years. In the Pantex Plant area, Bureau scientists found elevated tritium in all wells producing from a perched aquifer. Tritium levels in these wells range from 0.4 tritium (TU) (in well OW-WR-44) to 44 TU (in a private well 1.9 mi south of the Pantex Plant).

Nativ (1988) estimated that water sampled in 1985 with a tritium content of 73 TU was probably from a precipitation event that occurred between 1966 and 1967. Nativ (1988) calculated recharge rates based on the equation (see Figure on Page 6 of the letter from The University of Texas at Austin, dated February 25, 1993).

Because Turin and others (1992) accepted the validity of methods used by Nativ (1988) and Nativ and Riggio (1990), it is appropriate to apply this same method to calculate a "conservative" site-specific recharge rate of the Pantex Plant area based on the tritium levels reported for wells in the perched aquifer in the area. Two technical considerations complicate the selection of time intervals for recharge events based on current tritium levels. The first problem is that the input function for tritium today has dropped to a level that is nearly at prebomb background levels. Second, there is no simple method for taking into account mixing of younger waters recharging verticially with old water moving along the natural system. For example, a water sample with 5 TU might derive from a single source of water with 5 TU or from several sources by mixing 5 parts water with 100 TU and 95 parts water with no tritium; or infinite other combinations could apply.

Most of the tritium values reported for perched ground water in the Pantex area are too low (for example, less than 8 TU) to relate to the tritium-decay curve. In the well with 44 TU, however, a conversion can be made so that this water can be applied to Nativ's (1988) tritium-decay curve. The most reasonable time period for a recharge event with this tritium input function (44 TU in 1992 is approximately equal to 65 TU in 1985, the date at which Nativ's [1988] samples were collected) is 1966 to 1967. Thus, an elapsed time from recharge event to arrival in the perched aquifer at this well could be approximately 25 years. The average volumetric moisture content,. as measured by Bureau scientists in several boreholes in the area, ranges from about 0.1 to 0.2 m3, higher moisture contents being observed near the surface. The unsaturated zone at this well is reported to be approximately 200 ft (61 m) thick. Unsaturated thickness above some perched aquifers are as great as 260 ft (79 m). Using a range in moisture content of 0.1 to 0.2, thickness of an unsaturated zone ranging from 200 to 260 ft (61 to 79 m), and a time since recharge ranging from 25 to 40 years results in a range in recharge rates from 0.5 to 2.1 ft/yr (15.2 to 63.3 cm/yr).

Response #: E.5

This comment presents a report of field evidence of higher transport velocities than the Los Alamos National Laboratory assumed. Detailed responses to each paragraph of this comment are presented below which analyze the comment at some length. The Los Alamos National Laboratory believes that the extremely high recharge rates suggested by the Texas Bureau of Economic Geology, when combined with the other conservative assumptions made by Turin et al. (1992), form a scenario which is so conservative it appears to be unreasonable. Nevertheless, additional plutonium transport simulations were performed using this extremely conservative scenario. Below, the results are compared with the original predictions. Even with a very low assumed dispersivity of 1 cm, the maximum peak plutonium concentration in the Ogallala Aquifer recharge, while higher than the most conservative public water supply standard, still does not exceed the exposure-based standard described in Turin et al. (1992), Appendix B.

Paragraph 1: The comment states that Nativ (1988) reports elevated tritium in a well in Carson County... (Well No. 627, Texas Water Commission No., 06-44-207); this is incorrect.

Nativ (1988) reports a tritium concentration for this well of 0.7 TU. This value is close to typical tritium detection limits, does not conclusively indicate a significant nuclear-age component, and should not be considered elevated. The comment also discusses elevated tritium in a well in northern Armstrong County. According to Nativ (1988), this well had 6.9 TU, which suggests some influence from recent recharge. Nativ (1988) does not list a depth-to-water for this Armstrong County well, but by comparing Nativ's figures 18 and 21, it appears that depth-to-water at this well is between 150 and 200 ft. There is, therefore, no basis to conclude, as the comment does, that "...there is clearly some recharge in progress at rates capable of transporting tritium to the water table at depths of at least 200 to 500 feet (161 to 152 m [sic]), and this recharge has been occurring within the last 40 years." The comment then states that the Texas Bureau of Economic Geology has "found elevated tritium in all wells producing from a perched aquifer. Tritium levels in these wells range from 0.4 TU to 44 TU." (A tritium level of 0.4 TU cannot be considered elevated, but this is a small point.) These tritium data have not been reported in any published document; however, the Texas Bureau of Economic Geology has provided them to the Los Alamos National Laboratory, and they are addressed below under Paragraph 4.

Paragraph 2: The comment states that "Nativ (1988) estimated that water sampled in 1985 with a tritium content of 73 TU was probably from a precipitation event that occurred between 1966 and 1967." However, the comment does not mention the associated assumptions and caveats. As Nativ (1988) states, this estimate is based on "a simplified model that assumes piston-type flow and a complete displacement of water present in both the vadose and the saturated zone by the recharging water." As Turin et al. (1992) discussed, a piston-flow model is intuitively simple, but is not physically realistic. Specifically, it neglects dispersion, which would result in some high-tritium water reaching the water table at a faster rate than purely advective transport would predict. Using a piston-flow model would assign this faster rate entirely to advection, resulting in an erroneously high transport estimate. Nativ (1988) acknowledges this: "The model provides a minimum estimate for the water age and a maximum value for the local recharge rate."

In addition to this questionable model, Nativ's (1988) age estimate is further confused by mathematical errors, an inaccurate value for the half-life of tritium and a limited and flawed precipitation data set. The precipitation data set problems are more severe. Nativ cites no references for the precipitation data reported; however, comparison with data published by the International Atomic Energy Agency (IAEA, 1969; 1971; 1973; 1975; 1979; 1983; and 1986) and compiled by Shevenell (1990) reveals numerous differences, some minor, some major. The net effect of these errors is revealed in Figure E.5-1, which shows Nativ's (1988) data together with corrected data. Nativ (1988) concluded that 1985 water containing 73 TU was probably precipitation from 1966-1967. Figure E.5-1 shows that the corrected data predict that 1961 precipitation would also have approximately 74 TU. Therefore, even assuming that the piston-flow model is valid, a single tritium value cannot be assigned to a unique precipitation year. This conclusion is further illustrated by considering a more complete precipitation data set. Figure E.5-2 is based on published International Atomic Energy Agency data supplemented by estimates by Shevenell (1990). These data show that precipitation water from three different years (1958, 1961, and 1966) all would contain approximately 75 TU in 1985.

Nativ's (1988) simplified model also did not consider dispersive mixing. In order to give some idea of the nature of dispersive mixing, Figure E.5-2 presents a 5-point moving average of Nativ's (1988) data. This is not intended to represent an accurate estimate of the effects of dispersion, but shows how dispersion would cause "smoothing."

Paragraph 3: The comment states that, in Turin et al. (1992), the Los Alamos National Laboratory accepted the validity of the methods used by Nativ (1988) and Nativ and Riggio (1990). The statement is incorrect since the Los Alamos National Laboratory had no access to Nativ (1988) while Turin et al. (1992) was prepared. Additionally, inclusion of data from Nativ and Riggio (1990) was not intended as an endorsement. As discussed above, the Los Alamos National Laboratory does not accept Nativ's (1988) method for tritium-dating water, and seriously doubts the validity of the results.

Paragraph 4: Despite several uncertainties and complications with the tritium-dating method, Paragraph 4 applies that method to new tritium data from the perched aquifer beneath the Pantex Plant. These data consist of tritium concentrations from wells known or suspected to tap the perched aquifer beneath the Pantex Plant. These data, provided by the Texas Bureau of Economic Geology, are shown in the Table E.5-1. The distribution of these data is rather peculiar - six of the wells show less than 5 TU, three fall between 5 and 9 TU, and a single well shows 44 TU. The Texas Bureau of Economic Geology confirmed the 44 TU data point by reanalyzing the sample. Therefore, three hypotheses are possible: a) the true concentration of tritium in the perched aquifer is somewhere between 0 and 9 TU, and the single high-tritium well is anomalous; b) the true concentration is around 44 TU, and the nine low-tritium wells are anomalous; or c) the perched aquifer is so heterogeneous in age that tritium concentrations ranging from 0 to 44 TU coexist within a short-distance.

Hypothesis b) is difficult to defend because the possibility of nine wells all producing similarly anomalous low-tritium water seems remote. Hypothesis c) is difficult to disprove; however, evidence against it includes the fact that the high-tritium well is within a mile of a well producing water with 5.64 TU. The water level in these two wells differs by only 24 feet, suggesting close hydrologic contact. Furthermore, lower-tritium wells include those immediately around the Pantex Plant Playa #1, which is strongly suspected to be a site of anomalously high recharge due to Pantex Plant waste water operations. High tritium in these wells could more easily be correlated to rapid recharge.

Hypothesis a) is the most likely explanation due to the risks posed by improperly constructed wells that can provide a short-circuit route to the water table. The well which produced the 44 TU sample is a private well in an agricultural setting that taps a shallow aquifer. This is exactly the type of well most at risk for short-circuiting.

Assuming that the true tritium concentration of the perched aquifer is 0 to 9 TU, what can we say about the transport rate? Figure E.5-3 shows that either with or without dispersion-driven smoothing, 1992 tritium concentrations of 9 TU may be associated with precipitation from about 1955. Lower tritium concentration water could be considerably older, with the 0.4 TU water having a minimum (piston-flow) age of 47 years, based on a pre-bomb background level of 6 TU. Thus, the perched-zone samples exhibit an age range of 37 - >47 years. For an unsaturated zone between 61 and 79 m thick (based on the comment), this corresponds to a velocity range of <1.3 - 2.1 m/yr, or, assuming a volumetric moisture content of 0.15, a recharge rate of <19 cm/yr - 32 cm/yr. (The additional uncertainty introduced into the Texas Bureau of Economic Geology's recharge estimates by uncertainty in moisture content is irrelevant to this problem because velocity, rather than recharge, is the key parameter affecting solute transport.)

These velocity and recharge rates are significantly higher than the assumed rates used in Turin et al. (1992), which were based on literature recharge estimates. It is difficult to explain the discrepancy -- possible contributing factors include errors in the tritium age introduced by the piston-flow model; extreme transport acceleration due to preferential flow; and anomalously high recharge rates in the immediate vicinity of the Pantex Plant due to waste water discharge to Pantex Plant Playa #1. Regardless of the cause, the Texas Bureau of Economic Geology tritium data suggest that downward velocities as high as 2.1 m/yr may be possible. Therefore, the Los Alamos National Laboratory has conducted additional advection/dispersion simulations using the CXTFIT computer code, with downward velocities of 2.0 and 4.0 m/yr (corresponding to recharge rates of 30 cm/yr and 60 cm/yr, with a volumetric moisture content of 0.15), and dispersivities of 1 cm and 1 m. The results of these simulations are shown in the Figures E.5-4, E.5-5, and E.5-6.

The most obvious impact of increased transport velocity is a shorter travel time to the water table. Peak plutonium concentrations reach a 50-foot deep water table in 6,200 - 7,600 years at 2 m/yr (Figure 4) and in 3,100-3,800 years at 4 m/yr (Figure E.5-5), compared to the base case shown in our report, with a travel time of 52,000-75,800 years at 20 cm/yr velocity (3 cm/yr recharge). With these shorter vadose-zone residence times, radioactive decay has less opportunity to reduce plutonium concentrations. However, this effect is mostly offset by the increased initial dilution of the 2.0 $\mu Ci/m^2$ surface loading caused by the increased annual recharge. As can be seen in Figure E.5-4, with a velocity of 2.0 m/yr, the 1 cm dispersivity simulation predicts a peak recharge concentration of 7.7 pCi/L, which exceeds the conservatively-calculated public water supply drinking water based standard of 1.3 pCi/L, but is significantly below the conservatively-calculated total exposure based standard of 30 pCi/L (see Appendix B of Turin et al. (1992) for details on dose calculations, including an explanation of conservatively-calculated). This calculated recharge concentration represents the concentration in a drop of water in the vadose zone just above the Ogallala Aquifer water table. Before this water reaches any potential receptor, additional horizontal and vertical mixing within the aquifer and in a water-supply well would further dilute the plutonium, likely leading to well-head concentrations below any applicable standard. With a more realistic dispersivity of 1 m, the predicted peak recharge concentration is 0.94 pCi/L, well below both previously-mentioned dose standards. Again, dilution within the aquifer and well casing would further decrease plutonium concentrations before any potential receptors are reached. Doubling the recharge rate and velocity does not greatly affect predicted peak recharge concentrations: 8.65 pCi/L and 1.02 pCi/L for 1 cm and 1 m dispersivities, respectively (see Figure E.5-5). The relationship of these predictions to dose standards is much the same as for the 2.0 m/yr velocity results.

With a more typical depth to water of 200 feet, recharge plutonium concentrations will peak at 3.1 pCi/L assuming a 1 cm dispersivity, and at 0.33 pCi/L with a more realistic assumed dispersivity of 1 m (see Figure E.5-6). These values should be compared to the most conservative public water supply standard of 1.3 pCi/L and the total exposure standard of 30 pCi/L.

To summarize: because of the concerns of the Texas Bureau of Economic Geology about the assumptions used in Turin et al. (1992) for estimating recharge, additional plutonium transport simulations were performed using conservative velocity and recharge estimates, based on the Texas Bureau of Economic Geology unpublished tritium data. These additional simulations assumed transport to a 50-foot deep aquifer (which only occurs south of the Pantex Plant) in a direction opposite the prevailing wind.

A ten-fold increase in surface loading over the stated cleanup levels was also assumed, and the entire unsaturated zone was postulated to exhibit the relatively low plutonium sorption measured for Ogallala Sand, an assumption that Texas Bureau of Economic Geology admits is extremely conservative (Comment 1006/6). It was conservatively assumed that the entire surface plutonium loading dissolves in a single year's recharge. Given all these assumptions, even with a very low assumed dispersivity of 1 cm, the maximum plutonium concentration in recharge is predicted at 8.65 pCi/L. This figure is higher than the most conservative public water supply drinking water standard but significantly lower than the total exposure based standard of 30 pCi/L. When aquifer and well-casing dilution is taken into account, anticipated plutonium concentrations reaching a potential receptor are lower than either standard. With a more realistic dispersivity of 1 m, our analysis predicts that even the recharge concentration would be lower than any applicable standard.

Considering the extreme conservatism of the assumptions of this analysis, the Department continues to support the original conclusion of the Environmental Assessment that the hypothetical plutonium dispersal accident does not pose a significant threat to the Ogallala Aquifer.

cm = centimeter
m = meter
μCi = microCurie
pCi = picoCurie
L = liter
TU = tritium units
yr = year

Table E.5-1 - Texas Bureau of Economic Geology Perched Aquifer Tritium Concentrations.

Perched Aquifer Well	Tritium Concentration. (TU)
PM-19	7.28/8.39
PM-20	1.39
PM-38	4.71/4.92
PM-44	0.44/0.40
PM-45	6.10/8.75
C. Wink	1.77
P. Smith	42.7/44
F. Wink	5.64
E. Pratt	1.40
PM-106	0.72

Source: Alan Fryer, Texas Bureau of Economic Geology, personal comment, 3/30/93.

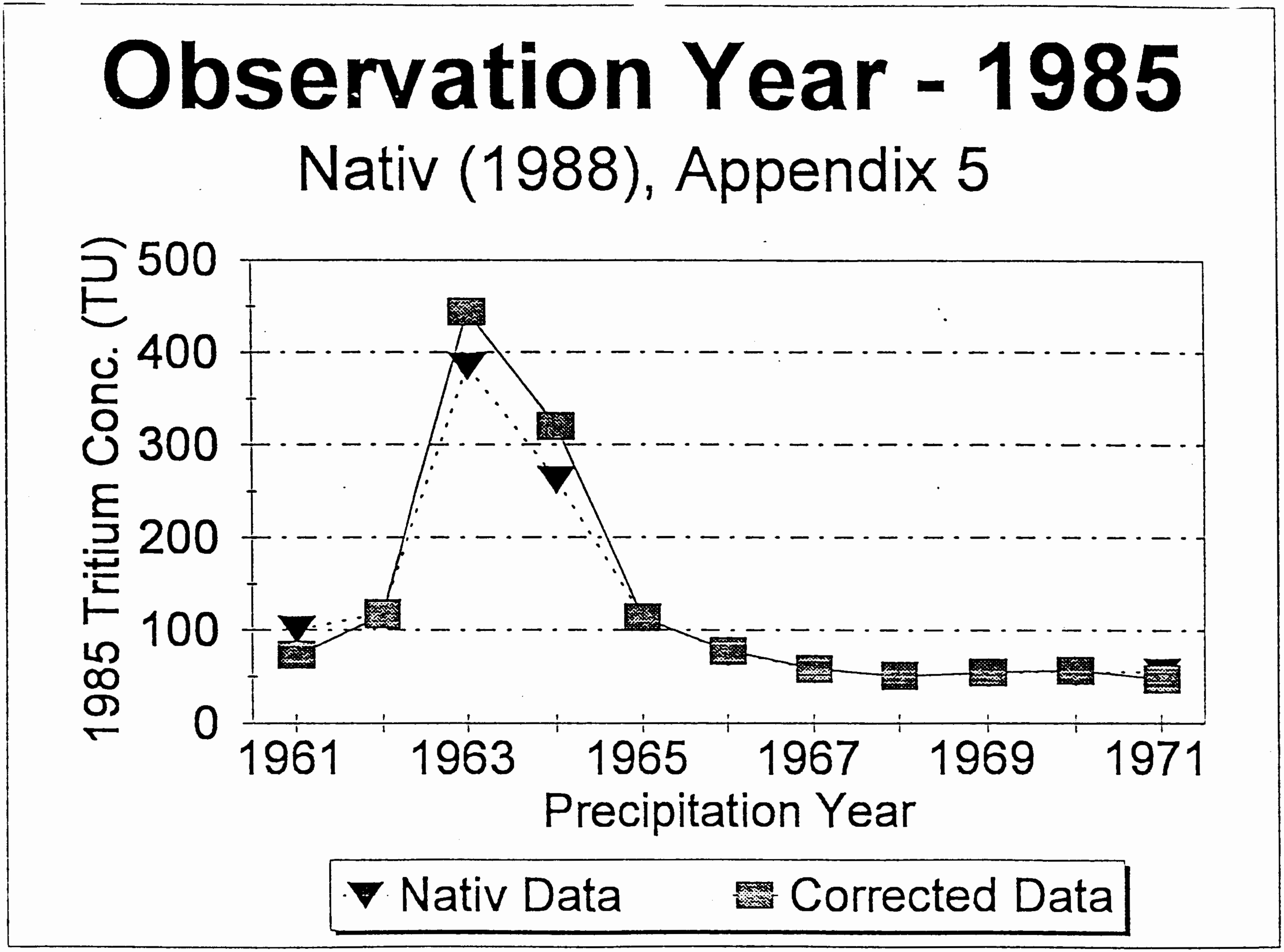
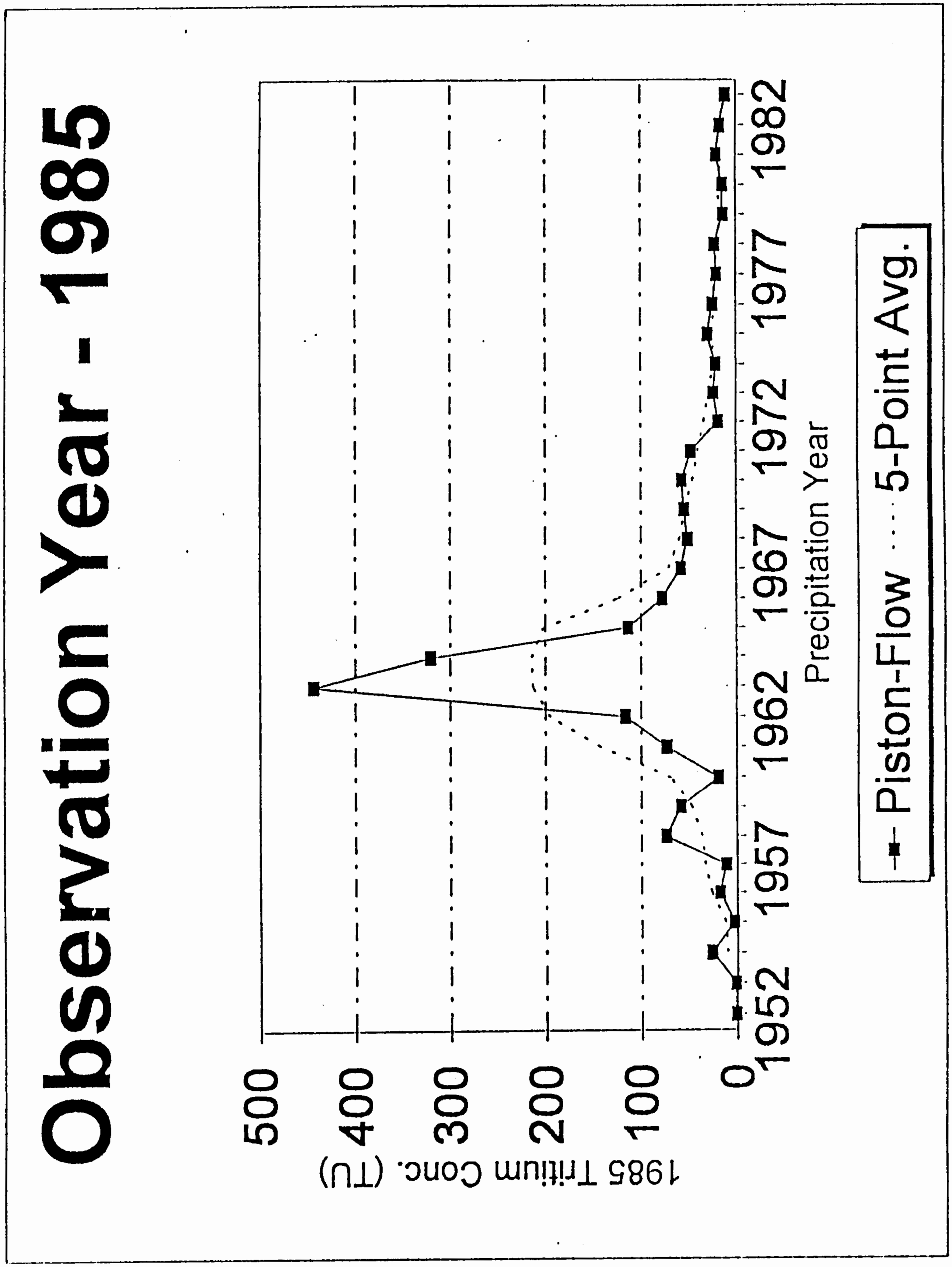


Figure E.5-1 - Observation Year - 1985 Nativ (1988), Appendix 5

Figure E.5-2 - Observation Year - 1985



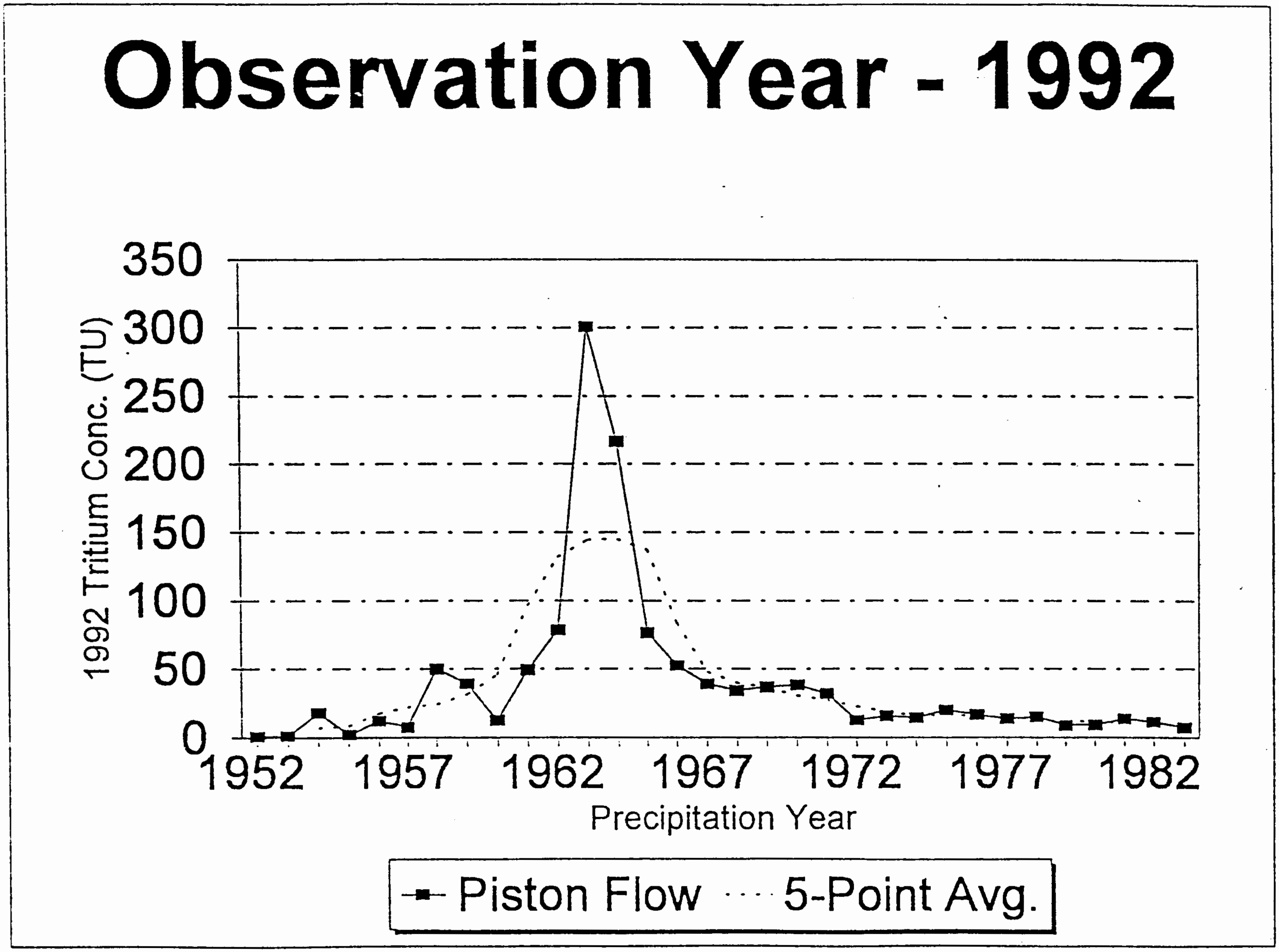
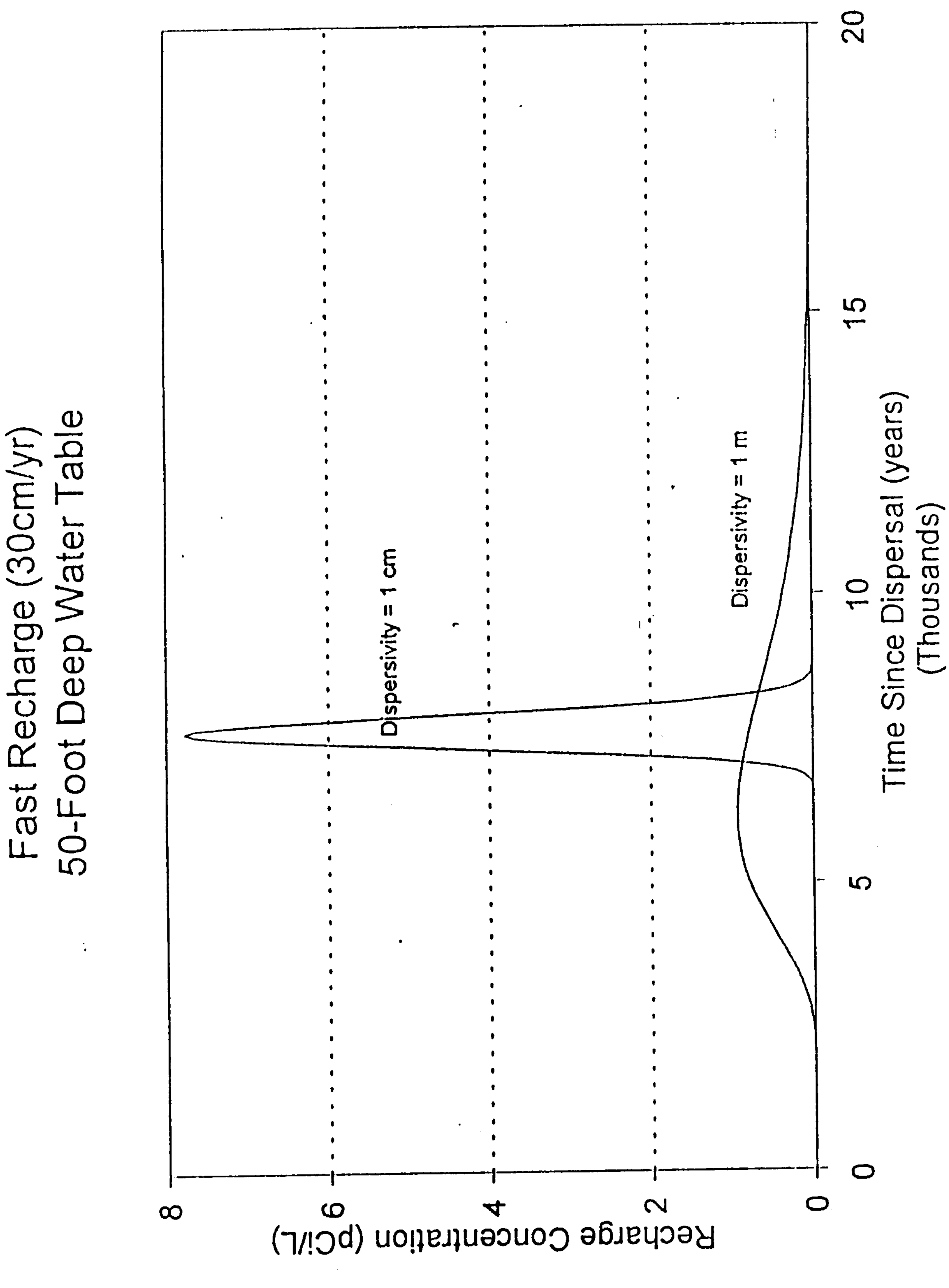


Figure E.5-3 - Observation Year - 1992

Figure E.5-4 - Fast Recharge (30 cm/yr)
50-Foot Deep Water Table



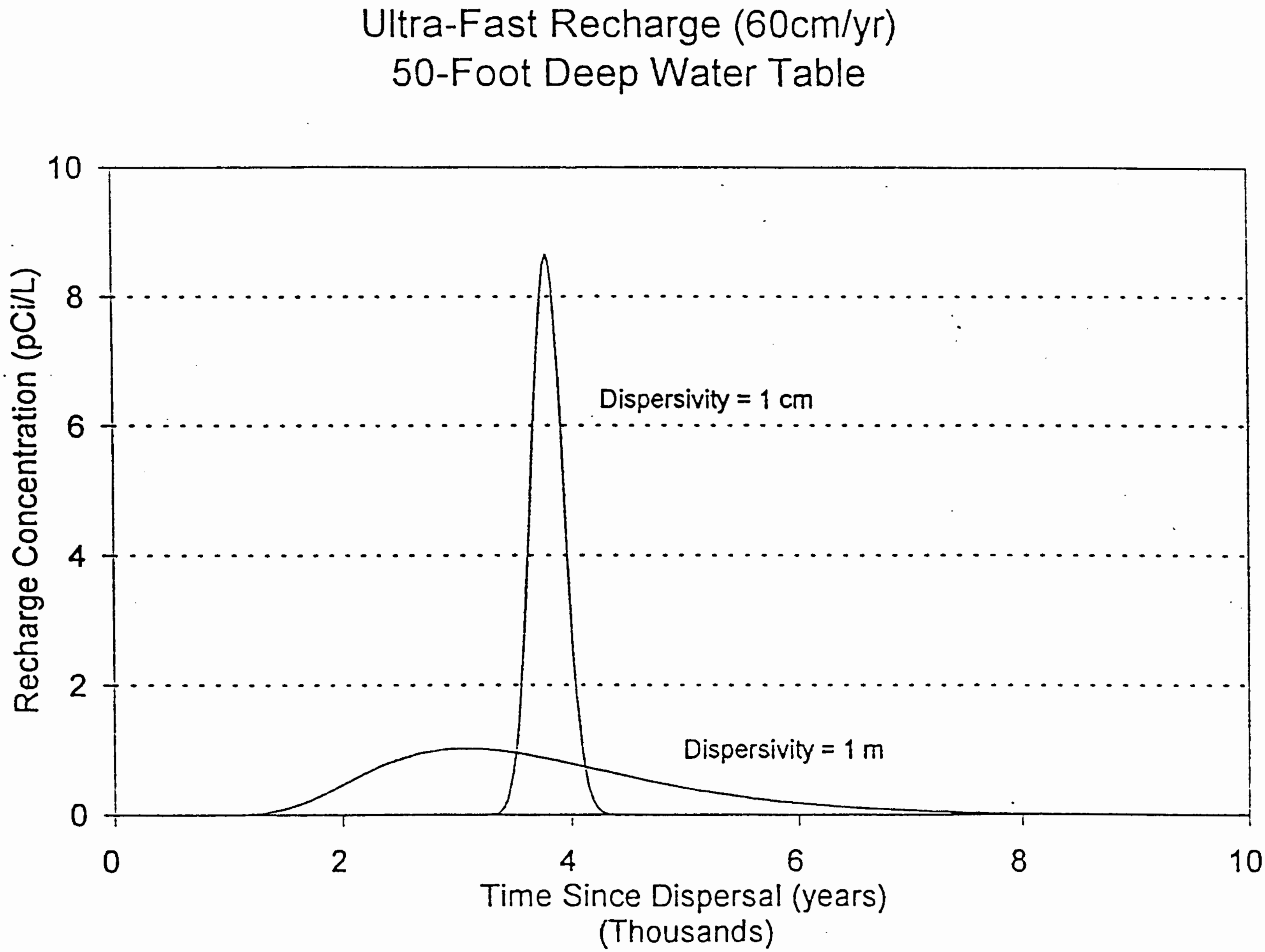


Figure E.5-5 - Ultra-Fast Recharge (60 cm/yr)
50-Foot Deep Water Table

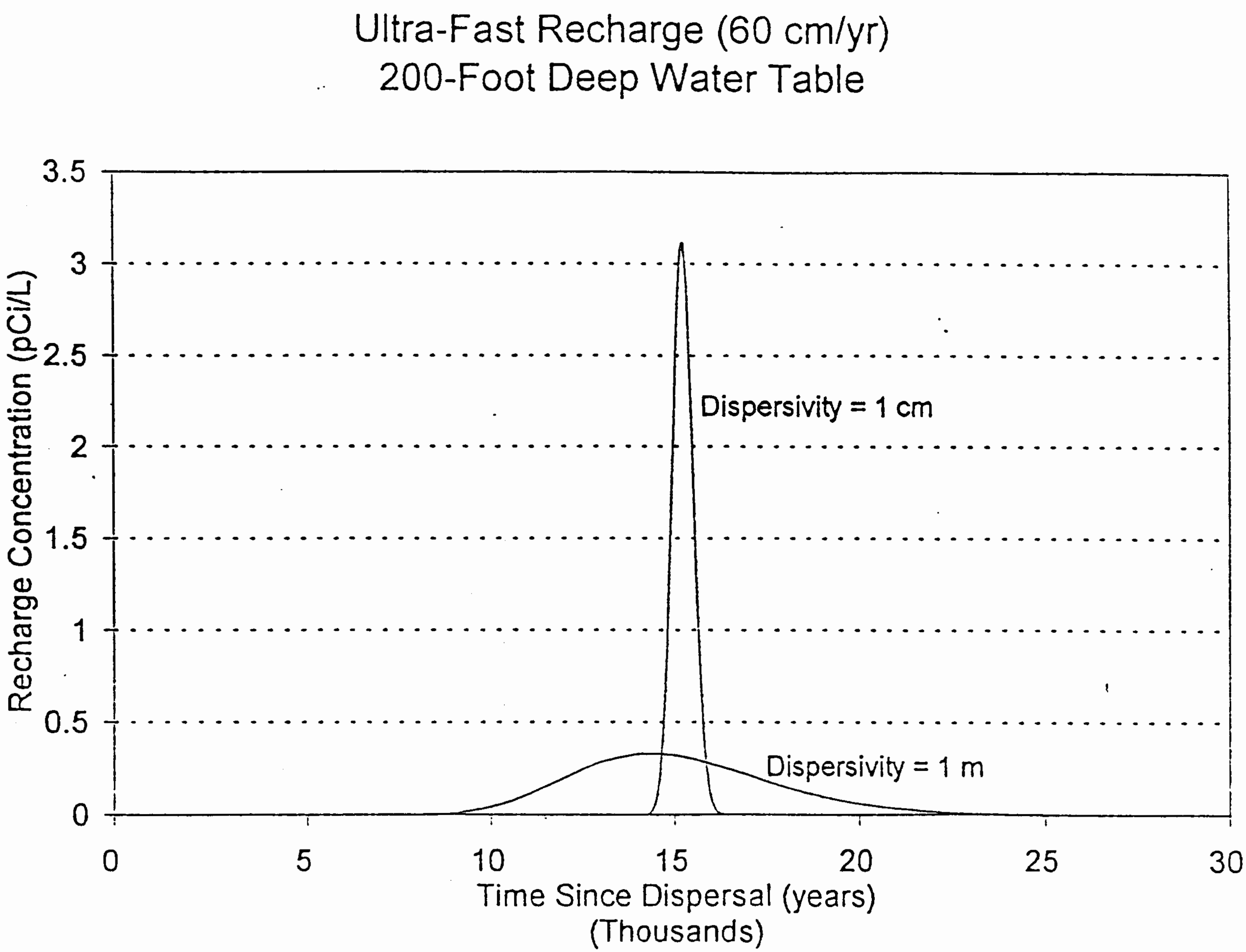


Figure E.5-6 - Ultra-Fast Recharge (60 cm/yr)
200-Foot Deep Water Table

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (E.6) FOLLOWS.

Document #: *1006* **Comment #:** *5* **Date:** *2/25/93*

Auburn L. Mitchell
Univ. of Texas, Austin, Bureau Economic Geology

Comment:

C. Calculation of a "Conservative" Velocity for Determining Contaminant Transport in the Vicinity of Pantex

The above site-specific recharge range describes the volume rate of transfer of water to the aquifer, not the velocity at which a water molecule moves through the unsaturated zone. Velocity, which is critical in determining contaminant transport, is calculated by dividing the thickness of the unsaturated zone, 200 to 260 ft (61 to 79 m), by the time since recharge, 25-40 years. Given these values, the velocity beneath the Pantex Plant is approximately 5 to 10 ft/yr (150 to 300 cm/yr).

In addition to "bomb" tritium levels observed at depth, recharge experiments conducted at the Bushland Agricultural Research Station demonstrate the potential for subsurface velocities substantially exceeding those assumed in the Turin report. Recharge experiments were performed in basins that had been excavated to a depth of 3.9 ft (1.2 m) to remove the Pullman soil and expose the unconsolidated caliche layer (Aronovici and others, 1970). Infiltration rates beneath the basins were on the order ~ 3.3 ft/d ~1,200 ft/yr (100 cm/d ~ 36,500 cm/yr).

In sum, our view is that for purposes of this site-specific ground-water analysis, contaminant transport concepts, which consider the velocity of water movement through the unsaturated zone, should be used rather than volumetric-oriented ground-water resources concepts, which focus on the rate at which water is recharged to an aquifer. For the Pantex Plant area, tritium-dating methodology indicates water may move at significantly higher rates in the subsurface than assumed in the Turin report.

Response #: E.6

When Turin et al. (1992) was prepared, the Los Alamos National Laboratory did not have the unpublished tritium data from the Texas Bureau of Economic Geology. Therefore, recharge rate estimates, adjusted for effective water saturation, were used to perform the transport calculations. Upon learning that the unpublished tritium data from the Texas Bureau of Economic Geology suggested faster velocities, the potential impacts of these velocities on plutonium transport were analyzed. (See Response E.5.)

The infiltration rates referenced in the comment were the result of experimental conditions designed to maximize recharge rates and do not appear relevant to natural recharge situations.

Document #: *1006* **Comment #:** *6* **Date:** *2/25/93*

Auburn L. Mitchell

Univ. of Texas, Austin, Bureau Economic Geology

Comment:

V. Plutonium Sorption/Preferential Flow Paths

The fifth asumption (listed on page 7-2 of the EA report and on page 1 of Turin and others, 1992) states that "The entire unsaturated zone exhibits a plutonium sorption coefficient of 100 mL/g, approximating the sorption of clean Ogallala sand." There are several issues here. First, it is our view that actual retardation of plutonium filtrating through the Pullman and Randall soils is, in the absence of preferential flow, going to be substantially greater than that reported. Actual mobility, however, would have to be evaluated in terms of preferential flow through fractures or root tubules, which these batch-equilibrium sorption coefficients do not consider. Thus, this assumption, while conservative to the extent of its reach, does not fully address the issue of plutonium either at the surface or in the subsurface.

A. Plutonium Sorption Coefficient for Porous Media

The experiments reported to validate this assumption are based on plutonium sorption studies performed on Pullman soil and Ogallala sediment and did not consider the Randall clay soil. Unfortunately, the actual Kd reported from these experiments cannot be directly evaluated. The authors report using the 75 to 500 um size fraction for their experiments. This size fraction, although somewhat representative of Ogallala sediments, is inappropriate for evaluating sorption of inorganic solutes. This size fraction is dominated by framework silicates, and, if the sample is not disaggregated first, by soil aggregates of some unknown structure.

Most importantly, however, sorption is dominated by the clay fraction, in which particle size is generally less than a few microns. Based on our evaluation of the Pullman and Randall soils, the specific surface areas of the bulk soil are approximately 20 to 40 m2/g, whereas specific surface areas of the size fraction used in the Turin report experiments are approximately 0.01 to 0.05 m2/g, or three orders of magnitude smaller. Thus, in the absence of preferential flow, actual retardation of plutonium infiltrating through Pullman and Randall soils is going to be substantially greater than that reported, based on the experiment's size fraction. This part of the Turin analysis is, therefore, extremely conservative. However, we again emphasize that these results are valid only in the absence of preferential flow.

Response #: E.7

The experimental procedure used for the batch sorption measurements was developed at the Los Alamos National Laboratory specifically to determine the sorption of actinides onto unconsolidated material. The specific sample preparation method and grain-size selection was shown by Thomas (1987) to maximize reproducibility of results. Thomas (1987) showed that irreproducible results are obtained if particles of all sizes are utilized to determine sorption coefficients, due to the practical problems involved in separating the solution from the solid phase which is an integral part of the batch sorption procedure. Because of this problem, the Los Alamos National Laboratory developed careful procedures to sieve unconsolidated materials without causing fractionation (Rogers and Meijer (1993)). Rogers and Meijer (1993) report that the sorption coefficients obtained using particles in the size range from 4 mm to 75 μm do not vary with particle size.

However, because of the concern raised by the comment author, the batch sorption experiments have been repeated using bulk soil samples instead of the specific size fraction used previously. For these new experiments, the field soil samples were carefully and gently ground to break up soil aggregates, and then passed through a 2 mm sieve to remove gravel-sized particles. Results from these new experiments are compared to the results reported by Turin et al. (1992) in Tables E.7-1 and E.7-2. The new results show increased sorption for the Pullman Soil samples (5,000 -7,000 mL/g versus 3,000 - 4,000 mL/g) and no significant change for the Ogallala Sand (100 -200 mL/g versus 60 - 500 mL/g). Using 100 mL/g for all K_D values still appears to be a highly conservative assumption.

Response E.8 discusses the issue of preferential flow.

mm = millimeter
µm = micrometer
mL = milliliter
g = gram

Table E.7-1 - Plutonium Sorption onto Pullman Soil from Deionized Water
K_D (mL/g)

Initial Plutonium Oxidation State	Sample 1A: 75 - 500 µm (Turin et al., 1992)	Sample 1A: <2 mm (new data)	Sample 1B: 75 - 500 µm (Turin et al., 1992)	Sample 1B: <2 mm (new data)
IV	4000	6000	3000	7000
V	3000	5000	4000	5000

Table E.7-2 - Plutonium Sorption onto Ogallala Sand from Deionized Water
K_D (mL/g)

Initial Plutonium Oxidation State	Sample 3A: 75 - 500 µm (Turin et al., 1992)	Sample 3A: <2 mm (new data)	Sample 3B: 75 - 500 µm (Turin et al., 1992)	Sample 3B: <2 mm (new data)
IV	300	200	500	100
V	60	100	100	100

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (E.8) FOLLOWS.

Document #: *1006* **Comment #:** *7* **Date:** *2/25/93*

Auburn L. Mitchell

Univ. of Texas, Austin, Bureau Economic Geology

Comment:

B. Preferential Flow Paths

The report by Turin and others (1992) does not fully describe the potential for preferential flow of recharging waters and retardation of plutonium moving through the Ogallala and Blackwater Draw Formations. Cores from these formations and from playa-filling sediments contain abundant open root tubules that are typically 0.04 in (1 mm) in diameter but range up to 0.3 in (8 mm) in diameter. Root tubules are commonly lined with a thin layer of illuvial clay. Cores through the Randall Clay commonly contain fractures, some filled with silt and very fine sand and some with oxidized zones. Both root tubules and fractures are sites through which preferential flow and infiltration can occur. Root tubules are preserved throughout the fine-grained eolian facies of both the Blackwater Draw and Ogallala Formations. The presence of open tubules and fractures indicates that pathways exist through which downward flow is accelerated and contact with sediments is reduced, thus lessening the potential for sorption of radionuclides. Such pathways may explain the high flow rates discussed in Aronovici and others (1970). As noted in the attached specific comments, the subject of preferential flow should be examined in much greater detail.

Document #: *1006* **Comment #:** *15* **Date:** *2/25/93*

Auburn L. Mitchell

Univ. of Texas, Austin, Bureau Economic Geology

Comment:

Page 18: Preferential Flow section: A much more detailed evaluation of preferential flow should be presented because this is a critical issue with respect to recharge beneath playas. Numerical simulation of preferential flow should include mobile and immobile water. Using twice the calculated water velocity is not a sufficiently conservative assumption. A review article by Beven and Germann (1982) cites velocity ratios between matrix and macropore flow between 100:1 and 400:1. The subsurface beneath playas is particularly conducive to preferential flow because the soils are close to saturation and are subject to a ponded upper boundary when playas contain water. Because this is the most likely area of recharge and is critical for contaminant transport, the subject of preferential flow should be examined in much greater detail.

Document #: *1011* **Comment #:** *13* **Date:** *2/18/93*

Dana O. Porter

Citizen Comments

Comment:

2. The authors of the report indicated that preferential flow is expected to have negligible contribution to the aquifer contamination risk. The Pullman clay loam and Randall clay soils, containing appreciable amounts of montmorillonitic clay, are subject to cracking which increases opportunity for preferential flow.

Document #: *1015* **Comment #:** *15* **Date:** *2/20/93*

Addis Charless, Jr.

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

Potential Ogallala Aquifer Impacts...: The "preferential flow" arena is by the EA's own admission an unknown regarding flow rates to and effects on the Ogallala aquifer.

Response #: E.8

Turin et al. (1992) estimated the effect of preferential flow on contaminant transport by doubling the assumed transport velocity. Since determining preferential flow effects is an active soil science research area, this estimate can be disputed and cannot be confirmed without local field experiments and/or measurements. Nevertheless, it is a conservative estimate based on good professional judgment.

The root tubules and fractures mentioned in the comment may or may not act as conduits, depending on local soil moisture tension and the nature of fracture or tubule fills. As was mentioned in Turin et al. (1992), Goss et al. (1973) did not detect deep contaminant migration (below 9 ft) in their experiments, despite obvious and visible open soil pores. While this is not conclusive evidence, it suggests that the visible pores may not accelerate transport as much as might otherwise be thought.

Mobile/immobile water models are a useful conceptual tool for research into preferential flow (but of minimal practical application in this case) because of the paucity of site-specific experimental data needed to estimate the numerous parameters required by such models. Doubling the downward velocity is analogous to a mobile/immobile water situation with a domain ratio of 1:1, and no solute exchange between the two domains. This no-exchange assumption is actually more conservative than standard mobile/immobile water models. The velocity ratios cited in the comments are of academic interest, but irrelevant to the discussion at hand. Both Turin et al. (1992) and a mobile/immobile water model assume an infinite velocity ratio.

ft = feet

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (E.9) FOLLOWS.

Document #: *1006* **Comment #:** *8* **Date:** *2/25/93*

Auburn L. Mitchell

Univ. of Texas, Austin, Bureau Economic Geology

Comment:

Page 3, Line 13-14: The statement that the Ogallala Formation has been eroded and is no longer present along the Canadian and Pecos Rivers is incorrect. The Ogallala Formation is present in the Canadian River Valley for at least 70 mi northeast of the Pantex Plant.

Response #: E.9

The Ogallala Formation does indeed extend northeast of the Pantex Plant; however, in the study area north of the plant, the Canadian River (and Lake Meredith) flow through outcrops of pre-Tertiary rocks, indicating that the Ogallala has been completely eroded away in this area.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (E.10) FOLLOWS.

Document #: *1006* **Comment #:** *9* **Date:** *2/25/93*

Auburn L. Mitchell

Univ. of Texas, Austin, Bureau Economic Geology

Comment:

Page 6, Line 8-9: The statement is made that "Local recharge rates in the playa basins must therefore significantly exceed the regional averages cited above." This relationship between playas and recharge supports use of specific recharge rates instead of regional averages.

Response #: E.10

As mentioned in Section 7.0 of the Environmental Assessment and discussed in Turin et al. (1992), an estimated local playa recharge rate of 3 cm/yr was used instead of the regional average value of approximately 0.3 cm/yr.

cm = centimeter
yr = year

Document #: *1006* **Comment #:** *10* **Date:** *2/25/93*

Auburn L. Mitchell

Univ. of Texas, Austin, Bureau Economic Geology

Comment:

Page 6, line 19-20: the statement is made that "no recent contour maps showing depth-to-water for the study area were available." It should be noted that Bureau researchers simultaneously submitted to DOE (1) a report on perched aquifers at the Pantex Plant (referenced in Turin and others, 1992) and (2) a report containing potentiometric-surface maps of the Ogallala aquifer through 1991 (not referenced in Turin and other [1992]).

Response #: E.11

The Turin et al. (1992) statement concerning the availability of recent maps showing depth-to-water was not intended to imply that the potentiometric-surface maps provided by the Texas Bureau of Economic Geology were not available when the Environmental Assessment was prepared. The potentiometric-surface map does not show depth-to-water and deriving depth-to-water from potentiometric-surface maps is difficult.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (E.12) FOLLOWS.

Document #: *1006* **Comment #:** *11* **Date:** *2/25/93*

Auburn L. Mitchell

Univ. of Texas, Austin, Bureau Economic Geology

Comment:

Page 7, Line 4: At steady state, the Ogallala outcrop areas along the margins of the Canadian River and Palo Duro Canyon were clearly discharge zones. With the continued lowering of Ogallala water levels in some areas, a reversal in gradients may occur and what were previously discharge zones may in fact convert to recharge zones.

Response #: E.12

This comment speculates that if water levels in some areas of the Ogallala Aquifer continue to be lowered, discharge zones along the margins of the Canadian River and Palo Duro Canyon may become recharge zones. The Environmental Assessment does not address this because predicting future groundwater levels beneath the Southern High Plains is beyond its scope.

Document #: *1.006* **Comment #:** *12* **Date:** *2/25/93*

Auburn L. Mitchell

Univ. of Texas, Austin, Bureau Economic Geology

Comment:

Page 7, Line 20: Considering the differences in geology, hydrology, climate, and vegetation, the comparison between the Trinity site and the Pantex Plant seems inappropriate.

Response #: E.13

While the Trinity Site and the Pantex Plant are not identical with respect to geology, hydrology, climate, and vegetation, they are similar. Also, the Trinity Site data are the only available estimates of surface transport concentration effects on fallout. To account for the differences between the two sites, the observed Trinity Site concentration factors of 1.5 to 2 were conservatively increased to a factor of 10 for the Environmental Assessment analysis.

Document #: *1006* **Comment #:** *13* **Date:** *2/25/93*

Auburn L. Mitchell
Univ. of Texas, Austin, Bureau Economic Geology

Comment:
Page 9, Line 11: It is regrettable that Pullman soils and Ogallala sediments were collected but Randall soils with their higher clay content were not.

Response #: E.14

Samples of the Randall Clay soil, not available during the preparation of Turin et al. (1992), were recently obtained by the Los Alamos National Laboratory. The sample was measured for its plutonium absorption properties using experimental procedures described in Appendix A of Turin et al. (1992) with the exception that sorption was measured on a bulk soil sample instead of a sieved size fraction. The soil was prepared by air-drying, followed by crushing the hard clay clods in a shatterbox. The sorption results, presented in Table E.14-1, show that the Randall Clay soil has plutonium sorption properties similar to the Pullman soil. (See Appendix A of Turin et al. (1992).) Both the Pullman and Randall soils sorb plutonium more strongly that the Ogallala sand, so applying the Ogallala sand properties in the original analysis was a conservative assumption.

Table E.14-1 - Plutonium Sorption Characteristics of Randall Clay Soil

Initial Pu Oxidation State	Distilled Water K_D (mL/g)		Ogallala Aquifer Water K_D (mL/g)	
	Sample A	Sample B	Sample A	Sample B
V	1×10^3	1×10^3	3×10^3	3×10^3

NOTE: Initial Ogallala Aquifer water was pH 8.2, Eh 240 mV
After preconditioning, Ogallala water was pH 7.7, Eh 240 mV

mL = milliliter
g = gram
mV = milliVolt

Document #: *1006* **Comment #:** *14* **Date:** *2/25/93*

Auburn L. Mitchell
Univ. of Texas, Austin, Bureau Economic Geology

Comment:
Page 9, Line 13-14: ***More detail is needed concerning advection-dispersion simulations to allow full evaluation of the results. For example, the specific boundary and initial conditions and flow and transport parameters used in the simulations are not described.***

Response #: E.15

The technical details of the CXTFIT runs were not included in Turin et al. (1992) because that report was intended for a general, non-technical audience. These details are provided below.

CXTFIT (Parker and van Genuchten (1984)) when used in the predictive mode (as opposed to its inverse, curve-fitting mode) is a relatively straightforward FORTRAN program that uses well-established numerical approximations of transcendental functions to provide analytical solutions to the one-dimensional advection-dispersion equation. The solution requires auxiliary conditions and transport parameters.

Necessary auxiliary conditions include initial conditions and boundary conditions. For this project, initial conditions were set to zero plutonium concentration throughout the system. The soil surface is assigned a third-type (flux-type) boundary condition, while the lower boundary condition is set as a finite concentration gradient at infinite depth (semi-infinite domain). Full details on the boundary condition assumptions and solution method are presented by Parker and van Genuchten (1984).

Relevant transport parameters are listed and defined in Table E.15-1, and the various CXTFIT runs performed are described in Table E.15-2.

yr = year
μCi = microCurie
pCi = picoCurie
m = meter
cm = centimeter
L = liter

Table E.15-1 - CXTFIT Parameters

	Definition	Value
C_0	Input Concentration at Upper Boundary	$C_0 = \frac{2.0\mu Ci/m^2}{I \cdot t_0}$ Varies: See Table E.15-2
t_0	Input Pulse Width	1 year
I^*	Recharge Rate	Varies: See Table E.15-2
θ^*	Volumetric Water Content	Varies: See Table E.15-2
v	Downward Water Velocity	$V = \frac{I}{\theta}$ Varies: See Table E.15-2
R	Plutonium Retardation Factor	1000
α^*	Dispersivity	Varies: See Table E.15-2
D	Dispersion Coefficient	$D = \alpha \cdot v$ Varies: See Table E.15-2
k	Plutonium Radioactive Decay Constant	2.84×10^{-5} $year^{-1}$ (based on ^{239}Pu)

*These parameters are not directly input into CXTFIT; they are used to determine other parameter values.

Table E.15-2 - CXTFIT Parameter Values

Run ID (Obs. depth)	Figure	C_0 (pCi/L)	I (cm/yr)	θ	v (cm/yr)	α (cm)	D (cm^2/yr)
PLUTO3 (50') PLUTO5 (200')	Turin Report, Figure 4-1	6.67×10^4	3	0.15	20	1	20
PLUTO4 (50') PLUTO6 (200')	Turin Report, Figure 4-1	6.67×10^4	3	0.15	20	100	2000
PLUTO7 (50')	Turin Report, Figure 5-1	6.67×10^4	3	0.075	40	1	40
PLUTO8 (200')	Turin Report, Figure 5-1	6.67×10^4	3	0.075	40	100	4000
PLUTO9 (50') PLUTO13 (200')	Response E.5, Figures E.5-5, E.5-6	3.33×10^3	60	0.15	400	1	400
PLUTO10 (50') PLUTO14 (200')	Response E.5, Figure E.5-6	3.33×10^3	60	0.15	400	100	40000
PLUTO11 (50')	Response E.5, Figure E.5-4	6.67×10^3	30	0.15	200	1	200
PLUTO12 (50')	Response E.5, Figure E.5-4	6.67×10^3	30	0.15	200	100	20000

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (E.16) FOLLOWS.

Document #: *1010* **Comment #:** *5* **Date:** *2/8/93*

Walt Kelley

City of Amarillo, Emergency Management

Comment:

(At a minimum, the following areas should be covered in the study or unclassifed supporting documents:)

A matrix of possible contamination levels that can be expected, off-site, based on the number of ruptured pits. This data should be presented in progressive levels of 25 to the maximum number that will be stored in any one area.

Response #: E.16

Although not referenced in the Environmental Assessment, Sandia National Laboratories performed an analysis of the possible off-site contamination resulting from ruptured pits. The document stating the results of the analysis (Memorandum from R.E. Smith Org. 0333, Sandia National Laboratories to David E. Rosson, Jr., Department of Energy, Albuquerque Operations Office/WMOSD dated December 11, 1992, Subject: 'Plutonium Dispersal Consequence Analysis of Hypothetical Aircraft Crash into Pantex Zone 4.') has been placed in the Department of Energy public reading rooms in Amarillo and Panhandle, Texas and Section I of this document.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (E.17) FOLLOWS.

Document #: *1011* **Comment #:** *7* **Date:** *2/18/93*

Dana O. Porter
Citizen Comments

Comment:
The potential risks of groundwater contamination were evaluated by the Los Alamos National Laboratory - a D.O.E. facility. Are their findings assumed to be objective? Can we accept the results without question?

Document #: *1021* **Comment #:** *13* **Date:** *1/25/93*

Lawrence D. Egbert, MD
Physicians For Social Responsibility

Comment:
Their reference to threats to the Ogallala aquifer is internal DOE research by Turin et al from the Los Alamos National Laboratories so it is no wonder they concluded no risk would occur to the aquifer. The DOE cites no local criticism.

Document #: *1021* **Comment #:** *17* **Date:** *1/25/93*

Lawrence D. Egbert, MD
Physicians For Social Responsibility

Comment:
... research cited has come from DOE sponsored laboratories and is therefore suspect. I recommend some outside reading: (see listing in letter)

Response #: E.17

The Los Alamos National Laboratory was assigned to estimate objectively and independently the potential effect on Ogallala Aquifer in the event of a hypothetical accident. It was understood from the outset that the Department would accept the results, regardless of the outcome. Further, no pressure, real or implied, was applied by the Department relative to the reported results or findings. With regard to the credibility of the conclusions reached by the Los Alamos National Laboratory, it should be noted that the comment and comment resolution process effectively provide an independent review of the Los Alamos National Laboratory's work.

Document #: *1011* **Comment #:** *12* **Date:** *2/18/93*

Dana O. Porter
Citizen Comments

Comment:
In the report, Potential Ogallala Aquifer Impacts of a Hypothetical Plutonium Dispersal Accident in Zone 4 of the Pantex Plant, compiled by the Los Alamos National Laboratory, there were several points I find questionable.

1. According to the report, research has shown that recharge rates below playa lakes in the area have been estimated between 1.3 and 8 cm/year (page 8). The report indicates that a "conservative" recharge estimate of 3 cm/year was used in the modeling project. Why was the 8 cm/year estimate not used?

Document #: *1016* **Comment #:** *23* **Date:** *2/16/93*

Jeri Osborne
Citizen Comments

Comment:
The report mentions the "conservative" figures numerous times as in the recharge rates of the Ogallala Aquifer. Why weren't the higher rates used? If the rates of 1.3 to 8cm/year, why use 3 cm/year? If the higher rate is possible, it should be used.

Response #: E.18

The question of estimating recharge rates is central to the analysis of the hypothetical accident on the Ogallala Aquifer and is addressed in great detail in Response E.5. The 8 cm/yr estimate mentioned in Turin et al. (1992) was a maximum estimate based on tritium analyses for a higher recharge area south of the study area and was not considered reasonable for the actual study area. However, the unpublished tritium data from the Texas Bureau of Economic Geology (Nativ (1988)) suggests higher recharge rates may be possible near the Pantex Plant. Therefore, these higher recharge rates have now been evaluated. The analysis supports the original conclusion of the Environmental Assessment that the hypothetical plutonium dispersal accident does not pose a significant threat to the Ogallala Aquifer.

cm = centimeter
yr = year

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (E.19) FOLLOWS.

Document #: *1011* **Comment #:** *14* **Date:** *2/18/93*

Dana O. Porter
Citizen Comments

Comment:
Mobility of potential groundwater pollutants downward through the soil is often dependent upon the chemical properties of contaminants, the soil properties, and the interactions between the contaminants, soil, and water in the system. Organic matter content, cation exchange capacity, moisture content, and pH of the soil, as well as pre-existent soil structure and condition, can affect the transport of potential pollutants toward the aquifer. These issues are not adequately addressed by the Los Alamos report.

Response #: E.19

Laboratory sorption studies using plutonium, actual soil samples from the Pantex Plant area, and Ogallala Aquifer water were conducted to evaluate how the soil properties cited in this comment affect contaminant mobility in the area of the Pantex Plant site. These experiments are described in Appendix A of Turin et al. (1992); the results were used in the transport models.

The comment raises the question of soil structure. There are no routine methods available for collecting soil samples with representative soil structure intact. Therefore, in the Los Alamos National Laboratory's experiments, the soil was sieved, effectively destroying the soil structure. It is difficult to precisely estimate the impact of sieving on the soil's sorptive properties. Because of this uncertainty, a conservatively low K_D value was used, making the technical analysis fully adequate.

Document #: *1011* **Comment #:** *15* **Date:** *2/18/93*

Dana O. Porter

Citizen Comments

Comment:

3. The group at Los Alamos used a computer model to estimate plutonium transport rate by advection-dispersion analysis. In order to account for preferential flow, the investigators increased the assumed flow velocity by a factor of 2. In the report, they cited research which had found accelerated solute transport rates at 5 times the predicted rates. Why did the investigators choose a factor of 2 instead of the more conservative factor of 5 in the model runs? Why were the accelerated rates not applied with the piston flow model?

Response #: E.20

The overall approach taken by the Los Alamos National Laboratory in evaluating the potential effects of the hypothetical plutonium dispersion accident on the Ogallala Aquifer was to use conservative but reasonable assumptions rather than extreme values. Of the seven studies of preferential flow cited in Turin et al. (1992), three resulted in an acceleration factor of one (no acceleration), three in a factor of two, and one in a factor of five. Without local site-specific field experiments, using a factor of two was a conservative, but reasonable assumption.

The piston-flow model was presented primarily as a teaching tool and an introduction to the more rigorous advection/dispersion analysis, rather than as a realistic analysis of contaminant transport. Therefore, all of the complicating factors, such as preferential flow, were not incorporated into the piston-flow model runs. The Environmental Assessment conclusions are based on the more accurate advection/dispersion model which was run under various scenarios, including preferential flow.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (E.21) FOLLOWS.

Document #: *1011* **Comment #:** *16* **Date:** *2/18/93*

Dana O. Porter

Citizen Comments

Comment:

4. Experiments conducted at Los Alamos to estimate the plutonium sorption characteristics of the Pullman soil used only the A (upper) Horizon of the Pullman soil. These samples were air-dried and sieved to obtain particles in a given range (Appendix A). Sieving eliminates the soil's characteristic structure (aggregates, etc.) from the tests. Since the A horizon was all that was tested, sorption properties of lower horizons are not known. Can we reasonably assume that undisturbed field soils will behave like the samples tested in the experiments?

Response #: E.21

As discussed in Response E.19, the effects of soil structure are difficult to predict, as are the sorptive properties of untested subsurface horizons of the Pullman soil. To account for this, Turin et al. (1992) made the extremely conservative assumption that all soils encountered by the plutonium contaminant would have the sorptive properties of the Ogallala sand. This assumption is known to be conservative because the Pullman A horizon was measured at roughly ten times greater sorption than the Ogallala sand. Also, while subsurface Pullman soils are likely to have lower sorption than the A horizon, based on reported mineralogy, subsurface Pullman soil will most likely show higher sorption than the Ogallala sand.

Document #: *1011* **Comment #:** *17* **Date:** *2/18/93*

Dana O. Porter

Citizen Comments

Comment:

As a research engineer involved in modeling of soil-water flow, I must point out that models are only as good as the data and assumptions that are put into them. They can only provide estimates of soil water behavior according to the understanding of the model developer. The performance of a model in a particular application is limited by the quality of data used to describe the specific site conditions to the model.

I recognize that my questions are directed to increase conservatism in estimates of groundwater pollution risk. I feel that in a project of such great importance, and with such great potential for damage to the environment and to the people in the Texas panhandle, that this conservatism is appropriate. It is reasonable to expect the D.O.E. to provide best-case and worst-case scenarios. It is reasonable to investiage the history of Pantex's environmental stewardship.

Response #: E.22

Turin et al. (1992) used conservative, yet reasonable assumptions, and clearly stated those assumptions. Making extreme assumptions (piling one extreme on top of another) was purposely avoided because it can result in predictions that, while theoretically possible, are so extremely unlikely as to be misleading. Instead, values that are at the conservative end of a reasonable range were selected.

Document #: *1012* **Comment #:** *3* **Date:** *1/16/93*

Margie K. Hazlett (1)

Citizen Comments

Comment:

According to the Los Alamos report, "Plutonium transport through the unsaturated zone is a major risk, under evaluated, and is primarily controlled by the degree of plutonium sorption onto local soils and aquifer materials (sic) Members of the Los Alamos Laboratory Earth and Environmental Science Division described in their report, the potential for Ogallala Aquifer contamination should plutonium be released to the environment within an 80 km. (Kilometer) radius of Pantex Plant. As in an accident that disperses plutonium into the environment, active groundwater recharge projects should be shut down, if possible, and I doubt seriously if there would be any manpower left to shut down these projects which would have vanished.

Response #: E.23

This comment misquotes Turin et al. (1992) as follows: "Plutonium transport through the unsaturated zone is a major risk, under evaluated, and is primarily....". The sentence in Turin et al. (1992) on page 8 actually begins: "Plutonium transport through the unsaturated zone is the major risk under evaluation in this report, and is primarily....". The meaning of the phrase as misquoted is significantly different than the meaning of the actual phrase.

The comment also suggests that manpower may not be available to shut down groundwater recharge projects in the event of a plutonium dispersion accident. The Department has no reason to suspect, and the comment provides no support for its hypothesis, that groundwater projects cannot be terminated in the extremely unlikely event of plutonium dispersion.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (E.24) FOLLOWS.

Document #: *1018* **Comment #:** *1* **Date:** *1/20/93*

Bob Bullock, Lt. Governor
State of Texas

Comment:
The briefing included a technical presentation regarding the risks of plutonium contamination to the Ogallala Aquifer, but did not cover contamination of surface water. I would appreciate information regarding the risks and the potential consequences of contamination to surface water and soil.

Response #: E.24

A comprehensive analysis of all the potential consequences of accident events found to occur with a frequency less than one in a million per year was not conducted by the Department. The only accident which would have the potential for contaminating surface water would be an aircraft crash into an interim storage magazine with subsequent dispersal of plutonium material. This accident, together with subsequent dispersal, was found to have the probability of less than one in a million per year.

Although the potential consequences to surface water were not specifically analyzed, impacts to the Ogallala Aquifer were analyzed, as stated in the comment, and an analysis was conducted to project the contaminated area of such an accident. This area was found to be 75 km^2 which is an order of magnitude less than that of accidents analyzed within the Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983) for operations which continue to be conducted at the Pantex Plant. In addition, the dispersal of plutonium material and the immediate health effects of such a dispersal were also found to be significantly less than that of accidents analyzed within the above mentioned document.

km = kilometer

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (E.25) FOLLOWS.

Document #: *1024* **Comment #:** *1* **Date:** *3/10/93*

Jay R. Roselius, County Judge
Carson County

Comment:
... request that authorities from these different agencies be assembled together in their area of expertise and address and formulate the best possible response to the following areas which seem to me to be the areas of most concern when considering all of the various comments...
1. The chance of contaminating the Ogallala Aquifer.

Response #: E.25

Los Alamos National Laboratory was tasked by the Department of Energy to analyze potential consequences to the Ogallala Aquifer as a result of a hypothetical plutonium release. Many of the comments raised during the State and public review of the Environmental Assessment and the analysis by Turin, et al questioned the assumptions, data, and the subsequent result of calculations. The Department, having addressed the issues raised, continues to conclude that the hypothetical plutonium dispersal accident does not pose a significant threat to the Ogallala Aquifer.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (E.26) FOLLOWS.

Document #: *1048* **Comment #:** *15* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

7.0 Potential impacts on the Ogallala Aquifer...does not address the possibility of cracks in the soil, from Texas Panhandle droughts, thereby creating faster pathways to the Ogallala. Why were DOE LANL studies used and not studies done by local geologists (sic)

Response #: E.26

The Los Alamos National Laboratory was selected by Department of Energy Albuquerque Operations Office to analyze the potential effects on the Ogallala Aquifer of a hypothetical plutonium dispersal accident, utilizing the expertise of health physicists, plutonium chemists, and geologists. It is felt that the Los Alamos National Laboratory study is technically credible and accurate.

This comment also inquires about preferential pathways which might be created by cracks in the soil from panhandle droughts. Turin et al. (1992) estimated the effect of preferential flow on contaminant transport by doubling the assumed transport velocity. This approach is conservative based on good professional judgment.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (E.27) FOLLOWS.

Document #: *1048* **Comment #:** *24* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

7-2 ... "Field experiment ... suggests colloidal transport will not enhance radionuclide transport enough to significantly effect groundwater quality". Hogwash, "suggest", "not enough" and "significantly affect" have no place in a study of drinking water for the people of the area. We are being fed a document prepared by an agency that has no credibility in preserving present water supplies at any of their other facilities.

To come to the final conclusion of "no significant threat to the Ogallala Aquifer from plutonium dispersal" is simply conjectural.

Response #: E.27

The analysis of the potential for contamination of the Ogallala Aquifer determined that, if an event such as that hypothesized in the aircraft crash analysis expected to occur with an annual frequency of 7×10^{-7}, plutonium could migrate through the soil and reach the aquifer in 76,000 years [Turin et al. (1992)], if the aquifer is 50 feet below the surface. The analysis used geological parameters that are reasonable and conservative, rather than extreme. The estimated concentration of plutonium predicted to appear in the aquifer following this extremely unlikely event, while not zero, should not be significant.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (E.28) FOLLOWS.

Document #: *1048* **Comment #:** *23* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

who (sic) have done in-depth studies on the Ogallala? LANL studies have not correctly addressed the full scope of the aquifer and the potential impacts. DOE's previous record of contamination to underground water supplies only reinforces the lack of accountability in DOE studies.

Response #: E.28

The reference list provided in Turin et al. (1992) lists a number of in-depth studies of the Ogallala Aquifer. As required by the National Environmental Policy Act, the scope of the Environmental Assessment was defined based on the proposed action of adding increased interim plutonium storage capacity at the Pantex Plant. To that end, the potential impacts to the Aquifer as a result of the proposed action were fully addressed.

Document #: *1011* **Comment #:** *5* **Date:** *2/18/93*

Dana O. Porter

Citizen Comments

Comment:

The groundwater contamination models were run with the assumption that, in the event of a plutonium release, any contaminated soil would be de-contaminated to a 0.2 uKCi/L. (sic) In the event of a release of radioactive dust, how large of (sic) area would be affected? What costs in human safety, agricultural productivity, and environmental quality would be associated with such a clean-up operation? Is it possible that contaminated surface soils would have to be removed from a large area? How would these contaminated soils be treated or disposed?

Response #: E.29

The size of the area that would be contaminated above the proposed Environmental Protection Agency guideline of 0.2 $\mu Ci/m^2$ depends on the energy source (thermal or explosive) available to disperse the plutonium, the amount of plutonium involved in the accident, the size of the particles resulting from the accident, and the meteorological conditions at the time of the accident. The energy source postulated by the Environmental Assessment for dispersing plutonium is a large, long-lasting fire resulting from the ignition of aircraft fuel. The amount of plutonium available to be dispersed in an accident was reasoned to be 25 percent of the maximum inventory in a Modified-Richmond or Steel Arch Construction Magazine. (See Section I of this document.) Experiments have shown that in a thermal environment, 1 percent of the exposed material is aerosolized and 5 percent of the aerosolized particles are 10 micron aerodynamic diameter or less. Based on these parameters, the maximum calculated area that is expected to be contaminated to a level above the proposed Environmental Protection Agency guideline due to an accident in Zone 4 is 75 km^2.

The Final Environmental Final Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983) estimated the expected contaminated area and the cleanup costs resulting from 120 kg and 30 kg of plutonium dispersed by detonation of high explosives under meteorological conditions D and E (see Section 4.2.5 and Tables 4.2.7-1 and 4.2.7-2). The contaminated area predicted from the 120 kg case for conditions of D and E stability were 824 km^2 and 1,036 km^2, respectively. The areas predicted from the 30 kg case were 650 km^2 and 751 km^2. These predictions should be compared to the estimated areas of contamination presented above (75 km^2 maximum) which may result from an aircraft crash into a magazine used for interim storage of pits in Zone 4.

Cleanup, as described on Page 4-44 of the Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983) could be accomplished by vegetation and soil removal using farm or road machinery. The extent of the vegetation and soil removal would be determined by the level of contamination. Decontamination technologies which involve soil cleanup as opposed to permanent removal may also be used and have been demonstrated at Johnston Atoll. Material generated as a result of a cleanup activity would be treated and disposed of in compliance with Environmental Protection Agency and State of Texas requirements. All Federal response and recovery activities would be coordinated by the Federal Emergency Management Administration. A lead Federal Agency, such as the Environmental Protection Agency or the Department of Energy, would be appointed. The lead Federal Agency would work out specific response efforts with the State. Additional information regarding coordination and management for emergency and recovery activities can be found in Response G.1.

ENVIRONMENTAL ASSESSMENT TEXT CHANGE

Section 7.0 was changed to reflect the comment.

μCi = microCurie
m = meter
km = kilometer
kg = kilogram

SECTION E REFERENCES

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STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (F.1) FOLLOWS.

Document #: *1001* **Comment #:** *2* **Date:** *2/25/93*

Ann W. Richards, Governor

State of Texas

Comment:

In addition, state officials believe that the methodologies used in the report ..., and the section addressing the Aircraft Hazard Analysis, are so fundamentally flawed that they must be revisited. In their current form, it is impossible to determine whether the resulting conclusions are, in fact, valid.

Document #: *1003* **Comment #:** *2* **Date:** *1/12/93*

Thomas A. Griffy

Univ. of Texas, Austin, Dept. of Physics

Comment:

On a more detailed note, I believe the analysis presented of aircraft accidents is fundamentally flawed. While aircraft accidents might occur at a rate estimated to be more than 1.0E-6 per year, analysis of the impact of air carrier or military accidents was not included on the basis that this subgroup had a probability estimated to be less than 1.0E-6 per year. This procedure of dividing an accident class into subgroups in order to reduce the probability of each subgroup below that necessary for inclusion is surely unjustified. (When carried to its logical conclusion one could divide the class of aircraft accidents to a subgroup which consisted of MD-88 aircraft, carrying exactly 121 passengers flown by a captain named Kruger on Thursday!) Risk analysis should be performed on the basis of probability times consequences.

Document #: *1005* **Comment #:** *9* **Date:** *2/8/92*

Jeri Osborne & Family

Citizen Comments

Comment:

Overall, considerable work is requred to produce an acceptable analysis of hazards posed by aircraft. This Aircraft Hazards Analysis does not provide a comprehensive or accurate picture of the danger posed by aircraft to material stored at the Pantex plant.

Response #: F.1

The Environmental Assessment uses a generally accepted methodology for examining aircraft crash. The aircraft crash rates for commercial, military, and general aviation are different. This is not unexpected because the nature of the operations are significantly different and, we believe, independent. To lump all the accident rate data together and use a single number to estimate the probability of impact would be unrealistic. On the other hand, the total probability of an aircraft crash has been generated by developing the probability for the subclasses and then summing these estimates. (See, for example, An Assessment of the Probability of Aircraft Impact with Pantex Structures, SAND76-0120, Sandia National Laboratories, June 1976; Estimate of the Probability that an Aircraft Will Impact the PVNGS, Solomon, K.A., NUS-1416, Revision 1, Arizona Nuclear Power Project, July 25, 1975; and NUREG-0800.) Argonne National Laboratory reviewed various methods of aircraft hazard analysis, including Solomon and NUREG-0800. Argonne reviewed the body of published literature, found that it corresponds to the method of Solomon and the data bases, methodologies, and modeling approaches are adequate to estimate the threat and plant response. (For additional information, refer to Evaluation of Aircraft Hazards Analyses for Nuclear Power Plants, NUREG/CR-2859, ANL-CT-81-32, Argonne National Laboratory, June 1982).

If this document were intended to be a probabilistic risk assessment, then the analysis would be based on the product of the frequency (probability of occurrence) and consequence. However, the underlying analysis (the Final Safety Analysis Report, Pantex Plant Zone 4 Magazines, Issue D, April 1993) on which the Environmental Assessment is based is not and was not intended to be a probabilistic risk assessment. Quantitative methods were used wherever appropriate.

Document #: *1002* **Comment #:** *1* **Date:** *2/19/93*

Alison A. Miller

Texas Air Control Board

Comment:

Subdivision into Aircraft Subclasses is Used to Eliminate the Need to Consider the Impact of Certain Types of Aircraft with Zone 4 Structures

Initially, the EA finds the probability that an aircraft will impact a Zone 4 structure to be greater than one-in-a-million. In other words, the chance of airplane impact with a structure scheduled for the interim storage of plutonium is calculated to be a credible event. However, the potential consequences of airplane impact with Zone 4 structures are not reported.

The probability of impact is developed by dividing aircraft into four classes: air carriers, military aircraft, aerial application, and general aviation. The probability of impact for any specific class of aircraft, except general aviation, is calculated to be less than one-in-a-million. Thus the EA concludes, it is unnecessary to consider any class of aircraft except for general aviation. This is a clear deviation from the 1976 Sandia report, which concludes only that the probability of aircraft impact is 4.7 in 100,000 (4.7E-05). The most critical objection to the methodology of the EA is that conclusions are drawn about the probability of subclasses of aircraft while the methodology followed is clearly developed for a population estimate. This technique of subdivision into aircraft classes is used in order to reduce credible events into incredible specific events. I am especially concerned about the validity of subpopulation estimates of probability since the environmental consequences of an incredible event do not have to be analyzed.

The probability of impact for a general aviation aircraft with a Zone 4 structure was calculated to be greater than one-in-a-million annually. Again, the method of subdivision into aircraft classes was applied. General aviation aircraft were subdivided into two classes: single engine aircraft and multi-engine aircraft. Multiple engine aircraft are then shown to have an impact probability which is incredible. It is possible to further subdivide the class of single-engine general aviation aircraft so that the impact of those subclasses of planes with the Pantex Zone 4 structures is an incredible event. However, the report instead references analyses by Jacob (sic) Engineering (Appendix C) which "suggest it is reasonable to exclude single-engine aircraft from further consideration in the accident analysis." Clearly, by employing a subdivision method, it is possible to reduce the probability of almost any event to an incredible level.

Response #: F.2

The statement that the sum of the probabilities of any aircraft crash into Zone 4 is greater than 1×10^{-6}/yr is correct. However, the Environmental Assessment also states the sum of the probabilities of aircraft crash with a potential for significant impact and consequences is less than 1×10^{-6}/yr. Therefore, neither the Environmental Assessment nor the safety analysis report present the potential consequences for this event. Nevertheless, selected aspects of the potential consequences of an aircraft crash may be found in Section I of this document.

The reviewer objects to using categories stating that the methodology reported is a "clear deviation from the Sandia study (An Assessment of the Probability of Aircraft Impact with Pantex Structures, SAND76-0120, Sandia National Laboratories, June 1976)." The method used is not a deviation from the Sandia National Laboratories study. This current effort was conducted using the Sandia National Laboratories methodology. As a point of information, the following is reproduced from the Sandia National Laboratories study.

Conclusion

The total probability (emphasis added) of an aircraft impact per year with structures at the Pantex Plant is 4.7×10^{-5}. Table VII describes the contributions to the total. A sensitivity analysis of the input parameters has been completed. The values chosen for the analysis represent the range over which parameters might reasonably be expected to vary. The most sensitive single parameter is the skid factor and its effects are relatively insignificant (Figure 11).

TABLE VII - Probability of Crash at the Pantex Plant per Year

	Buildings	Ramps	Total
Air Carrier	1.9×10^{-6}	1.7×10^{-7}	2.1×10^{-6}
Military	9.8×10^{-6}	1.1×10^{-6}	1.1×10^{-5}
General Aviation	3.0×10^{-5}	3.5×10^{-6}	3.4×10^{-5}
Aerial Application	2.4×10^{-7}	2.8×10^{-8}	2.7×10^{-7}
Total	4.2×10^{-5}	4.8×10^{-6}	4.7×10^{-5}

An Assessment of the Probability of Aircraft Impact with Pantex Structures, SAND76-0120, Sandia National Laboratories, June 1976.

Thus, it can readily be seen that the total probability is the sum of the individual probabilities by aircraft type and target. Also, it should be remembered that in the Sandia National Laboratories study buildings and ramps in Zone 4 and Zone 12 were the targets of concern.

Further, the reviewer seems to discount the fact that the consequences of an aircraft impact will be very much a function of the type of aircraft impacting the structure. To suggest that the consequences are somehow just a function of an impact is simply incorrect. A portion of the general aviation class was excluded on the grounds that an impact of a single-engine, 3,500-lb. class aircraft would generally not have sufficient energy to cause consequences of concern. To retain the probability that this class of aircraft would crash in the total probability and then to estimate the consequences based on the energetics of larger commercial, general aviation, or military aircraft would be incorrect and lead to erroneous conclusions.

The reader is referred to Response F.1 for information regarding the methodology. The Final Safety Analysis Report, Pantex Plant Zone 4 Magazines (Issue D, April 1993) was placed in Department of Energy reading rooms located in Amarillo and Panhandle, Texas, and was provided to State of Texas officials in April 1993.

yr = year
lb = pound

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (F.3) FOLLOWS.

Document #: *1002* **Comment #:** *2* **Date:** *2/19/93*

Alison A. Miller
Texas Air Control Board

Comment:

Zone 4 Effective Areas Reduced from 1976 Sandia Report

In order to calculate the probability of a plane impacting into the Zone 4 structures, a formula was used which considers only the portion of Zone 4 where an aircraft could strike a magazine. The formula given is equal to the sum of the actual area the building occupies, a shadow area dependent on the subclass of aircraft considered and a skid area dependent on the subclass of aircraft. The areas used are smaller than the areas used in the 1976 Sandia report. This is due to a substantial reduction in the skid areas and the wingspans capable of doing damage to Zone 4 structures from the values used in the 1976 Sandia report. This reduces the "effective" area for over 60 percent (%) of the aircraft to less than one-tenth of a square kilometer. From the maps provided in the environmental assessment and references, it appears that Zone 4 covers at least one square kilometer. Thus, the Zone 4 areas where an airplane crash might cause damage has been reduced by 90% for most types of aircraft considered. This cannot be verified as the actual dimensions of Zone 4 and its structures were not provided in the environmental assessment.

Response #: F.3

The geographical area of Zone 4 is not a significant factor to the analysis because the size of the targets at risk (i.e., the storage magazines) is what must be considered in the analysis. The effective size of the target at risk is related to its physical size, the size of the aircraft, and the potential skid distance of an aircraft that impacts away from the magazine and skids into the structure. The information presented in the Sandia National Laboratories study (An Assessment of the Probability of Aircraft Impact with Pantex Structures, SAND76-0120, Sandia National Laboratories, June 1976) for the physical size of the magazines is essentially the same as that used in the Environmental Assessment for the actual physical dimensions of the targets. Earlier work did look at buildings in Zone 4 (magazines) and Zone 12, plus the ramps that connect the buildings. The estimates would be lower than the Sandia estimates if only Zone 4 were examined.

On the other hand, it is the modification of the skid distance that has the most significant effect on the results. Appendix E to the Environmental Assessment describes the rationale used to reduce the skid contribution for this analysis. It was the consensus of the technical reviewers and others involved in such analyses that the skid distances assumed in the earlier referenced works were much too conservative. These skid estimates were revised and updated in a reasonable and consistent manner.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (F.4) FOLLOWS.

Document #: *1002* **Comment #:** *3* **Date:** *2/19/93*

Alison A. Miller

Texas Air Control Board

Comment:

Probability per Kilometer of an Aircraft Crash is Reduced from the 1976 Sandia Report:

A crucial element for calculating the probability of aircraft impact with a Zone 4 structure is the probability of an aircraft crash per kilometers flown. The type of aircraft crash considered is one in which the aircraft is significantly damaged since the assessment claims these are the only type of crashes which could impact a magazine. In addition, only crashes which occurred while the plane was inflight are considered. For every subclass of aircraft, the 1992 EA reports a substantially lower probability per kilometer of a significant inflight aircraft crash than the 1976 Sandia report (see Table 1). [Table 1 - not reproduced here]

The EA relies on fatal accident figures (provided by the National Transportation Safety Board [NTSB] in a memo from Lin and Tenney of Sandia National Laboratories, dated July 2, 1992, to R.E. Smith) upon which to base a new rate for the probability per kilometer of an inflight United States air carrier crash. This relationship is assumed despite a comment by Lin and Tenney that "the number of aircraft destroyed is not highly correlated to the number of fatal accidents." The EA reduces the mean fatal accident rate by the ratio 18/31 to provide an estimate of the inflight accident rate in which the accident is severe enough to seriously damage or destroy a Zone 4 magazine (page E-2). This method of estimation assumes a linear relationship between the known quantity (fatal accident rate) and the unknown quantity (inflight severe accident rate). This is not a valid assumption unless the two variables are correlated.

Response #: F.4

The reviewer notes that the aircraft crash rates are greatly reduced from the values used in the Sandia National Laboratories study (An Assessment of the Probability of Aircraft Impact with Pantex Structures, SAND76-0120, Sandia National Laboratories, June 1976). To ignore the demonstrable fact that aircraft crash rates have declined in the last two decades for all types of aircraft would be improper analysis. Section E.1, Appendix E of the Environmental Assessment provides an extensive discussion of our rationale.

The reviewer correctly quotes Lin and Tenney to the effect that the "number of aircraft destroyed is not highly correlated to the number of fatal accidents" for U.S. air carrier operations. The reason for this lies in the method the Federal Aviation Administration uses to declare that a flight had a fatal accident associated with it. In the accident data bases, a flight is listed as a flight with fatalities if there are any deaths associated with it. For example, if an aircraft is arriving or departing from a passenger gate and strikes and kills a ramp worker, that flight is listed as one with fatalities. (See for example the Federal Aviation Administration Statistical Handbook of Aviation, Calendar Year, 1989, U.S. Department of Transportation). Similarly, if a passenger should suffer a fatal heart attack enroute, the flight would be listed as one with fatalities. These sorts of events have no bearing on accidents that can cause damage to the Zone 4 magazines. However, based on analysis of the accidents in the data base, there is a strong correlation between fatalities and aircraft destroyed inflight. Therefore, in examining the data, those accidents that involved both fatalities and destruction were selected. The ratioing of accidents with fatalities and destruction (18) to the total reported flights with fatalities (31) was used to account for the peculiarities of the Federal Aviation Administration reporting system as follows. The Federal Aviation Administration defines the fatal accident rate as the number of flights with fatal accidents divided by the total number of miles flown. The inflight fatal accidents with destruction rate is approximated in the analysis by multiplying the average annual fatal accident rate by the number of accidents with fatalities and aircraft destroyed inflight (18) and dividing by the total number of fatal accidents (31).

Document #: *1002* **Comment #:** *4* **Date:** *2/19/93*

Alison A. Miller

Texas Air Control Board

Comment:

In order to estimate the probability per kilometer of a severe inflight general aviation crash, the NTSB data base was again referenced (memo from Lin of Sandia National Laboratories, dated August 13, 1992, to R.E. Smith). The EA generates a severe inflight accident rate for general aviation using the data provided by Lin (page E-2). The most critical assumption in calculating the accident rate is the average speed. The memo from Lin provides "average speeds" for the various classes of aircraft included in the general aviation group. However, the average speeds used in the EA are greater than the average speeds reported by Lin. These appear to be the only numbers from the memo that were changed for the EA. By adjusting the speeds upward, the estimated probability of a severe inflight crash is decreased. The EA does not provide justification for using the higher average speeds. Furthermore, the total accident rate per mile for general aviation and the total accident rate per mile for general aviation except single engine aircraft (Table E-6, last two columns) cannot be calculated from the information in the EA or the reference documents. Since this is a critical subclass of aircraft, additional documentation is necessary to justify the average speeds used in the calculations. At a minimum, the average speeds used in the calculations for the last two columns of Table E-6 should be provided.

Response #: F.5

The reviewer is correct that the analysis reported in the Environmental Assessment uses average aircraft speeds that are higher (10 percent to 29 percent) than those assumed by Lin. This modification upward was based on information obtained from individuals who regularly fly such aircraft and from a review of information available in Jane's All the World's Aircraft. The analysts believe these to be more appropriate representations of average speeds for the various aircraft types.

The information in Appendix E of the Environmental Assessment can be used to generate the accident rates summarized in Table E-6. However, the authors do acknowledge that the methodology is not as well documented in the appendix as it might have been. The following information is provided by way of further clarification.

The values reported in Table E-5 of the Environmental Assessment are obtained by taking the number of aircraft destroyed Inflight from Table E-4 and dividing that by the number of hours flown taken from Table E-3. The total reported in Table E-5 must be obtained by using the total number destroyed in flight from Table E-4 and the total number of hours from Table E-3. The total rate per 100,000 hours is not the sum of the individual class rates, but the weighted sum (i.e., weighted by the hours flown). Therefore, the totals from Tables E-3 and E-4 must be used to get the totals in E-5. The values reported in Table E-6 are obtained by dividing the number destroyed by class (Table E-4) by the product of the estimated speed (Table E-6) and hours flown (Table E-3). For example:

(502 Single Engine Aircraft Destroyed)/(26.3 x 10^6 hr)(160 mph) = 0.119 Destroyed/1 x 10^6 mi

As noted above, the total rate destroyed per million miles (Column 6, Table E-6) cannot be obtained by simply summing the individual rates. The total number destroyed (Table E-4) must be divided by the total miles flown, that is, the sum of the products of estimated speed and hours flown for each class. For example:

$576/[(26.3 \times 160)+(4.8 \times 225)+(1.6 \times 275)+(1.3 \times 450)] \times 10^6 = 576/(6.31 \times 10^9) = 0.091$

where: 0.091 = Total Rate of Aircraft Destroyed
576 = Total Number Aircraft Destroyed (Table E-4)
160, 225, 275, 450 = Estimated Speeds in mph (Table E-6)
26.3, 4.8, 1.6, and 1.3 = million hr flown (Table E-3)

A similar approach is taken to generate the estimate of Modified Total without Single-Engine Aircraft (Column 7, Table E-6). That is:

$74/[(4.8 \times 225)+(1.6 \times 275)+(1.3 \times 450)] = 74/(2.1 \times 10^6) = 0.035$

0.035 = Total Rate of Aircraft Destroyed (excluding single engine)
74 = Total Number of Nonsingle-engine Aircraft Destroyed (Table E-4)
160, 225, 275, 450 = Estimated Speeds in mph (Table E-6)
26.3,4.8, 1.6, and 1.3 = million hr flown (Table E-3)

The values reported in Columns 8 and 9 of Table E-6 (i.e., the rates per mile) are simply the values in Columns 6 and 7 divided by one million. This explanation should resolve the issues raised in the comment.

As indicated, the total accident rate per mile for general aviation and the total accident rate per mile for general aviation except single-engine aircraft are calculated from the number of aircraft destroyed divided by total miles flown for the types of aircraft involved. Thus, it is not necessary to have an average speed for the last two columns of Table E-6.

It should be noted that there are numerical errors in the 1988 entries in Columns 5, 6, and 7 of Table E-6. The values clearly should be 0.004, 0.059, and 0.0365, respectively. The analysts have carried three significant figures through the analysis as a computational convenience to avoid round off issues. It would not be unreasonable to reduce the three significant figures to no more than two for the summary values.

Information regarding stall speed is provided in Response F.17.

ENVIRONMENTAL ASSESSMENT TEXT CHANGE

Table E-6 was changed to reflect the comments.

mi = miles
mph = miles per hour
hr = hour

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (F.6) FOLLOWS.

Document #: *1002* **Comment #:** *5* **Date:** *2/19/93*

Alison A. Miller
Texas Air Control Board

Comment:
Note on Aerial Application Probability

For aerial application, the EA claims the "accident rate for aerial application of (2.945E-02/100,000 km, 4.7E-07/mi) was retained (from the 1976 Sandia report) for analysis" (page E-7). However, on page E-22 a different accident rate is recorded. It appears the accident rate per kilometer was recorded as the accident rate per mile.

Response #: F.6

Table E-10 did contain a typographical error. The crash rate per kilometer was incorrectly listed for the crash rate per mile. The correct values for aerial application are: 2.95×10^{-7}/km (4.71×10^{-7}/mi). Based on the comment, the calculations were reexamined and it was established that the proper values were used in estimating the probability of aircraft impact into Zone 4 magazines. Accordingly, the only change to the Environmental Assessment is to correct the typographical error.

ENVIRONMENTAL ASSESSMENT TEXT CHANGE

Table E-10 was changed to reflect the comment.

km = kilometer
mi = mile

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (F.7) FOLLOWS.

Document #: *1002* **Comment #:** *6* **Date:** *2/19/93*

Alison A. Miller

Texas Air Control Board

Comment:

General Notes

After reviewing the reference material provided by the author of "Appendix E, Aircraft Hazard Analysis," I can find no justification for using three significant figures.

Document #: *1007* **Comment #:** *16* **Date:** *2/25/93*

Joseph A. Martillotti

Texas Dept. of Health, Bureau of Radiation Control

Comment:

Page E-25, Table E-13: Use of three significant figures here appears to be unjustified. Therefore, 6.63E-07 may be rounded up and expressed as 1.0E-06.

Response #: F.7

The analysts dealt with the significant figure issue throughout the preparation of the study. In general, significant figures are carried to three digits through the calculations to minimize round-off error problems, but then reduced to two and sometimes one when the data is sketchy. The appendix is not consistent in this regard; however, it is not necessary that the approach be consistent since it does not change the conclusion drawn from the analysis.

However, the solution recommended in the comment is not correct either. The value reported was 6.63E-07, which may be reasonably rounded up to 7E-07. In order to compare to other numbers, the proper way to round to one significant figure is shown in the following from Table E-13:

Air Carrier	2.78E-08	=	3.E-08
Military	2.50E-07	=	3.E-07
General Av	3.31E-07	=	3.E-07
Aerial App	5.42E-08	=	5.E-08
Total	6.63E-07	=	7.E-07

There is no consistent rounding technique that will result in a Total of 1E-06.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (F.8) FOLLOWS.

Document #: *1002* **Comment #:** *7* **Date:** *2/19/93*

Alison A. Miller

Texas Air Control Board

Comment:

General Notes

A reference on page E-20 is off by one section. Specifically, the probability equation is defined in Section E.2 not E.2.1.

Response #: F.8

The comment is correct.

ENVIRONMENTAL ASSESSMENT TEXT CHANGE

Section E-2 of Appendix E was changed to reflect the comment.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (F.9) FOLLOWS ON PAGE F-13.

Document #: *1002* **Comment #:** *8* **Date:** *2/19/93*

Alison A. Miller

Texas Air Control Board

__*Comment:*__

General Notes

According to the reference material (reference 8 of Appendix E) used to generate Table E-2, Summary of Aircraft Accidents - U.S. General Aviation, the number of fatalities and serious injuries in 1978 was 1,146, not 1,145, and in 1986, the number of fatalities and serious injuries was 790 and not 748.

Document #: *1002* **Comment #:** *9* **Date:** *2/19/93*

Alison A. Miller

Texas Air Control Board

__*Comment:*__

General Notes

In Table E-3. General Aviation Hours Flown (Millions) by Aircraft Class, the number of hours flown for single engine aircraft in 1988 should have been 21.2, not 21.1, according to the reference material (see reference 8 of Appendix E). In 1988, the total number of hours flown for all general aviation aircraft should be 27.1, rather than 21.1, according to the reference material.

Document #: *1002* **Comment #:** *10* **Date:** *2/19/93*

Alison A. Miller

Texas Air Control Board

__*Comment:*__

General Notes

The Table E-5. General Aviation Aircraft Destroyed Inflight Per 100,000 Hours by Class has a column for the Total. It appears from the text that this column should contain the sum of the preceding four columns. The numbers that appear in the Total column are not equal to the sum of the preceding columns. Likewise, the Modified Total w/o Single Engine Aircraft does not appear to contain the sums of the previous columns.

Document #: *1002* **Comment #:** *11* **Date:** *2/19/93*

Alison A. Miller

Texas Air Control Board

__*Comment:*__

General Notes

Table E-7. Summary of Military Aircraft Crash Rates. The reference (a memo authored by Lin from Sandia National Laboratories, dated August 25, 1992) used to create Table E-7 reports the number of miles flown for the C-5 type of military aircraft to be 517 million miles. In the table, the number of miles flown for the C-5 type of military aircraft is reported to be 414.4 million miles.

Document #: *1005* **Comment #:** *8* **Date:** *2/8/92*

Jeri Osborne & Family

Citizen Comments

__*Comment:*__

Throughout the document, mathematical errors are found. Speeds are quoted in mph when they are actually in knots, roughly a 15% error in non-conservative direction. The impact energies considered are low in magnitude by as much as 32% due to the use of incorrect units of velocity (based upon the velocity-squared term in the equation for kinetic energy).

Document #: *1007* **Comment #:** *15* **Date:** *2/25/93*

Joseph A. Martillotti

Texas Dept. of Health, Bureau of Radiation Control

__*Comment:*__

Page E-24, Table E-12: The TOTAL column contains erroneous data.

Document #: *1016* **Comment #:** *24* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

In Appendix E, numerous mathmatical (sic) errors are on the "conservative" side. These tend to bring the credibility and validity of the EA into question.

Response #: F.9

[Document 1002, Comment 8] The number of fatalities and serious injuries in 1978 should have been reported as 1,146, not 1,145. For 1986, the number of fatalities and serious injuries is correctly stated as 748 in Table E-2 of the Environmental Assessment. The sum of the entries (431 and 317, respectively) in Columns 2 and 3 of Table 1 in "U.S. General Aviation Aircraft Accidents" (Y.T. Lin, Sandia National Laboratories Memorandum, August 13, 1992) is 748 and not the 790 shown in Column 5. The correct values were used in the analysis.

[Document 1002, Comment 9] In Table E-3 of the Environmental Assessment, the number of hours flown for single-engine aircraft should have been reported as 21.2×10^6 hr, similarly the total number of hours should have been reported as 27.1×10^6 hr. The only effect of these typos is that the total rate of aircraft destroyed inflight per 100,000 hours (Column 6, Table E-5 of the Environmental Assessment) should be 1.13 rather than the 1.45 reported. This error does not flow through because the values in Table E-6 in the Environmental Assessment were computed separately.

[Document 1002, Comment 10] The values reported in Table E-5 of the Environmental Assessment are obtained by taking the number of aircraft destroyed inflight from Table E-4 and dividing that by the number of hours flown taken from Table E-3. The total reported in Table E-5 must be obtained by using the total number destroyed inflight from Table E-4 and the total number of hours from Table E-3. The total rate of aircraft destroyed inflight per 100,000 hours is not the sum of the individual class rates, but the weighted sum (i.e., weighted by the hours flown). Therefore, the totals from Tables E-3 and E-4 must be used to get the totals reported in Table E-5. This is also the case for the totals without single-engine aircraft.

[Document 1002, Comment 11] The values reported in Table E-7 of the Environmental Assessment are correct. The miles flown (in millions) estimate is the product of the hours flown (in millions) in Column 2 and the assumed speed in Column 3. The product of 1.036×10^6 hr and 400 mph is 414.4×10^6 mi, the value used in the analysis. The 517 mph value is a typographical error in "Military Aircraft Crash Rate (Y.T. Lin, Sandia National Laboratories Memorandum, May 18, 1992)."

[Document 1005, Comment 8] The National Transportation Safety Board reports use miles per hour. Military normally use Knots Indicated Air Speed in knots. Our analysis used miles per hour, this produces conservative results in that it under predicts the mileage flown and thus over predicts the accident rate. Even if the assumed impact velocity is increased by 15 percent (kinetic energy by 32 percent), this does not alter the conclusion of the structural analysis (Appendix C of the Environmental Assessment) that the single engine aircraft will not penetrate the magazines.

[Document 1007, Comment 15] Apparently when the information in Table E-9 in the Environmental Assessment was revised to reflect the removal of a portion of the General Aviation, the total column was not properly checked. This typographical error has no impact on the analysis because the traffic counts for the individual flight paths and categories are used in the calculations. The total on a given flight path is not used in the calculation. The total column should simply reflect the sum of Columns 3 through 6.

[Document 1016, Comment 24] While some typographical errors and numerical inconsistencies have been discussed, none have a significant impact upon the conclusions of the effort.

ENVIRONMENTAL ASSESSMENT TEXT CHANGE

Appendix E was changed to reflect the comment.

hr = hour
mi = miles
mph = miles per hour

Document #: *1002* **Comment #:** *12* **Date:** *2/19/93*

Alison A. Miller

Texas Air Control Board

Comment:

General Notes

The definition of an incredible event is based upon an annual probability of occurrence. I am concerned that this may offer a false sense of security. The probability of an event occurring during the anticipated 10 years of storage is much greater than the probability an event will occur during the one year period used for calculation. For example, the annual probability of a military aircraft impacting a Zone 4 structure is estimated in the EA to be 2.5E-07. Thus, over a 10 year storage period, the probability of a Zone 4 structure being seriously impacted by military aircraft climbs to 2.5E-06. That is, over a 10 year period, the chance of military aircraft impacting a Zone 4 structure is much greater than one-in-a-million.

Response #: F.10

The definitions of various events including an incredible event, are based upon a deliberate process of comparison between events having various societal risks. Ultimately, the definition of an incredible event is based upon the expectation that the event has a sufficiently small likelihood of occurrence such that it need not be further assessed. In particular, it need not be further assessed relative to other societal risks.

All events that are quantified are typically stated in terms of annual probability of occurrence. It is the standard practice for consistency and convenience and because it provides a standard block of time to make a judgement on the acceptability of risks from different events. As an example of industry practice, the Nuclear Regulatory Commission, in its Nuclear Regulation 0800 Section 2.2.3, evaluates the acceptability of an accident on the basis of the event occurring annually.

Document #: *1003* **Comment #:** *3* **Date:** *1/12/93*

Thomas A. Griffy

Univ. of Texas, Austin, Dept. of Physics

Comment:

Excluding low probability events (below some threshold) which could have catastrophic consequences is clearly wrong.

Response #: F.11

If this document were intended to be a probabilistic risk assessment, the analysis would be based on the product of frequency (probability of occurrence) and consequence. However, the underlying analysis (Final Safety Analysis Report, Pantex Plant Zone 4 Magazines (Issue D, April 1993)) on which the Environmental Assessment is based is not, and was not intended to be, a probabilistic risk assessment. Quantitative methods were used wherever appropriate.

Aspects of the potential radiological consequences were examined separately. These are reported in the memorandum located in Section I of this document.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (F.12) FOLLOWS.

Document #: *1004* **Comment #:** *1* **Date:** *1/28/93*

C. Ross Schulke

U.S. Dept. of Trans., Federal Aviation Administration

Comment:

During ... January, February, and March, 1991, ... I provided information to a contractor for the Department of Energy. This information was limited to Amarillo Air Traffic Control Towers' monthly traffic count logs and the Daily Flight Progress Strips on aircraft operating in our airspace.

The Aircraft Hazard Analysis Data on pages 6-5 through 6-8 and Appendix E of the Environmental Assessment ... has no resemblance to the data provided by this office. Therefore, I am unable to comment on any information contained in the Assessment. For your information, the total aircraft operations for the Amarillo area in the CY1992 was 91,800. Any further restrictions to flight or changes of airspace to the Pantex Prohibitive area would have an immediate and adverse impact on the utilization of Amarillo International Airport.

Document #: *1009* **Comment #:** *2* **Date:** *2/22/93*

Tom Millwee, Chief

Texas Dept. of Public Safety, Div. of Emergency Management,

Comment:

The data provided by the Amarillo Air Traffic Manager differs from the aircraft hazard analysis pages 6-5 through 6-8. The variance on the number of aircraft flying into Amarillo must be reconciled. The projected increase in plutonium pits must be compared with the projected aircraft traffic during the interim storage period. Using invalid data will render an invalid conclusion.

Document #: *1024* **Comment #:** *2* **Date:** *3/10/93*

Jay R. Roselius, County Judge

Carson County

Comment:

... request that authorities from these different agencies be assembled together in their area of expertise and address and formulate the best possible response to the following areas which seem to me to be the areas of most concern when considering all of the various comments...

2. The data used to reach a decision on a plane crash into a bunker/magazine or other strategic location.

Response #: F.12

Information was requested from the Amarillo Air Traffic Manager in 1991 to assist in verifying that current aircraft crash analysis conducted for the Final Safety Analysis Report, Pantex Plant Zone 4 Magazines (Issue D, April 1993) could be accomplished using the methodology from the Sandia National Laboratories study (An Assessment of the Probability of Aircraft Impact with Pantex Structures (SAND76-0120, Sandia National Laboratories, June 1976)). The Sandia National Laboratories study was a thorough assessment of air operations in the Pantex Plant area and the probability of aircraft impact into Pantex Plant structures. It included a characterization of the air traffic in the area, the classes of aircraft, the nature of the operations, the number of operations per year, and other information that could affect the probability of an aircraft crash onto the Pantex Plant.

The information obtained from the Amarillo Air Traffic Manager as well as other recent flight data from the Federal Aviation Administration assisted in verifying the adequacy of the methodology used in the Sandia National Laboratories study. Because the flight information from these sources was encompassed by the flight information within the Sandia National Laboratories study, the yearly flight operations in the Sandia National Laboratories study were used to maintain conservatism in the analysis. For this reason, we believe that the Amarillo Air Traffic Manager did not recognize the data in the Environmental Assessment and stated he was unable to comment on the information contained in the document.

Document #: *1005* **Comment #:** *1* **Date:** *2/8/92*

Jeri Osborne & Family

Citizen Comments

Comment:

He [James Michael Osborne] noted that the EA did not address Helecopters (sic) that fly over the site. All types of military helecopters (sic) can be seen on a regular bases (sic). This type of aircraft does not crash by skidding. They crash by falling straight down.

Response #: F.13

As noted in the cited response, the helicopter traffic in the vicinity of the Pantex Plant has not been quantified as there was no data on helicopters recorded in the Federal Aviation Administration flight data that was examined.

However, based on data that is available, helicopters have an annual fatal accident rate (per 100,000 hours) comparable to that of general aviation (see Analysis of Helicopter Accident Risk Exposure Near Heliports, Airports, and Unimproved Sites, R.J. Adams, E.D. Maconkey, L.D. Dzamba, DOT/FAA/RD-9019, February 1992) and have approximately an order of magnitude fewer flying hours. Also, accident data indicate that helicopters do not skid, therefore the area at risk (i.e., probability of impact) is significantly reduced. Furthermore, the subset of large helicopters that could cause significant damage is small compared to the total. For these reasons, helicopter crashes potentially leading to offsite consequences are qualitatively assessed as beyond extremely unlikely. (See Response F.24 for additional information on military aircraft.)

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (F.14) FOLLOWS.

Document #: *1005* **Comment #:** *2* **Date:** *2/8/92*

Jeri Osborne & Family
Citizen Comments

Comment:
Mike [James Michael Osborne] also noted that no mention of the about 1955 emergency landing of a B 25 on the site near the present burning ground after the plane ran out of fuel. (sic)

Response #: F.14

No data about the emergency landing of a B-25 aircraft in 1955 has been compiled in the accident data base. An emergency landing that resulted in no damage or injury would not be included in the accident data bases. It should also be noted that the class of aircraft represented by the B-25 aircraft (medium, multi-engine bombers of World War II vintage) are no longer flown. To include accident data for this type of aircraft would be inappropriate.

Document #: *1005* **Comment #:** *3* **Date:** *2/8/92*

Jeri Osborne & Family
Citizen Comments

Comment:

Secondly, the term "General Aviation" is grossly misused in the Aircraft Hazard Analysis. Traditionally, "General Aviation" has been used to describe all aeronautical activity that is neither military nor civil, that pertaining to airlines. Typically, agricultural aviation is also excluded from that heading. General aviation is made up of aircraft ranging in size from the 1600 lb Cessna 150/152 and smaller up through the 73,600 lb Gulfstream IV. The 3500 lb aircraft used in the Aircraft Hazard Analysis is hardly representative of General Aviation as it currently exists.

Thirdly, the definition of the takeoff and landing phases of flight as being within 5 kilometers of the airport in (sic) highly misleading. By using this definition of the takeoff and landing phases as being those within 5 kilometers of the runway, the analysis is able to take advantage of the lower occurrence of accidents for the "inflight" phase. This ignores the fact that a high percentage of the flights over the Pantex plant are by aircraft making straight-in approaches to the NE-SW runway at Amarillo International Airport. These flights consist of military training flights, as well as military cargo flights by C-5A, C-5B, C-141B and C-130 aircraft. Few light aircraft actually pass over the plant while on approach to the NE-SW runway at Amarillo International Airport due to the zone of prohibited airspace and due to normal operational requirements. Typically, these aircraft do not make straight-in approaches, but rather, fly a much smaller traffic pattern.

The combined effect of the mis-definition of General Aviation and the operation of larger military aircraft over the Pantex plant implies an exposure to accidents involving much heavier aircraft. A 3500 lb aircraft with a 500 lb engine is representative of single-engine aircraft only. The Beechcraft 300LW is also representative of General Aviation. This aircraft is a twin-engine turbo-prop up to 14000 lbs and being driven by two engines weighing 465 lbs each without accessories. The Learjet Model 35 is a twin-engine turbofan weighing up to 18500 lbs and powered by two engines weighing 734 lbs each without accessories. The Gulfstream IV mentioned above weighs up to 73600 lbs and is powered by two turbofan engines each weighing 3100 lbs without accessories.

At this point it should also be noted that the military cargo aircraft that routinely operate over Pantex operate at much higher weights. The C-130 turboprop weighs up to 155000 lbs and is driven by four engines each weighing approximately 1800 lbs. The C-141B weighs up to 343000 lbs and is powered by four turbofans weighing in excess of 4300 lbs each. Finally, the C-5B weighs up to 837000 lbs and uses four turbofans weighing more than 7900 lbs each.

...In summary, ... This does not address the unrealistically small aircraft and light weights ... used in the anlaysis.

Document #: *1044* **Comment #:** *7* **Date:** *3/15/93*

Margie K. Hazlett (3)
Citizen Comments

Comment:

Potter County includes Amarillo, Texas, which is only 7.68 miles from Pantex. The Amarillo Air Terminal is only 8.16 miles from the Pantex Plant. The run ways (sic) are even closer than this mileage. No city or town should be this close to Pantex; nor should the busy air terminal be in the vicinity of Pantex, as most of the air traffic includes passenger planes and a great number of military aircraft shooting running take-offs and landing. (sic)

Response #: F.15

General Aviation includes U.S. registered aircraft not conducting air carrier revenue operations under 14 Code of Federal Regulations 121, 125, or 127 or 135. In Section E.2.4 of the Environmental Assessment, only those single-engine aircraft as represented by a 3,500-lb aircraft flying below 18,000 ft were not counted. The single-engine aircraft were excluded on the basis of insignificant consequences. The reviewer is correct, a 3,500-lb aircraft does not represent the entire general aviation category. However, Appendix E of the Environmental Assessment shows that the aircraft crash analysis defines General Aviation in precisely the same manner that the reviewer proposes, i.e., all aviation that is not commercial air, military air, or crop dusting. The Environmental Assessment does not propose that the category general aviation be represented by a 3,500-lb aircraft. The Environmental Assessment does propose that the single-engine class of general aviation be represented by a 3,500-lb single-engine aircraft. (See Responses F.21 and F.22 for more information.)

Takeoff and landing are defined as the mode of the aircraft within 8 km (5 mi) of the airport (see A Methodology for Calculation of the Probability of Crash of An Aircraft into Structures in Weapon Storage Areas, SAND82-2409, Sandia National Laboratories, February 1983). The inflight mode includes the climb, inflight, and descent of the aircraft. The aircraft crash rate is strongly dependent on the mode of operation. Because the Pantex Plant is 13.6 km from the runway at Amarillo International Airport, only the inflight mode of aircraft operation is used for estimating the aircraft crash rate. All types of aircraft including air carrier, military, and general aviation are included in the yearly operations for estimating the overall crash probability. The single-engine aircraft are then excluded to estimate the probability of crash with significant consequences. If the aircraft cited by the reviewer (e.g., C-5, C-141, C-130) are on straight-in approaches, they are well beyond 8 km, and if they pass over the plant site, they must be at least 1200 ft above the terrain. Therefore, the use of inflight crash rates is reasonable and correct.

The reviewer is correct, the Environmental Assessment does consider that Zone 4 is exposed to aircraft crashes of heavier and higher performance aircraft than the single-engine class. The single-engine aircraft (as represented by the 3,500-lb aircraft) was excluded on the basis of the structural analysis indicating that the impact of such an aircraft would not cause unacceptable damage. Therefore, when this group of aircraft are excluded, the revised estimate of impact probability includes only heavier higher speed aircraft. The revised estimate put the combined events at a probability no greater than 1 x 10^{-6}/yr and no further analysis was conducted. Table E-13 of the Environmental Assessment is reproduced below.

Table E-13 - Annual Probabilities of Aircraft Crashes Capable of Producing Significant Consequences

Aircraft Class	Crash Probability/Year
Air Carrier	2.78E-08
Military Aviation	2.50E-07
General Aviation	3.31E-07
Aerial Application	5.42E-08
Total	6.63E-07

As noted by another reviewer (Document 1002, Comment 6), the use of three significant figures in a summary may imply more accuracy than the data available to support the analysis justifies. Therefore, it would not be unreasonable to round the Total reported above to 7E-07. But, even if the Total were rounded to 7E-07, the conclusion would remain unchanged.

ft = foot
lb = pound
km= kilometer
mi = mile
yr = year

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (F.16) FOLLOWS.

Document #: *1005* **Comment #:** *4* **Date:** *2/8/92*

Jeri Osborne & Family

Citizen Comments

Comment:

Further, the Aircraft Hazard Analysis seems to consider only accidents in which the aircraft slides to a stop, a condition consistent with takeoff or landing incidents. No effort is made to analyze higher angle impacts resulting in energy dissipation through cartwheeling (Sioux City, Iowa DC-10 accident) or the cratering resulting from high impact angles. Due to the distance from the runway (quoted as being 13.6 km), aircraft passing over the Pantex plant and following a standard 3 degree glide slope will be at an altitude of approximately 2300 feet above ground level. This is not conducive to a sliding impact, but rather a high angle impact with resulting vertical penetration of components into the crash site. In this type of accident, the low-pressure rotor shafts of turbine engines have been known to penetrate several feet of granite.

...In summary, ... No effort was made to address the penetration by high-density engine rotating components...

Document #: *1015* **Comment #:** *12* **Date:** *2/20/93*

Addis Charless, Jr.

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

Pg 6-6: The light aircraft penetration probabilities were all modeled on low-speed/low-angle-of attack (sic) scenarios. Not considered was a high-speed/perpendicular angle-of-attack scenario induced by vertigo such as occurred near my residence a few years ago. The aircraft engine in the above incident penetrated a hardland slope to a depth of 3-5 feet.

Also not considered was a similar situation involving commercial multi-engined craft or heavy military craft which seem to be in abundance in our air space.

Document #: *1016* **Comment #:** *5* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

Any aircraft that is likely to crash on Pantex is most likely to be a high angle impact instead of the 3 degree skidding crash.

Response #: F.16

The Environmental Assessment analysis considers direct impacts as well as skidding impacts. The reviewer implies that the analysis considered only impacts from a 3° angle. Appendix E, Section E.2.2 of the Environmental Assessment shows that an impact angle of 15° was used to estimate the shadow area. Higher angles of incidence were not used because the earlier Sandia National Laboratories study (An Assessment of the Probability of Aircraft Impact with Pantex Plant Structures, SAND76-0120, Sandia National Laboratories, June 1976) concluded from a sensitivity study that impact angle did not have a strong effect on the estimates of effective area. This was confirmed by the current analysts, although it was not reported in the Environmental Assessment.

The reviewer implies that the DC-10 incident at Sioux City, Iowa, involved cart-wheeling because the aircraft approached the ground at a high angle. Review of the extensive photo coverage of that event indicates that the DC-10 was approaching the ground at glide angles consistent with landing, not at a high angle. The National Transportation Safety Board report (AAR-90/06) described the Sioux City, Iowa, DC-10 accident as follows:

The airplane touched down on the threshold slightly to the left of the centerline on Runway 22 at 1600 hours. First ground contact was made by the right wing tip followed by the right main landing gear. The airplane's right wing began to break up immediately following touchdown. The remainder of the airplane broke up as it tumbled down the runway. The fuselage center section, with most of the left wing still attached, came to rest in a cornfield after crossing Runway 17. The cockpit separated early in the sequence and came to rest at the edge of Runway 17/35. The largely intact tail section continued down Runway 22 and came to rest on Taxiway "L". The engines separated during the breakup. The No. 1 and No. 3 engines came to rest near Taxiway "L" and the intersection of Runway 17/35, between 3,000 and 3,500 feet from the point of first impact. No. 2 engine fan rotor components forward of the fan forward shaft, as well as part of the shaft, had separated from the engine inflight.

High-speed, high angle of impact scenarios are implicit in the analysis by the way the effective target areas are estimated. It should also be noted that the higher impact angle will have lower probability of impact with a magazine of concern. The lower angle of potential impact (15 percent) used in the analysis is conservative in that it increases the estimated shadow area and, thus, the effective area, or probability of impact. In the limit, as the angle of impact increases, the shadow area goes to zero. This is easily recognized by examining the equation for determining shadow area (A_{sh}):

$$A_{sh} = Z(2d + D)/\tan \phi \qquad D = (a^2 + b^2)^{0.5}$$

where Z is the magazine height, d is the one-half the aircraft wingspan, a is the magazine length, b is the magazine width, and ϕ is the angle the aircraft path makes with the horizon at impact. The penetration analysis in Appendix C of the Environmental Assessment assumes perpendicular impacts into the structure, both roof and doors. A sensitivity study used several combinations of weight and speed (see Appendix C of the Environmental Assessment).

Document #: *1005* **Comment #:** *5* **Date:** *2/8/92*

Jeri Osborne & Family

Citizen Comments

Comment:

The aircraft speed of 80 mph at the time of the accident, as quoted in the Aircraft Hazard Analysis is also highly unrealistic. This is stated to be derived by multiplying the landing speed of a single-engine aircraft by 1.3. It should be noted that FAR Part 23-49 requires single-engine aircraft to have a stall speed of not greater than 61 knots Indicated Airspeed (KIAS), or 70 mph. Multiplying this value by 1.3 results in a speed of 79.3 KIAS or 91 mph. This is approximately the lowest speed that would be anticipated. Multi-engined aircraft typically stall at higher speeds, and most turbofan aircraft stall at speeds in excess of 100 KIAS or 115 mphwhen (sic) operating at light weights. At heavy weights, the stall speed may rise to more than 150 KIAS or 173 mph. These speeds are only consistent with low angle impacts. High angle impacts may occur at speeds exceeding the maximum operational speed of the aircraft.

...In summary, ... This does not address ... the low impact velocities used in the analysis.

Response #: F.17

The individual states that the 80 mph speed is unrealistic and then provides an argument that it should be 91 mph, or approximately 14 percent greater. This appears to be a relatively small change. Stall and/or impact speeds of other aircraft could be higher. However, that fact is not germane to the analysis conducted. The 80 mph figure was selected as representative of a single-engine aircraft experiencing difficulties, but with the pilot still exercising some degree of control. A review of stall speed data for single-engine aircraft of the types flying in the Amarillo area indicates that this is a reasonable value (approximately 30 percent above flaps down stall speed). The objective was to establish whether or not the single-engine class of aircraft could be eliminated from consideration on the basis that an impact by such an aircraft would not cause unacceptable damage. A limited sensitivity investigation in the structural analysis (Appendix C of the Environmental Assessment) indicates that even heavier aircraft at higher speeds will not penetrate or collapse the magazine. As noted in the other responses, the impact of other classes of aircraft were eliminated on the basis of the probability of the event, not the energetics of any potential event. (See Responses F.5 and F.25 for additional information.)

mph = miles per hour

Document #: *1005* **Comment #:** *6* **Date:** *2/8/92*

Jeri Osborne & Family
Citizen Comments

Comment:
Additionally, no mention is made of the effects of a post-crash fire or explosion in the Aircraft Safety Analysis. In the event of an accident involving a large turbine-engined aircraft, several thousand gallons of jet fuel would be available for combustion. This is not addressed.
...In summary, ... No effort was made to address ... post-crash fire.

Document #: *1016* **Comment #:** *6* **Date:** *2/16/93*

Jeri Osborne
Citizen Comments

Comment:
Fuel spills and subsequent fire or explosion resulting from such a crash are not adquatly (sic) addressed.

Document #: *1031* **Comment #:** *5* **Date:** *3/1/93*

Louise Daniel
Citizen Comments

Comment:
5. The very real danger of an airplane crash causing a major fire is not honestly examined.

Response #: F.18

The effects of a post-crash fire and aspects of the potential consequences of aircraft crash may be found in Section I of this document.

Document #: *1005* **Comment #:** *7* **Date:** *2/8/92*

Jeri Osborne & Family

Citizen Comments

Comment:

Finally, the military aircraft accident rates fail to include a number of major accidents. The C-5 is listed as having had no crashes when, in fact, two are easily recalled. The first of these in the 1970's involved a C-5, departing from the Republic of Vietnam, and carrying a large number of orphaned children. During the climb to altitude, several minutes after takeoff, a door seal failed and eventually resulted in the uncontrolled descent and crash landing of the aircraft. The second, more recent accident took place near Ramstein AFB in Germany and was associated with Operation Desert Shield.

The B-1B is also listed as having had no accidents. Disregarding the loss of one proto-type at Edwards AFB due to the failure to maintain proper center-of-gravity during a stall test, three operational aircraft have been lost to date. The first, in Colorado, was due to a bird strike while operating at low level and was a high-energy impact. The second, at Dyess AFB in Abilene, TX was due to the catastrophic failure of the low-pressure rotor of one of the four engines. The third was in late 1992 in the Davis Mountains of Texas.

At approximately the same time as the third B-1B accident, two C-141 aircraft were involved in a mid-air collision at high altitude over Montana. Both aircraft were destroyed. These accidents involve military aircraft of types that routinely fly over the Pantex plant and are not addressed in the Aircraft Hazard Analysis.

Response #: F.19

The C-5 aircraft accident in the 1970's, the third B-1B, and the two C-141 accidents in late 1992 were not in the military aircraft crash data provided through the Defense Nuclear Agency Headquarters because the database included the accidents from 1976 to early 1992. Therefore, the C-5 aircraft accident was prior to the period covered and the latter three had not yet been included. Also, of the three B-1B incidents, one was not an inflight accident and another involved a low-level, high-performance training mission which is not appropriate to the Pantex Plant analysis. Therefore, those accidents were not included in estimating the crash rate.

Document #: *1007* **Comment #:** *13* **Date:** *2/25/93*

Joseph A. Martillotti

Texas Dept. of Health, Bureau of Radiation Control

Comment:

Page C-10, Line 14: It is unclear why 3500 lbs is paired with 117 fps. Just above, on lines 8 and 9, 117 fps (80 mph) is paired with 6200 lbs. (Possible error)

Response #: F.20

There are two types of analysis being discussed here. First, the single degree of freedom model was used to investigate the deflection of the Modified-Richmond magazine roof panel under a loading from aircraft impact. The 3,500-lb aircraft at 117 fps (80 mph) was the base case and the one for which the response was only 1.3 times the elastic limit. In addition, three combinations of weight and speed that result in the maximum allowable deflection were identified and reported in Section C.8.1, Appendix C of the Environmental Assessment. A 6,200-lb aircraft at 117 fps is one of those combinations.

Second, the energy required for penetration of the combined earth overburden and concrete roof was investigated. As noted in the Environmental Assessment, bomb penetration data indicates that an energy of 38.0 x 10^6 lb, fps (as determined by the empirical relation $WV^{1.8}$ where W is the weight and V is the velocity) would be required for penetration. The base case aircraft (3,500 lb, 117 fps) has an energy of 18.4 x 10^6 lb, fps and therefore would not penetrate the magazine.

lb = pound
fps = feet per second
mph = miles per hour

Document #: *1007* **Comment #:** *14* **Date:** *2/25/93*

Joseph A. Martillotti

Texas Dept. of Health, Bureau of Radiation Control

Comment:

Page E-9, Lines 7-10: Aircraft take-off and landings have been excluded by this assumption. This does not appear to be conservative in approach, as most commercial and military aircraft operating to the north of the Amarillo Airport can be observed to fly very close to, if not directly over, the Pantex Plant.

Response #: F.21

Aircraft takeoffs and landings have not been excluded in this analysis. Aircraft using the Amarillo Airport (13.6 km (8.5 mi) from the Pantex Plant) are included in the overall traffic counts. Also, the literature contains ample data to indicate that beyond 8 km (5 mi) from an airport the crash rates are those characterized as inflight. (See for example A Methodology for Calculation of the Probability of Crash of An Aircraft into Structures in Weapon Storage Areas, SAND82-2409, Sandia National Laboratories, February 1983.) If the aircraft observed by the reviewer are over the Pantex Plant, they must be at least 1,200 ft above the terrain and they are more than 13 km (8.1 mi) from the runway. Therefore, the use of inflight crash rates is reasonable and correct. (See Response F.15 for more information.)

km = kilometer
mi = miles
ft = feet

Document #: *1010* **Comment #:** *2* **Date:** *2/8/93*

Walt Kelley

City of Amarillo, Emergency Management

Comment:

2. Even though a large plane accident is not considered creditable (sic) and not discussed in table 6-1, more information is needed to insure adequate planning and to give the assessment creditability (sic) with the public. The information used to determine the probability of this type accident seems to be questionable and needs to be reevaluated. Since a large aircraft accident is the only type of incident that can have extensive off site consequences more data must be provided in the assessment. At a minimum the following areas should be covered in the study or unclassified supporting documents:

The number of military flights that pass directly over area with specific data on the type of aircraft.

Document #: *1010* **Comment #:** *4* **Date:** *2/8/93*

Walt Kelley

City of Amarillo, Emergency Management

Comment:

(At a minimum the following areas should be considered in the study or unclassified supporting documents:)

The accident history of the type of military aircraft being flown in this area.

Document #: *1010* **Comment #:** *6* **Date:** *2/8/93*

Walt Kelley

City of Amarillo, Emergency Management

Comment:

(At a minimum the following areas should be covered in the study or unclassified supporting documents:)

Maximum health effects of an off-site release.

Document #: *1010* **Comment #:** *7* **Date:** *2/8/93*

Walt Kelley

City of Amarillo, Emergency Management

Comment:

(At a minimum the following areas should be covered in the study or unclassified supporting documents:)

Environmental effects and risk levels of maximum possible release.

Response #: F.22

Table 6.1 of the Environmental Assessment includes only events that are considered credible. A crash of a single-engine aircraft is considered credible based on the analysis in Appendix E of the Environmental Assessment; all others are not credible. Table 6.1 then proceeds to examine the effects of a crash of a single-engine aircraft. Based on the analyses in Appendices C and E of the Environmental Assessment, the effects of the crash of a single-engine aircraft are considered negligible. It should be noted that the Emergency Planning Zone developed during the Radiation Hazard Assessment is not affected by these analyses, and it is not anticipated that the Emergency Planning Zone will change. (See Response F.15 for more information.)

Aspects of the potential off-site consequence analyses of hypothetical aircraft crash into Zone 4 of the Pantex Plant are documented in the memorandum found in Section I of this document.

The reviewer also asks for the number of military flights that pass directly over the area with specific data on the type of aircraft and the accident history of the type of military aircraft being flown in this area. This information is presented in Appendix E of the Environmental Assessment. The following is quoted from the appendix:

"The 1976 Sandia study assumed, based on the work of Solomon (Reference 3), that military crash rates are approximately a factor of five greater than that for commercial aviation. Recently, Sandia National Laboratories were able to access the United States Air Force Aircraft Accident Data Base through arrangements with the Defense Nuclear Agency. The data base includes information by aircraft class, hours flown, and accidents by flight regime (e.g., landing, cruise). Following the approach developed for commercial air carriers and general aviation, Sandia established the number of aircraft destroyed as a result of in-flight accidents (Reference 9). Using the Federal Aviation Administration flight data for the Amarillo area, ten specific models of military aircraft flying in the vicinity of the Pantex Plant were identified. This was supplemented with information based on actual aircraft observed from the plant site, so that 13 aircraft models are considered. The flight information for these aircraft was converted to an accident rate per mile by multiplying the number of hours flown by the average cruising speed of the aircraft. The results are summarized in Table E-7. An examination of a randomly selected 14 days of 1989 Federal Aviation Administration flight records for the Amarillo area indicates that approximately 90.5 percent of the military traffic came from high performance aircraft (e.g., fighters and trainers) and 9.5 percent from cargo and bomber type aircraft.

Furthermore, it is noted that nearly 53 percent of the traffic comes from T-38 aircraft and approximately 79 percent from a combination of T-37 and T-38 aircraft. Therefore, a weighted military aircraft crash rate for the Amarillo area was generated by multiplying the "raw" rate for each aircraft class by the ratio of the number of that class to the total number of military flights (e.g., from Table E-7, for T-38 aircraft, [161/304] • 4.535E-09 = 2.402E-09/mile). These weighted rates may then be summed to generate a new overall rate. This "reduces" the accident rate for high performance military aircraft operating in the Pantex Plant area to 4.7E-09 per mile, and the total to 5.04E-09 per mile. The latter value will be used in the analysis."

Document #: *1010* **Comment #:** *3* **Date:** *2/8/93*

Walt Kelley

City of Amarillo, Emergency Management

Comment:

(At a minimum the following areas should be covered in the study or unclassified supporting documents:)
The qualifications of the pilots in command of these aircraft. This area is used for a lot of training flights.

Response #: F.23

The reviewer has asked for "The qualifications of the pilots in command of these aircraft. This area is used for a lot of training flights." Certainly, it is understood by the analysts that there are numerous training flights in the general area of the Pantex Plant. However, even if a flight is designated as training, it does not imply an unqualified crew. In peacetime in the continental United States, the majority of the military flights are training or proficiency missions. Pilots in command of these aircraft will have satisfied military qualification requirements. We are not aware of any record keeping that would provide an indication of the pilot credentials of individuals flying those aircraft on a routine basis, other than the training records of the particular unit to which the aircraft are assigned. If an aircraft has been involved in an accident, it would be possible, perhaps, to ascertain the qualifications of the individual at the controls when the accident occurred, but this would require an extensive review of the individual accident reports. Furthermore, it is not at all clear what one would do with this information. But, even it were possible to show that some percentage of all accidents occurred with a trainee in control, that would not provide any particular insights unless one knew what fraction of all flights involved trainees.

Document #: *1016* **Comment #:** *4* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

The plan also assumes the worst possible hazard would be the skidding crash of a light aircraft weighing 3500 pounds. The accompaning (sic) information in section E to support that assumption contains many inaccuracies. Most aircraft flying directly over the site are of the large military aircraft such as the B-1, C-130, C-141B, F-111, T-38, which are practicing "touch and goes" at the former SAC base Amarillo International Airport. By the time the larger aircraft are over Pantex, they are committed to land. Large military helicopters fly directly over the area regularly too.

Response #: F.24

The Environmental Assessment does not assume that the worst possible hazard would be the skidding crash of a light aircraft weighing 3,500 pounds. The estimation of the effective area takes into account the actual footprint of the structures (true area), the expanded footprint because the structure has height (shadow area), and the expanded footprint (skid area) because an aircraft could impact and skid. (See Response F.9)

The potential for impact by aircraft from all four categories (commercial air, military air, general aviation, aerial application) is considered. Military aircraft flying over the Pantex Plant are included in the yearly operation as shown in Table E-7, Appendix E of the Environmental Assessment. The data was based on 14 days of flight records obtained from the Federal Aviation Administration in 1989. The aircraft types and the numbers of aircraft flying over are representative near the Pantex Plant in 1989.

No data on military helicopters was recorded in the Federal Aviation Administration flight data we examined. However, based on available data, helicopters have an annual fatal accident rate (number/100,000 hours) comparable to that of general aviation (see Analysis of Helicopter Accident Risk Exposure Near Heliports, Airports, and Unimproved Sites, R.J. Adams, E.D. Maconkey, L.D. Dzamba, DOT/FAA/RD-9019, February 1992) and helicopters have approximately an order of magnitude fewer flying hours. Also, accident data indicate that helicopters do not skid, therefore the area at risk (i.e., probability of impact) is significantly reduced. Furthermore, the subset of large helicopters that could cause significant damage is small compared to the total. For these reasons, helicopter crashes potentially leading to offsite consequences are qualitatively assessed as beyond extremely unlikely.

The reviewer asserts that the information in Section E to support the assumption that a skidding 3500-pound aircraft contains many inaccuracies. We are unable to respond because from this limited statement we are unable to ascertain what information the reviewer considers inaccurate or why it is considered inaccurate.

Document #: *1017* **Comment #:** *15* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

C.2 Aircraft – The EA uses as an example a 3500 pound aircraft at 80 miles per hour. What about a 200,000 pound aircraft at 500 or 600 mph?

I heard an F111 crashing into a mountain. The plane weighs approximately 75,000 pounds and flies at speeds in excess of 600 mph. The body of the plane basically stayed on the side of the mountain but the engine shaft augered itself 150 feet through solid granite.

Response #: F.25

As noted in other responses (see Response F.15), the Environmental Assessment uses the 3,500-pound aircraft to exclude that type of aircraft from further consideration. The Environmental Assessment considers that other aircraft could impact the Zone 4 magazines, but does not present an analysis of the potential consequences because the total probability of such impacts is no greater than 1.0×10^{-6}/yr.

The "anecdotal" report of a F-111 crash into a mountain may be correct. But again, the analysis did not exclude this class of event on any grounds other than the probability of occurrence was no greater than 1.0×10^{-6}/yr.

A Monte Carlo simulation for predicting earth penetration by projectiles was performed using the PENDEPTH Code (see PENDEPTH Code Documentation Update, S.C. Wright, DNA-TR-91-232, Defense Nuclear Agency, June 1992). PENDEPTH contains empirically based equations derived from penetration tests (see Equations for Predicting Earth Penetration by Projectiles: An Update, C.Y. Young, SAND88-0013, Sandia National Laboratories, July 1988). The calculation modeled the engine as a 4,000 lbs, 18 inches by 24 inches, ogive nose shape, normally impacting a hard rock with S parameter of 0.7 and standard deviation of 0.4. A S number of 0.3 to 1.2 represents massive rock formation with very few cracks or fissures and no weathering. The results of this calculation are presented below.

Impact Velocity (fps)	800	900
Mean depth of penetration (ft)	39	44
Standard deviation (ft)	16	18
95th percentile (ft)	68	78

Based on this analysis, the penetration of an F-111 engine shaft through 150 feet of solid granite would appear to be a very unlikely, if not impossible, occurrence.

yr = year
lbs = pounds
fps = feet per second
mph = miles per hour
ft = feet

Document #: *1048* **Comment #:** *14* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

6.2.5, Appendix E Aircraft Hazard Analysis does not present an accurate account of aircraft over Zone 4. Wednesday, February 24, 1993, we sat right here in our home on the west side of Pantex with the Special Project Directors of the OTA Study on Dismantlement and watched three C-5A's practice "touch and go" for three hours. These aircraft fly directly over Zone 4. We have observed military aircraft of all descriptions flying over Pantex for years. This is regular military practice. Army helicopters regularly fly over Pantex. We watch them, we know this is happening! What hazard analysis do you propose for these aircraft?

Response #: F.26

Any aircraft over the Pantex Plant are in the inflight mode, therefore, these operations are included in the analysis. (See Response F.21.)

No data on military helicopters were recorded in the Federal Aviation Administration flight data examined. However, based on data that is available, helicopters, in general, have an annual fatal accident rate (number/100,000 hours) comparable to that of general aviation (see Analysis of Helicopter Accident Risk Exposure Near Heliports, Airports, and Unimproved Sites, R.J. Adams, E.D. Maconkey, L.D. Dzamba, DOT/FAA/RD-9019, February 1992), and helicopters have approximately an order of magnitude fewer flying hours. Also, accident data indicate that helicopters do not skid, therefore the area at risk (i.e., probability of impact) is significantly reduced. Furthermore, the subset of large helicopters that could cause significant damage is small compared to the total. For these reasons, helicopter crashes potentially leading to off-site consequences are qualitatively assessed as beyond extremely unlikely.

Document #: *1011* **Comment #:** *11* **Date:** *2/18/93*

Dana O. Porter
Citizen Comments

Comment:
The environmental assessment report states that the D.O.E., "as with all Federal agencies", will be responsible for cleanup of any contamination. Who would enforce this policy and ensure that the cleanup would be accomplished in a timely manner? What are their cleanup contingency plans?

Response #: G.1

The policy and plans for any emergency regarding a radiological release off-site of the Pantex Plant is founded in the Federal Response Plan and the Federal Radiological Emergency Response Plan. Under the Federal Radiological Emergency Response Plan, a Federal Radiological Monitoring and Assessment Center would be established to provide an organizational and structural focal point to coordinate all of the Federal agencies' radiological monitoring and assessment efforts and activities.

The Department of Energy would initially manage and operate the Federal Radiological Monitoring and Assessment Center and provide assets such as management and technical personnel; command and control; communications equipment; administrative and logistical personnel and equipment; and other equipment and personnel from elements such as Aerial Monitoring Survey, Accident Response Group, Atmospheric Release Advisory Capability, and others. The Federal Emergency Management Administration would coordinate the activity of all Federal Agencies.

After the emergency response activities are completed, a lead Federal Agency would take over the Federal Radiological Monitoring and Assessment Center. This could be the Environmental Protection Agency or the Department of Energy. In either case, the Department of Energy would continue to provide technical assistance. The Federal Emergency Management Administration would assist the lead Federal Agency in coordinating the activities from all Federal Agencies, such as Department of Agriculture, Department of Health and Human Services, Department of Justice, Department of the Interior, and others.

The lead Federal Agency would work out specific response efforts with the State. Recovery planning would be initiated at the request of the State, but would generally not take place until after the initiating conditions of the emergency have stabilized and immediate actions to protect public health and safety and property have been accomplished. The Federal government would, on request, assist the State in developing off-site recovery plans.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.2) FOLLOWS.

Document #: *1027* **Comment #:** *4* **Date:** *3/5/93*

Portia Dees
Citizen Comments

Comment:
How can both the United States and Texas governments guarantee the safety of citizens living near and in Amarillo?
I respectfully urge you to make sure that Texas citizens are protected from proven and potential hazards.

Response #: G.2

Although there is no way to provide for a risk free environment, the Department has dedicated significant resources and management attention to ensure compliance with all applicable Federal, State, and local safety standards to provide the safest environment possible. The Department continues to place safety as a predominant priority in the operation and management of its sites. Throughout the Environmental Assessment, the Department examined risk resulting from interim storage of additional plutonium components at the Pantex Plant. This issue was evaluated in terms of risk to workers, the public in the surrounding communities, and potential for contamination of the Ogallala Aquifer. The conclusion of the Environmental Assessment is that the only additional risk associated with implementing the proposed action is increased radiological worker exposure. As stated in Section 6.0 of the Environmental Assessment, the Department will carefully monitor this risk through the Pantex Plant personnel dosimetry program and take appropriate management actions to ensure limits are not exceeded.

The database compiled for this analysis includes a safety analysis; natural phenomena design reviews of the facilities; natural-phenomena hazard modeling; probability analysis of aircraft impacts, earthquakes, and tornados; external explosions; worker accidents such as a forklift accident; and damage from missiles. For a complete list of considerations involved in the development of the Environmental Assessment, the reader is referred to Appendix A of the Environmental Assessment.

This analysis has been documented in the Final Safety Analysis Report, Pantex Plant Zone 4 Magazines (Issue D, April 1993) and the Los Alamos National Laboratory study "Potential Ogallala Aquifer Impacts of Hypothetical Plutonium Dispersal Accident in Zone 4 of the Pantex Plant" (November 1992).

Document #: *1046* **Comment #:** *5* **Date:** *3/22/93*

Dan Morales, Attorney General

State of Texas, Office of the Attorney General

Comment:

III. DOE has failed to adequately assess the risk of dismantling thousands of nuclear warheads and storing the plutonium pits at Pantex.

DOE has failed to adequately address safety and risk issues in the draft EA. This is a fundamental deficiency of the draft EA. ...

B. Lack of Resources to Ensure Safety.

It is not only the lack of a meaningful DOE safety policy against which to measure a safety analysis which makes the draft EA deficient, it is also the lack of an adequate analysis of whether Pantex has the necessary resources to undertake its new mission. [footnote 6 (Until the last two years, the mission of Pantex was to construct and dismantle nuclear warheads. The components of dismantled weapons, including the plutonium pits, were shipped back to the facility from which they came originally. The mission of Pantex today--to dismantle thousands of warheads, store and manage the plutonium pits extracted therefrom, and to help maintain a nuclear weapon stockpile a fraction of the size which existed during the Cold War--is clearly different. Such a change in mission may in and of itself necessitate an EIS.)] As stated by the GAO:

Over the next several years, DOE must take custody of and dismantle thousands of nuclear weapons that the Department of Defense will retire. The capability of DOE to safely dismantle so many weapons could present a problem and tax the capabilities of DOE resources at the Pantex Plant in Texas. Storage of weapon components at the plant, the projected workload to accomplish this work, and the transportation of weapons to the plant are important issues that need to be examined carefully. (Emphasis added.) [footnote 7 (Statement by Victor S. Rezendes, Director, Energy Issues, GAO, given at Hearing, p. 5.]

I believe the adequacy of resources issue needs to be more fully addressed.

Response #: G.3

Dismantlement of nuclear weapons has always been a part of the Pantex Plant mission. In the past, the number of disassemblies was balanced with production requirements such that total production and disassembly requirements were carried out in accordance with National Security Directives, and the appropriate resources were allocated by the Department of Energy.

Currently, disassembly activities are conducted in accordance with National Security Directives and receive the required resources to accomplish that mission. The only difference is that, in the past where resources would have been allocated towards production, they can now be used towards disassembly. Thus, an increase in the total number of disassemblies per year would not impact the Department's capability to safely accomplish the work required to meet national arms reductions objectives. Discussion of the Department's Nuclear Safety Policy is presented in Response G.5.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.4) FOLLOWS.

Document #: *1048* **Comment #:** *18* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

What consideration is being given to the possibility of contamination to the land, the air or the Ogallala?

Response #: G.4

The Environmental Assessment addresses all potential accidents both from normal operational and abnormal means that could have a possibility of contaminating the environment, workers, or the public.

Document #: *1046* **Comment #:** *4* **Date:** *3/22/93*

Dan Morales, Attorney General

State of Texas, Office of the Attorney General

Comment:

III. DOE has failed to adequately assess the risk of dismantling thousands of nuclear warheads and storing the plutonium pits at Pantex.

DOE has failed to adequately address safety and risk issues in the draft EA. This is a fundamental deficiency of the draft EA.

A. Lack of Meaningful Safety Policy. DOE has long been criticized for its failure in developing a set of comprehensive and satisfactory safety procedures, i.e., a "safety policy," for its nuclear weapons facilities. Without such an overarching, meaningful safety policy against which to measure fundamental safety policy decisions at its sites, it is difficult to understand how the DOE under your predecessor was able to adequately develop the "Safety Analysis Report" (or "SAR") which preceded the draft EA and upon which much of the analysis of the draft EA was based. Moreover, it is difficult to understand how, if the draft EA would have properly analyzed the complete range of dismantlement activities at Pantex, DOE could adequately develop SARS for each of the activities associated with the dismantlement and storage of the nuclear weapons.

As stated by the Office of Technology Assessment; [footnote 3 (OTA Assessment Proposal: Managing Nuclear Materials from Warheads. Feb. 1, 1992: submitted to Senate Committee on Governmental Affairs.)]

In its Final Report on DOE Nuclear Facilities, the DOE Advisory Committee on Nuclear Facility Safety ["ACNFS"] noted that the job of solving the operational and safety problems at the DOE weapons complex is "far from complete" and that some of the problems"will take into the next century" to correct. [footnote 4 ([Footnote in original.] Advisory Committee on Nuclear Facility Safety. "Final Report on DOE Nuclear Facilities," report prepared for the Secretary of Energy, U.S. Department of Energy, Washington, D.C., Nov. 1991. p. 11. The ACNFS vigorously advocated the development of a department-wide safety policy which would allow different parts of the DOE to make internally consistent decisions between possibly conflicting values such as safety and production.)]

Although DOE did issue a new Nuclear Safety Policy in September 1991, DOE was subsequently criticized by the ACNFS in its final report for substituting nebulous language such as "continuous improvement" for measurable standards; for paying little attention to the largely chemical nature of the risk at some DOE facilities; and for inadequately treating the inevitable conflict between safety and production responsibilities by simply asserting that they are "compatible." The ACNFS's report stated that DOE needs to spell out how safety goals will be achieved, how priorities will be set, how self-assessments will be judged, and how progress and success will be measured. [footnote 5 (S e e. Statement by J. Dexter Peach, Assistant Comptroller General, General Accounting Office, given at Hearing before the Senate Committee on Governmental Affairs of Nuclear Disarmament on Department of Energy. Feb. 25, 1992 ("Hearing"). p. 5.]

At this time, we are not confident that DOE under your predecessor provided sufficient guidance to its regional and field offices for them to make meaningful decisions about acceptable risks, risk assessment methodology, and procedures and policies to identify and minimize safety risks. Such decisions would, of course, be reflected in the SAR or SARS providing the basis or bases of the EA or EAs. I believe that production of an EIS would ensure the public that important risk and safety issues were clearly and fully analyzed.

More specifically, the draft EA does little to allay our concerns about the potential safety problems that could arise from DOE's proposed activities. Of particular concern to us is the analyses in the draft EA of the probability of an airplane crash with Zone 4 Pantex plant structures and the potential impacts on the Ogallala Aquifer from a plutonium dispersal accident in Zone 4. We refer you to the comments submitted by the Texas Air Control Board and the Texas Department of Public Safety (Division of Emergency Management). Furthermore, we refer you to several issues raised by the City of Amarillo and the Counties of Potter and Randall regarding potential effects of the maximum winds of a category F4 tornado, as well as the possibility of terrorist actions involving an aircraft.

In analyzing both the potential airplane crash and impacts on the Ogallala aquifer of a dispersal accident, it is apparent that DOE relied on inaccurate assumptions and employed inappropriate methodologies. Given the seriousness of the deficiencies in these analyses, this office cannot have any confidence in DOE's ultimate conclusions concerning the possible environmental impacts of interim storage at the Pantex plant.

Response #: G.5

The Zone 4 safety and operational envelope associated with the proposed action is well defined and based on studies performed by professionals in accordance with sound analytical principles. The Final Safety Analysis Report, Pantex Plant Zone 4 Magazines (Issue D, April 1993) was started in August 1991, went through several iterations, and was accepted by the Department in December 1992 after considerable review and an independent analysis by a Technical Safety Review Panel. Issue D, the unclassified version, was provided to the public in April 1993.

The Environmental Assessment is based on the risk analyses provided by the Final Safety Analysis Report, Pantex Plant Zone 4 Magazines (Issue D, April 1993). This document identifies accident events that might produce a risk to the public. The assessment of these risks has been developed using techniques and procedures consistent with those used in the commercial nuclear industry. As such, the Environmental Assessment is sufficient to bound the environmental impacts for the National Environmental Policy Act decisions.

Department of Energy Order 5480.23, Nuclear Safety Analysis Reports was issued in 1992 specifying requirements for safety analyses involving Department of Energy nuclear facilities, and for submittal, review, and approval of contractor plans and programs to meet these requirements. Standards aiding implementation of this order are being issued, such as Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Report (DOE-STD-1027-92, December 1992). Additionally, the Department has developed an action plan to strengthen Department of Energy Nuclear Safety Standards. This action plan will:

a. Issue the Department of Energy's Nuclear Safety Policy to:

  - Establish/maintain management involvement and accountability to ensure nuclear safety requirements are met, priorities are set, and progress/success is measured.
  - Develop enhanced technical personnel competence and technical standards.
  - Use established nuclear safety goals as performance benchmarks.
  - Maintain nuclear safety oversight and a culture to enhance nuclear safety.

b. Enhance standards, managers/technical staff qualifications, training, and staffing.

c. Elevate organizational Department of Energy and contractors standards development and implementation to enhance assurance of public and worker health and safety.

Development of a strong standards program has been focused on achieving measurable performance improvement, and also on "continuous improvement" in the total quality sense.

Regarding chemical and occupational risks, the Pantex Plant management has initiated an Occupational Safety and Health Hazard Abatement Program that establishes a safety and health baseline audit program for each building and facility. Performance indicators are developed and published frequently.

For additional information, refer to the general response discussions for the Ogallala Aquifer Analysis and the Aircraft Crash Scenario Analysis, Sections E and F of this document.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.6) FOLLOWS.

Document #: *1008* **Comment #:** *2* **Date:** *2/1/93*

Boyd Deaver

Texas Water Commission

Comment:

Comment: Executive Summary: Page vii fifth paragraph. - "...would not result in additional generation or management of wastes."

Question: Is this referring to a pit as a waste?

Response #: G.6

The quoted statement does not refer to the pit. Instead, the statement refers to the fact that the proposed action, increased interim storage of the pits, would generate no additional or extremely insignificant amounts of waste. This waste, if generated, would be limited to compactible, low-level wastes such as paper wipes.

ENVIRONMENTAL ASSESSMENT TEXT CHANGE

The Executive Summary was changed to reflect the comment.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.7) FOLLOWS.

Document #: *1044* **Comment #:** *3* **Date:** *3/15/93*

Margie K. Hazlett (3)
Citizen Comments

Comment:
The increase in storage capacity for each Modified-Richmond magazine involves the use of a multiple stacking configuration of the pits within the magazine. S.A.C. Magazines have not been used previously for holding pits, and the multiple stacking arrangement has not been used previously in S.A.C. or Modified-Richmond Magazines. These methods of storage will be extremely dangerous for both workers and the public, as the pit containers in the vertical arrangement will be wall to wall and there is no way an inspector could inspect containers in the back, for the plans show no walking room. Some arrangements have a very narrow middle aisle. The interior of the pit storage igloos have an awesome, unhealthy atmosphere and the inspectors are allowed a very short time while inspecting the pit containers.

Response #: G.7

The Final Safety Analysis Report, Pantex Plant Zone 4 Magazines (Issue D, April 1993), from which the Environmental Assessment draws most of its technical hazard assessments, has shown that the Steel Arch Construction magazines are suitable for pit storage, and no incremental risk is created when compared to their current authorized use. In addition, extensive analysis of the concept and mechanical design of the canister pallets that hold the pit storage containers in place in the multiple stacking configuration show that the proposal is functional and, more importantly, safe. As discussed in the Environmental Assessment, there are no credible scenarios whereby plutonium would be released off-site to the public regardless of the magazine type or storage configuration used.

A concern was raised that inspections could not be safely done of containers located in the back of the magazines that are stored in the wall to wall vertical arrangement (identified in the Environmental Assessment as the maximum packing configuration). As stated in the Environmental Assessment, this storage configuration was used to provide bounding parameters for the safety and environmental analyses. The Department acknowledges that this is not an operationally feasible configuration and would not store the pits in this configuration. For those vertical configurations that have aisle spaces identified, the width is adequate for inventory and inspection activities. However, the configuration that the Department has proposed for use during interim storage is the horizontal stacked configuration that will have much wider aisle spaces and will allow for use of the shielded forklift to further mitigate worker exposure.

Due to concerns for maintaining minimal personnel exposure, the time spent inside the magazines will be short. The process will utilize methods to conduct the inventory in minimum time.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.8) FOLLOWS.

Document #: *1012* **Comment #:** *4* **Date:** *1/16/93*

Margie K. Hazlett (1)

Citizen Comments

Comment:

There are approximately 423,630 people living in the twenty-seven counties surrounding Pantex Plant. These people are proud of their heritage and bountiful crops of wheat, corn, other grains and vegetables. The many ranchers, over 80 feed-lot operators and many packing companies for processing and shipping. (sic) These farmers and ranchers furnish our nation with 76% of all beef consumed. These are the people who have traded in Amarillo for many years and have kept Amarillo's economy stable for generations.

Reasons for opposing the plutonium storage that is at Pantex, and opposing any more plutonium for storage:

In the event of an accident caused by forklift or plane crash, landing or taking off from the Amarillo Air Terminal which is much too close to a Nuclear Plant with plutonium storage.

Contamination of the Ogallala Aquifer, leaving plutonium on the water table which will be deadly for 76,000 years. If we are so unfortunate to be down-wind from an accident, we would be in the plume of plutonium dispersal, and it would be too late for any emergency care for our people. This is a reality and is causing much stress, plus physical and mental problems among healthy people.

Response #: G.8

The Environmental Assessment provides the analysis that concludes: 1) there would be no impact to the Ogallala Aquifer from a hypothetical accident; 2) there is no impact other than to workers in the immediate vicinity for a forklift accident; and 3) it is beyond extremely unlikely (less than one in one million probability) for the occurrence of an aircraft accident that would cause a dispersion of material.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.9) FOLLOWS.

Document #: *1022* **Comment #:** *8* **Date:** *2/11/93*

James Thomas

Hanford Education Action League (HEAL)

Comment:

Additionally, the recent recommendation (93-1, dated January 21, 1993) of the Defense Nuclear Facilities Safety Board (DNFSB) raises the possibility that nuclear safety might be deficient in those operations involving the disassembly of nuclear weapons. The Board specifically cited its concern of nuclear safety at Pantex.

Response #: G.9

The comment cites the Defense Nuclear Facilities Safety Board Recommendation 93-1 (dated January 21, 1993) as a reason to be concerned about the safety of Zone 4 operations. Defense Nuclear Facilities Safety Board Recommendations do not necessarily, as in this case, imply a lack of safe operations. Rather, in their independent oversight capacity, Defense Nuclear Facilities Safety Board Recommendations request the Department to focus emphasis in a particular area of interest to ensure public health and safety. Recommendation 93-1 requested that the Department perform an order compliance and standards management assessment to specifically address weapons related activities and to clarify how basic safety principles are applied within Departmental Orders and Directives. This is to ensure these principles are applied not only at facilities that produce and process fissile materials, but also at those facilities that assemble, disassemble, and test nuclear weapons.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.10) FOLLOWS.

Document #: *1044* **Comment #:** *2* **Date:** *3/15/93*

Margie K. Hazlett (3)

Citizen Comments

Comment:

I oppose the storage plan the Department of Energy has outlined for plutonium containers in the old, obsolete and unsafe Modified-Richmond and SAC (steel arch construction) huts or igloo type buildings.

Response #: G.10

The Final Safety Analysis Report, Pantex Plant Zone 4 Magazines (Issue D, April 1993) evaluates the integrity, both under normal and abnormal conditions, of the Modified-Richmond and Steel Arch Construction magazines. The magazines are structurally sound and meet or exceed the requirement to safely and securely stage or store nuclear weapon assemblies and other components, including the plutonium pits. The designs of the magazines are consistent and appropriate for the proposed activities.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.11) FOLLOWS.

Document #: *1021* **Comment #:** *5* **Date:** *1/25/93*

Lawrence D. Egbert, MD

Physicians For Social Responsibility

Comment:

One reason why citizen and local government interest is so crucial is that the DOE has been working for five decades in a shroud of secrecy and a war threat mentality spending their time preparing weapons and much less time, quite insufficient time, on the protection of the environment. When DOE reports that Pantex has been run in a "safe and responsible fashion for 40 years", they conveniently leave out the management of the plants at Rocky Flats in Colorado and Hanford in Washington. The DOE has a bad reputation for environmental and health hazards. Remember, considerations other than safety will be considered, e.g. timeliness, cost and efficincy (sic) in using space already available.

Response #: G.11

The Environmental Assessment addresses potential impacts of interim storage on the environment and on operations at the Pantex Plant. Operations at other facilities within the nuclear weapons complex are not the subject of this Environmental Assessment.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.12) FOLLOWS.

Document #: *1040* **Comment #:** *4* **Date:** *3/9/93*

Carl L. King, President

Texas Corn Growers Assn.

Comment:

When the Department of Energy moved everything from Rocky Flats, Colorado into Pantex, they stated that Pantex would not be a permanent storage site. This concerns us greatly because the D.O.E.'s credibility has been very bad for the people in the Panhandle area. We live less than 100 miles from this site in a very large agricultural area. We produce all types of crops and this is also the largest cattle feeding area in the world. The environment has a tremendous effect on not only the livestock and crops but especially the human beings that live here.

Document #: *1044* **Comment #:** *8* **Date:** *3/15/93*

Margie K. Hazlett (3)

Citizen Comments

Comment:

The storage of pit plutonium will be extremely hazardous and life threatening to the citizens of our entire Panhandle Area, and will have a destructive impact on the Ogallala Aquifer, our environment, our agriculture and livestock industries.

Response #: G.12

The Department recognizes the importance of agriculture to the Texas Panhandle. Agriculture is an integral part of the environment described in the draft Environmental Assessment and, accordingly, the Department must devote particular attention to any potential impacts to the Ogallala Aquifer. The analysis has revealed no credible accident, either operational or external to the facilities for interim storage, that would result in a measurable impact to the environment and subsequently to agriculture. The only accident identified as even potentially capable of affecting the environment was an aircraft crash into a storage magazine, an event with less than a one in a million probability of occurrence, per year.

Document #: *1021* **Comment #:** *10* **Date:** *1/25/93*

Lawrence D. Egbert, MD
Physicians For Social Responsibility

Comment:
The DOE has not used EPA or OSHA standards for their work.

Response #: G.13

Department of Energy Order 5400.1 requires compliance with applicable Federal, State and local environmental protection laws and regulations for all the Department of Energy operations. Department of Energy Orders 5480.4 and 5483.1A require compliance with a number of Occupational Safety and Health Administration standards. In addition, new departmental incentives were established in December 1992 for Department of Energy contractors to enhance Occupational Safety and Health performance and to acknowledge excellence in a contractor's Occupational Safety and Health performance. Department of Energy Order 5480.4 also requires that where both Department of Energy and non-Department of Energy Environment, Safety, and Health standards are applicable and mandatory, and there are conflicts in such standards, the Environment, Safety, and Health standards providing greater protection shall govern.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.14) FOLLOWS.

Document #: *1022* **Comment #:** *3* **Date:** *2/11/93*

James Thomas

Hanford Education Action League (HEAL)

Comment:

The Department of Energy, in coordination with the President and the Department of Defense, should declassify the Nuclear Stockpile Memorandum. It can no longer be argued that keeping this information from the American public is in the national interest. The Russian government knows because of the provisions in the recent START agreements.

Response #: G.14

This comment is outside the scope of the Environmental Assessment.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.15) FOLLOWS.

Document #: *1021* **Comment #:** *3* **Date:** *1/25/93*

Lawrence D. Egbert, MD
Physicians For Social Responsibility

Comment:
We should know that breeder technology and Pu fuel cycle nuclear programs are not working well because of safety and economic problems so we can anticipate a big increase in the inventory of Pu in other forms than warheads. We should not set Texas up for this kind of storage.

Response #: G.15

The proposed action calls for increased interim storage of plutonium pits. The storage of any other form of plutonium is outside the scope of the proposed action and would not be undertaken without appropriate National Environmental Policy Act considerations.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.16) FOLLOWS.

Document #: *1049* **Comment #:** *1* **Date:** *3/12/93*

Jerome W. Johnson
Panhandle 2000

Comment:
Texas governor Ann Richards recently forwarded to Secretary of Energy Hazel O'Leary the comments received by the State of Texas regarding the Environmental Assessment of the proposed interim storage of plutonium at the Pantex Plant in Amarillo, Texas. In her letter to Secretary O'Leary, Governor Richards requests an extension of the deadline for comments to be submitted to DOE on the Environmental Assessment to March 16, 1993. Panhandle 2000 supports the Governor's request for an extension, and would respectfully request that DOE favorably consider granting the extension. The extension will provide State agencies and other interested parties sufficient time to comment fully on the Environmental Assessment, and will allow all parties to feel as though they have had their "day in court" with DOE on this issue. Granting the extension will, in our opinion, foster support for DOE's final decision on interim storage, and will demonstrate that the cooperative relationship with the State of Texas DOE has established will continue in the new Administration.

Response #: G.16

The extension requested in the Governor's letter was granted.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.17) FOLLOWS.

Document #: *1049* **Comment #:** *2* **Date:** *3/12/93*

Jerome W. Johnson
Panhandle 2000

Comment:

We at Panhandle 2000 clearly support DOE's preliminary decision to house the interim storage function at Pantex, and understand fully its importance in the context of the full-blown reconfiguration plans. After carefully reviewing the comments submitted to date, it is our opinion that the debate centers not on DOE's conclusion that no significant increase in risk will occur from the additional storage, but merely on the data and methodologies used by DOE in its analysis. Such a debate, while important, should not serve to impede DOE's plans regarding interim storage or final reconfiguration. pantex (sic) continues to enjoy strong support from State officials and residents, especially those from the Texas Panhandle. We look forward to a swift resolution of the issues discussed in the comments, and implementation of the plans for interim storage at Pantex.

I also wish to express our support for the proposed plan to site a research facility at the "plutonium site" selected by DOE in the reconfiguration process. We are hopeful Secretary O'Leary will concur in this aspect of the reconfiguration plan and stand ready to assist you in accomplishing this end. The heads of the University of Texas, Texas A&M University, and Texas Tech University are formulating plans for a research consortium to assist DOE in its research efforts, especially if Pantex is chosen as the site for this research facility.

Finally, we have noted with interest the Secretary's recent decision to review the Nonnuclear Reconfiguration Cost Effectiveness Study. We are willing to assist DOE in the selection of the consultants charged with evaluating this decision if appropriate, and look forward to working with your office on this issue.

Response #: G.17

The data and methodologies presented in the Environmental Assessment have been shared with the State and public. If the National Environmental Policy Act commenting process reveals any discrepancies in the data or methodologies used in the preparation of this document, appropriate consideration will be given to any necessary alterations of the Environmental Assessment or associated additional analyses.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.18) FOLLOWS.

Document #: *1016* **Comment #:** *1* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

I have been an observer of the "Pantex mentality" and the "Pantex work ethic" for many years. I have often seen "damned if I care" attitude portrayed by the workers at the plant.

Document #: *1021* **Comment #:** *18* **Date:** *1/25/93*

Lawrence D. Egbert, MD

Physicians For Social Responsibility

Comment:

I conclude that the 40 years of "responsible and safe" work done at Pantex cannot be extrapolated to a future of ten years of storage of Pu. I also conclude that the DOE has a long history of secrecy and willingness to take risks which have harmed the environment and the health of workers and neighbors. So, go SLOW!

Response #: G.18

The concerns raised in these comments are understandable. During the past year, the Department of Energy, through the Office of the Assistant Secretary for Defense Programs and the Albuquerque Operations Office, has put more focus on the day-to-day activities at the Pantex Plant. In addition and on its own initiative, Mason & Hanger-Silas Mason Co., Inc. (the Pantex Plant Management and Operating contractor) has developed and has been carrying out since November 1992 a Performance Improvement Plan aimed at achieving a level of discipline and formality in operations that addresses the types of concerns raised in the comments. The Department has been and will continue to monitor Mason & Hanger's progress on their implementation of the Performance Improvement Plan.

Document #: *1042* **Comment #:** *11* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

Issues that must be specifically discussed include: ...

c. Activities from all dismantlement activities, including optimum and maximum rates for dismantling warheads; transporting materials off site; and storing and disposing of materials on site, including multiple handling of pits (including moving or shifting them during storage);

d. Disclosure of effects on workers of realistic accidents from disassembly, on-site transportation, failures in storage facilities, and exposures from "normal" operations, including increased exposures from disassembly, materials handling, doses from more frequent and more lengthy inspections, maximally exposed worker, and discussion of having few workers having relatively higher doses versus more workers having more minimal exposures;

Document #: *1043* **Comment #:** *5* **Date:** *3/12/93*

Mavis Belisle, Director

the Peace Farm

Comment:

The EA should include the full scope of dismantling activities at Pantex, including increased worker exposure to radiation and other hazardous materials throughout the dismantling process, transportation on and off site, any increase in chemicals used to clean work areas, tools and clothing, and any increased disposal of high explosive material associated with increased dismantling. It should also include analysis of the increased handling and short-term storage of other nuclear materials involved in the dismantling process.

Hazards are dealt with speciously in the current document, and should be dealt with fully when there is risk of catastrophic harm, even if the likelihood itself is very low. The document should include effects of interim storage on structures and surrounding soil overburden. It should include an assessment of any risks involved in transit from dismantling to storage and transit accidents, and of the consequences of accidents in monitoring procedures or in the event of corrosion, either of containers or structures themselves.

Response #: G.19

The proposed action calls for increased interim storage of plutonium pits. The comments with respect to other activities throughout the dismantlement process (transportation, high explosive disposition, etc.) are outside the scope of this Environmental Assessment but are discussed in the Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983). (Further discussion is provided in Response B.1). Discussions regarding operations associated with the proposed action with respect to the storage magazines, on-site transit, operations during the interim storage period, worker exposure, and potential for accidental releases during operations or interim storage are provided in the Environmental Assessment. (Additional information is provided in Section D of this document.)

Document #: *1044* **Comment #:** *1* **Date:** *3/15/93*

Margie K. Hazlett (3)
Citizen Comments

Comment:
In this nation which supports freedom of speech, I feel that it is my democratic obligation to express my sincere views and comments on the proposed plutonium pit storage at the Pantex Plant, which was designed solely for assembling and disassembly of nuclear warheads, missiles and conventional bombs during World War II. Prior to now, only a few assembled bombs and disassembled parts were stored at Pantex until they could be transferred to a proper, safe facility which stores plutonium pits underground, so the temperature of the containers will have an environment of more constant temperature.

Response #: G.20

The magazines in Zone 4 used to house weapons components are designed for storage of weapons as well as weapon components. Furthermore, the weapon components at issue are themselves contained in the AL-R8 storage container. There is no evidence to indicate that storage underground would have any environmental benefit, or that storing components above the ground in magazines and the packaging drums currently used creates any additional safety risk.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.21) FOLLOWS.

Document #: *1027* **Comment #:** *1* **Date:** *3/5/93*

Portia Dees

Citizen Comments

Comment:

Have the following questions been adequately answered? Has worker safety in all divisions of the plant been adequately studied? If so have the recommended safety precautions been taken? Have dangers to surrounding farmland and agricultural workers been studied? Are there safeguards for the land, it's (sic) productive qualities and it's (sic) agricultural value?

Response #: G.21

The Environmental Assessment addresses worker safety and the potential impacts to the environment with regard to the proposed action. Safeguards will be maintained through programs that keep radiation exposure to the workers at levels well below required standards. There are no potential operational accidents in the Zone 4 operations that would produce a danger to surrounding farmland and agricultural workers. In addition, the facilities within Zone 4 provide for safety from external abnormal events. Worker safety throughout the plant is under constant review, enhancement, and external oversight to ensure that the safety and health of all the Pantex Plant workers is maintained.

Document #: *1007* **Comment #:** *12* **Date:** *2/25/93*

Joseph A. Martillotti

Texas Dept. of Health, Bureau of Radiation Control

Comment:

Page 6-7, Table 6-1: Note 3 refers to Tables 7-2A and 7-2B; should be 6-2A and 6-2B.

Response #: G.22

The Department acknowledges the error in Note 3 of Table 6-1 and has corrected the Environmental Assessment.

ENVIRONMENTAL ASSESSMENT TEXT CHANGE

Section 6, Table 6-1 was changed to reflect the comment.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.23) FOLLOWS.

Document #: *1016* **Comment #:** *14* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

If the transportation of the Pu is too dangerous to move, how safe can the transportation of bringing the warheads to Pantex be? Maybe it's best to just dismantle them and store the components right where they are.

Document #: *1031* **Comment #:** *4* **Date:** *3/1/93*

Louise Daniel

Citizen Comments

Comment:

Transportation to and from the Pantex site, and between all facilities, is not adequately addressed.

Response #: G.23

Transportation of warheads and components within the nuclear weapons complex is outside the scope of the Environmental Assessment. In addition, the Environmental Assessment does not mean to imply that transportation of plutonium is dangerous. The analysis indicated that no environmental benefit would be derived by transporting the pits off-site. In addition, the Pantex Plant is the only facility currently capable of handling the volume of weapons requiring dismantlement to meet National Security Initiatives.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.24) FOLLOWS.

Document #: *1019* **Comment #:** *8* **Date:** *1/20/93*

W. H. O'Brien

Operation Commonsense

Comment:

While I believe most of us in the community can be convinced of the safety of the plan, there will be many outside the community who will be hesitant to locate in this area because they are wary of the unknown or unproven. There will be little doubt that the future growth of business in Amarillo and the surrounding area will suffer with the public knowledge of the storage of these pits. This probability creates the need for DOE to assert an active and effective role in planning an (sic) assisting Amarillo in maintaining the growth we have every right to expect, notwithstanding the plutonium storage plans. Active help from DOE in directing certain highly desirable non-nuclear government operations here or funding to assist in recruiting new businesses is appropiate (sic) and necessary.

Response #: G.24

The Final Environment Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983) does discuss the economic impact of the plant and plant activities in the community.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.25) FOLLOWS.

Document #: *1018* **Comment #:** *2* **Date:** *1/20/93*

Bob Bullock, Lt. Governor
State of Texas

Comment:
Since increasing the number of pits will necessitate additional handling and transportation, I would like information about any increased risk of human error or accident resulting in localized spillage or contamination.

Response #: G.25

Based on the analyses presented in the Environmental Assessment and the Final Safety Analysis Report, Pantex Plant Zone 4 Magazines (Issue D, April 1993), there is no increased risk associated with the Pantex Plant operations now planned for the 1990's compared to those conducted in the 1980's or to the previously scheduled 1990's workload. The risks (probability and consequences) of localized on-site spillage or contamination are proportional not only to the number of items handled but also to the relative hazards associated with the items handled. The risk associated with the activities involving weapons assemblies is higher than activities involving pits because of the presence of explosives in nuclear weapons assemblies. As pointed out in the Environmental Assessment and the Final Safety Analysis Report, Pantex Plant Zone 4 Magazines (Issue D, April 1993), the total plant workload is not expected to increase in the 1990's. The increase in the number of weapons dismantled will be offset by the reductions in new weapons assembly requirements and the other major component of plant workload, stockpile surveillance. The stockpile surveillance program should decrease with the reduced numbers of nuclear weapons in the total national inventory. Accordingly, any increased pit handling and transportation at the Pantex Plant associated with the dismantlement program would be offset by decreased handling and transportation of pits and assembled nuclear weapons associated with new weapon production.

The Final Safety Analysis Report, Pantex Plant Zone 4 Magazines (Issue D, April 1993) identifies a hypothetical operational accident due to human error that could result in measurable on-site and off-site contamination and worker exposure. This accident scenario reflects the puncture of a container and the associated pit inside the magazine structure by a forklift tine. The consequences of this postulated accident were calculated to be as follows:

1. 0.6 mg plutonium, as plutonium oxide, is released inside the magazine.

2. Worker dose calculated to be 0.02μCi; 50-year committed effective dose equivalent whole body dose is 7 rem; 50-year dose to the lung is 24 rem.

3. The off-site exposure (calculated at 2.1 km from Zone 4) was estimated to be 0.47 mrem lung and 0.13 mrem whole body 50-year committed effective dose equivalent. This is far below the current Department requirement that limits off-site exposure to no greater than 100 mrem/yr and below the measured background levels of 300 mrem/yr.

It should be noted that the above impacts are based on extremely conservative assumptions. The detailed analysis and discussion supporting this are found in Chapter 7 of the Final Safety Analysis Report, Pantex Plant Zone 4 Magazines (Issue D, April 1993). The forklift scenario is applicable to the horizontal palletized storage configuration projected for future Zone 4 operations. However, forklift and system operation design goals planned for future operations are expected to reduce the probability to less than 1 x 10^{-6} per year. The horizontal palletized pit storage configuration will not be implemented until the National Environmental Policy Act process is complete.

mg = milligrams
μCi = microCurie
km = kilometer
mrem = millirem
yr = year

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.26) FOLLOWS.

Document #: *1042* **Comment #:** *33* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

5. Page 2-1. The draft EA states that without additional storage, disassembly would cease by as early as the fourth quarter of 1993. Would such cessation in any way violate the terms of negotiated arms agreements? What contingency plans exist or are being developed to avert such a cessation?

Response #: G.26

Given the current dismantlement rates, magazine capacity would likely be reached in the first quarter of 1994.

Under present arms control agreements, thousands of nuclear warheads will be removed from weapons systems as the United States and the successors to the Soviet Union reduce their weapons arsenals. The key issue is the disposition of these fully-assembled warheads. Placing many thousands of excess nuclear warheads in long-term storage is a major international concern and is viewed by many nations as being contrary to arms control and nonproliferation objectives. Because of the seriousness of this issue, the United States and the Former Soviet Union have made unilateral declarations to eliminate and dismantle nuclear warheads (e.g., Presidential Initiative to reduce United States nuclear forces, September 27, 1991), even though dismantlement per se is not required by the negotiated arms agreements. If the United States fails to dismantle its own weapons, it is logical to expect that Russia would cease its dismantlement efforts, thereby seriously undermining a major United States nonproliferation goal. Significantly, the sense of Congress has been to insist on dismantling the nuclear warheads resulting from "ongoing and future arms reduction negotiations and agreements" (see, for example, the National Defense Authorization Act for Fiscal Year 1993).

At present, the only alternative to dismantling nuclear weapons and storing the plutonium components is to store fully assembled warheads. Putting aside Presidential direction to eliminate and dismantle the United States inventory of Theater Nuclear Weapons, dismantlement is a sounder alternative when compared to storing fully assembled weapons. First and foremost, dismantlement eliminates the potential for an accidental or unauthorized detonation. Secondly, dismantlement reduces the number of highly attractive targets for terrorists--weapons are more attractive than pits. Finally, dismantlement opens the way for more cost effective operation for the Department of Defense.

There are many factors influencing the future use of munitions storage facilities in the Department of Defense. An overriding consideration in the military services is realignment of bases, and consolidation of forces into remaining installations. The Army is returning 600,000 short tons of conventional ammunition from Europe (North Atlantic Treaty Organization) and Pacific storage sites between 1991 and 1998 and has allocated all available space in the Continental United States (to include previous nuclear storage sites) for this project. The Air Force and Navy are consolidating units and moving nuclear and conventional weapons to maximize storage space, and match missions of on-base and regional forces. Many sites are not available because the host military service has moved or plans to move a mission (or facility) from a closed based to a retained base.

Document #: *1011* **Comment #:** *19* **Date:** *2/18/93*

Dana O. Porter

Citizen Comments

Comment:

If an accident occurs at the Pantex facility, the economy of the entire area is at risk.

Document #: *1016* **Comment #:** *26* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:

To ensure the safety of the peoples and of the environment, we request that the DOE post a bond in the amount of at least $200,000,000. This bond would be used to help pay damages in case of contamination or destruction of any private property, crops, livestock, as well as bodily injury or death of a person or persons outside the parimeter (sic) of the plant. Property owners and/or their heirs must be compensated for their loses (sic).

Document #: *1017* **Comment #:** *22* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:

I would also like for DOE to post a $200,000,000 bond to be forfeited in case of contamination or destruction of any private property, crops, or livestock or bodily injury or death of a person or persons outside the parimeter (sic) of the plant. This bond should pay property owners or their heirs for losses incurred.

Document #: *1043* **Comment #:** *4* **Date:** *3/12/93*

Mavis Belisle, Director

the Peace Farm

Comment:

There should be a provision for compensation for any real or perceived loss in property value caused by interim storage of a large quantity of plutonium pits and a provision for compensation for loss of value, real or perceived, to agricultural products of the area caused by any activity associated with dismantling.

Response #: G.27

All potential accidents were evaluated within the draft Environmental Assessment. The impacts of almost all credible potential accidents, both operational and externally initiated events, were limited to on-site effects. Only an aircraft accident, which was found to be beyond extremely unlikely at less than one in a million probability, would have the capability to disperse a significant amount of nuclear material off the Pantex Plant. Even this accident was found to be bounded by analysis previously conducted for the Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983) of an aircraft crash into a nuclear weapon staging facility.

In the unlikely event that contamination does occur from a nuclear incident at the Pantex Plant, the Price Anderson Act (42 United States Code 2014-2210, § 170 of the Atomic Energy Act) creates a comprehensive system to allow compensation for third party claims.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.28) FOLLOWS.

Document #: *1003* **Comment #:** *1* **Date:** *1/12/93*

Thomas A. Griffy

Univ. of Texas, Austin, Dept. of Physics

Comment:

The decision to significantly increase the amount of plutonium stored at this facility is an important one and the environmental impacts of this decision need to be carefully assessed. Unfortunately one cannot judge from the document provided whether or not this has been done.

The report provided creates the impression of providing a detailed analysis (often quoting results to three significant figures!) while at the same time withholding some of the essential data on which those calculations are based. The public is therefore presented with what appear to be detailed calculations, on the basis of which well-informed judgements might be reached, when in fact this is not the case.

There may be valid security concerns which preclude including such information as the dimensions of the structures in which the plutonium is stored or the amount of plutonium contained in each pit. If so, two reasonable options are available:

1) present only the results of the analysis (i.e. trust me!) or

2) present the details of the calculation in a classified document which could be reviewed by individuals having the appropriate clearances.

The report as it stands appears to be a full and open discussion of the problem when in fact it is not.

Document #: *1022* **Comment #:** *7* **Date:** *2/11/93*

James Thomas

Hanford Education Action League (HEAL)

Comment:

p. 6-4 -- DOE has failed to provide the public with sufficient information to assess the Department's safety analysis. DOE has refused to make available to the public the most recent version of the Pantex Safety Analysis Report.

Document #: *1042* **Comment #:** *14* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

Final Safety Analysis Report, Pantex Plant Zone 4 Magazines, the basic document describing the anticipated exposures has not been made available to the public. Prior to the issuance of the final EA, or a draft EIS, the SAR must be publicly available. Any national security aspects can be segregated in a classified appendix.

Response #: G.28

The details of the calculations summarized in the Environmental Assessment and the data on which they are based are formed in the Final Safety Analysis Report, Pantex Plant Zone 4 Magazines (Issue D, April 1993). This document was made available to the public (in Amarillo area Department of Energy reading rooms) and to State officials in April 1993.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.29) FOLLOWS.

Document #: *1013* **Comment #:** *1* **Date:** *2/15/93*

Margie K. Hazlett (2)
Citizen Comments

Comment:
I previously forwarded to you my comments concerning plutonium storage at Pantex Plant. I understood that these comments were due in the near future. One thing that has not been available is the Texas Department of Health's publication, Environmental Monitoring Annual Report for 1990-1991. Any review or assessment should be postponed until such time when this report is completed, printed, distributed and ample time for reading it, so that a knowledgeable assessment can be made. A complete assessment is of utmost importance, as it will affect the Texas Panhandle citizens for generations.

Response #: G.29

While the issuance of the Texas Department of Health Report is not under control of the Department of Energy, monitoring data for the Pantex Plant are available in the Annual Environmental Report for the Pantex Plant. The latest report, for the Calendar Year 1991, was issued in January 1993.

Document #: *1050* **Comment #:** *1* **Date:** *3/22/93*

Senator Teel Bivins (Dist 31)
The Senate of the State of Texas

Comment:

This letter is to commend you and your staff on the process you have implemented regarding the Department of Energy's Predecisional Environmental Assessment for Interim Storage of Plutonium Components at the Pantex Nuclear Weapons Facility in Amarillo, Texas. As the Texas Panhandle's state senator, I'm sensitive to the issues you face as you deliberate the future of our nuclear weapons complex, including Pantex. My constituents have the most to gain economically and lose environmentally from Pantex. To proceed with any DOE plans for Pantex, it's important for citizens of that area, and the officials who represent them, to have a high degree of confidence that DOE activities will be conducted in a safe, environmentally sound fashion.

In the past, the public has been unable to have this kind of trust in DOE activities. I'm delighted to see the new administration is operating in an open, cooperative manner. This new openness is reflected in the approach your department took regarding the interim plutonium storage issue at Pantex. You invited comments not only from state agencies but also from other interested parties. To give everyone an opportunity to comment fully on the issue, you extended the deadline for comments not once, but twice, when requested by the state. The January 1993 briefing by top DOE staff for state officials and other parties on the interim storage issue was very informative and exhibited the new constructive dialogue encouraged by the department which is welcomed by the state. Finally, DOE's offer to respond to all comments before proceeding with the plans, although the department is not required to do so, build on the improved relationship between DOE and the state.

I respectfully encourage you to continue this healthy dialogue after DOE responds to the state's comments on the interim storage issue. Agreeing to sit down and discuss differences, with the goal of resolving them, will ensure that the interests of both DOE and the state are protected. Further, this dialogue would serve to resolve outstanding issues in an expeditious manner and avoid a long, drawn-out "paper exchange." Although this dialogue may conclude with differences of opinion on some small issues, I'm confident that an accord can be achieved on the "big picture" items which will allow DOE to proceed after taking the comments into account. I would appreciate being involved in these meetings and will pledge my assistance and support to the process.

Response #: G.30

The Department of Energy is aware of the role that both citizens and officials of the State of Texas have in safe and environmentally responsible conduct of operations at the Pantex Plant. The Department of Energy is committed to continuing the dialogue established with the State and is establishing a citizen advisory board for the Pantex Plant.

Document #: *1048* **Comment #:** *25* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

8.0 All issues should have been discussed openly with federal, state and local agencies with local citizen input. To only have kept the state agencies informed of the development of the document undermines the integrity of the work of the state agencies.

Response #: G.31

The National Environmental Policy Act process followed in developing the draft Environmental Assessment for Interim Storage of Plutonium Components at the Pantex Plant has taken into account input from Federal, State and local agencies. In addition, comments from local citizens and other interested parties and groups have been reviewed and responded to in this document. Forty-six letters with a total of 423 comments were addressed.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.32) FOLLOWS.

Document #: *1007* **Comment #:** *1* **Date:** *2/25/93*

Joseph A. Martillotti

Texas Dept. of Health, Bureau of Radiation Control

Comment:

Page 3-1, Lines 29-32: It is noted that assembled weapons and components will continue to be staged in a number of the SAC magazines. The proposed action does little to diminish the potential threat to public health and safety and the environment from these items.

Document #: *1007* **Comment #:** *11* **Date:** *2/25/93*

Joseph A. Martillotti

Texas Dept. of Health, Bureau of Radiation Control

Comment:

Page 6-5, Paragraph 6.2.5: The Aircraft Hazard Analysis is purported to be conservative in nature, but much effort has been expended to reduce the calculated probability of an occurrence from unlikely to extremely unlikely. The stated purpose of this document was to determine environmental impacts, if any, from storing more pits in an igloo than before. At issue is the fact that the maximum amount of plutonium permitted per Modified-Richmond magazine has not increased, while the maximum number of igloos containing only plutonium pits will increase. The amount of plutonium proposed for storage in the SAC magazines is consistent with the previous limit on the Modified-Richmond magazines. There is also a corresponding decrease in the number of igloos available to stage weapon assemblies and other nuclear explosive components, which remain the most serious threat from Zone 4 activities. These igloos, in addition to some specific Zone 12 facilities, continue to present the most serious potential off-site consequences if involved in an initiating event.

Response #: G.32

The Department of Energy continues to believe that the low risks associated with weapon staging are acceptable and bounded by current analyses, specifically the Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983). The aircraft hazard analysis is considered conservative in that it uses the air traffic data from the earlier analyses, even though the available information indicates that the total air traffic in the vicinity has declined. Some changes were made in assumptions (e.g., reduction of crash rates and skid areas, dropping of single-engine aircraft) to reflect the current thinking in regard to such modeling.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.33) FOLLOWS.

Document #: *1012* **Comment #:** *6* **Date:** *1/16/93*

Margie K. Hazlett (1)
Citizen Comments

Comment:
The reason which stands out above the others listed is that we would prefer to live the only life God gave us in a peaceful, healthful atmosphere. The plutonium storage in the Panhandle of Texas will envolve (sic) too much - we saw some of the people who have terrible diseases because of plutonium and different types of cancers. We want to protect this generation and healthy generations to come.

Document #: *1015* **Comment #:** *1* **Date:** *2/20/93*

Addis Charless, Jr.
Panhandle Area Neighbors and Landowners (PANAL)

Comment:
Pg. 1-1: The statement that PX has conducted its activities in a safe and responsible manner belies the facts of elevated cancer rates of downwinders and retired PX personnel, ...

Document #: *1035* **Comment #:** *9* **Date:** *2/19/93*

Karen Son
Citizen Comments

Comment:
There are several severe environmental polluters that I believe are causing extremely high percentages of cancer and immune system diseases.

#1. Hoechst Celanese - Pampa, Texas
- *a. has polluted the air & water for 40 years*
- *b. even our creek in our parks in Pampa*
- *c. 4 million pounds of benzene dumped on us every year; plus many other chemicals (toxic)*

#2. Phillips Petroleum Plant - Borger, Texas (I have no statistics on this plant, but I assume it is as bad or worse than H. Celanese in Pampa (sic) -> Could very well be contaminating Lake Meredith (the Panhandle's water supply).

Document #: *1035* **Comment #:** *10* **Date:** *2/19/93*

Karen Son
Citizen Comments

Comment:
#3 Pantex - Amarillo
- *a. Pantex has kept important environmental facts from the public.*

Response #: G.33

Regarding health effects attributable to the Pantex Plant operations, a Texas Department of Health letter dated April 7, 1992, to Mrs. Jeri Osborne of Panhandle, Texas, states: "Based on cancer incidence data (for the years 1980-1990), no significant excess of cancer exists in the southwest quadrant of Carson County. This finding parallels a previous analysis, which showed the total cancer mortality of Carson County to be lower than what would be expected based on the cancer mortality experience of the entire state of Texas. ... Finally, the chances of a person developing cancer as a result of exposure to an environmental contaminant are slight. ..." This letter substantiates earlier data presented in the Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983) that indicate no measurable increase in cancer mortality rates due to Pantex Plant operations. Therefore, it appears that Pantex Plant operations impose no measurable addition to cancer mortality in the Panhandle area.

The Department of Energy cannot comment regarding the health affects from the activities and operations of Hoechst Celanese and the Phillips Petroleum Plant cited in Ms. Son's letter.

No environmental facts have been kept from the public. Documents such as the Site Annual Environmental Report are made available to the public and open meetings such as the Environmental Monitoring Council are held regularly.

Document #: *1036* **Comment #:** *1* **Date:** *3/1/93*

Arjun Makhijani, Ph.D.

Institute for Energy & Environmental Research

Comment:

I. General Comments (bolded) - The stated purpose of the proposed action in the EA "is to provide interim storage of pits removed from nuclear weapons in response to the President's nuclear weapons reduction initiative." (p. 2-1) The proposed action would expand the capacity for storage of pits from the current 6,800 (p. 3-1) to 20,000 or more pits. The EA claims that there is considerable urgency in implementing this expansion because the DOE may have to cease disassembly activities "as early as the fourth quarter of 1993" if the proposed action is not implemented (p.2-1).

The EA does not provide the information required to independently verify the claim of urgency or the overall goal for expansion of capacity that DOE seeks under the proposed action. Two items are at issue:

First, the EA does not provide any figure for the actual number of pits in storage as of December 1992. There is only a chart for "projected" storage capacity requirements (p. 2-2) that starts in the fourth quarter of 1992 in the range of about 3,500 to about 3,800 pits. The EA does not state whether this is an actual figure or was a projection for 1992 based on an assumed disassembly rate of 2,000 weapons per year. The projected date when current storage capacity may run out must be based on actual figures for pits currently in storage. Second, information must also be provided on how the disassembly figure of 2,000 weapons per year was arrived at, and how it might vary, in light of past rates of dismantlement and assembly combined.

Document #: *1045* **Comment #:** *3* **Date:** *3/22/93*

Beverly Gattis

Serious Texans Against Nuclear Dumping (STAND)

Comment:

2) The draft EA does not present realistic time frames for when current storage capacity will be reached, yet timing is portrayed as urgent.

a) The draft EA could, but does not, present sufficient information about the number of pits already cumulated at Pantex so that an accurate starting inventory can be established. Information from other DOE sources (see attached document 1: U.S DOE Pantex Plant Nuclear Weapons Disassembly History FT 1980 thru FY 1992) indicate the actual dismantlement resulting in pits potentially remaining at Pantex are: FY 1990 - 1151; FY 1991 - 1595; FY 1992 - 1303.

b) There is insufficient information provided in the draft EA to substantiate any of the statements about when capacity would be reached, such as, "Capacity, at currently projected dismantlement schedules could be reached as early as 4th calendar quarter of 1993." (p. 3-1)

Since 1990, the highest annual rate of disassembly, for either retirement or evaluation, appears never to have exceeded 1757. (see attached document 1) Historical records seem to indicate the DOE's goal of maintaining a disassembly rate of 2,000 weapons per year may be overly ambitious.

Clearly the actual rate of dismantlement is variable, and should be, since different weapons systems have different requirements, etc. More importantly, the primary consideration of the Plant must be worker and operational safety.

In order to establish a better basis for planning, free of exaggerated time constraints, the establishment of both a clear starting point and an achievable rate of dismantlement is necessary, and offers no threat to national security. Indeed, it enhances safety by supporting informed decision-making which is not driven unnecessarily by a false sense of urgency.

Response #: G.34

The Environmental Assessment states that the proposed action will result in "...An increase in the number of pits stored, up to (emphasis added) 20,000;" The projected capacity requirement is based on the assumed disassembly rate of 2,000 weapons per year. This rate of disassembly is required to achieve nuclear weapon reduction goals established in international treaties and agreements. More information on the purpose and need for the Environmental Assessment can be found in Response B.1 (National Environmental Policy Act Issues) and Response C.1 (Alternatives).

Figure 2.1 of the Environmental Assessment presents the actual data for the starting pit inventory at the Pantex Plant. As of November 1, 1993, the total number of pits stored at the Pantex Plant is approximately 5,200. Based on this figure, it is expected that storage capacity will likely be reached in the first quarter of 1994.

Document #: *1045* **Comment #:** *9* **Date:** *3/22/93*

Beverly Gattis

Serious Texans Against Nuclear Dumping (STAND)

Comment:

8) As a public process (made possible at this point only by the efforts of the state of Texas) which will produce a public document, it is important that there is some definition of terms.

a) Both NEPA and DOE use certain words and phrases with a particular intent. For example, an "environmental" impact as defined by NEPA is very broad, encompassing far more than the usual implication of the word. For the DOE, there are numerous terms such as "DOE orders" or "safeguards and security" which have a consistent definition for DOE which should be clarified for the general reader.

The draft EA offers listings of Acronyms (p. iv) and Abbreviations - Units and Measures (p. vi). To enhance the public understanding of what is actually being said, a listing and clarification of terminology should be added as well.

b) In addition, the EA must be careful not to confuse issues by using a similar set of words which could give one impression but which could just as easily refer to something else.

For instance, "the DOE Orders and procedures for ensuring safe and secure storage of the pits would continue to be followed rigorously." (p. 3-1) One standard term for DOE is "safeguards and security," referring to the control of the material rather than safety in a health sense. "Safe and secure" leaves a reader in some doubt as to exactly what the DOE is "rigorously" committed to by that statement.

Response #: G.35

The words "safe and secure" were used in the broader sense than the words "safeguards and security," which has a more limited application. The Safeguards and Security program for the Pantex Plant is specifically designed to prevent loss, theft, or diversion of materials; to protect classified information; and to protect against damage theft, loss, or other harm to government property. The safeguards and security function includes: physical security, material control and accountability, and emergency preparedness. While Department of Energy Orders which require implementation of the Safeguards and Security program will be rigorously followed, there are other equally stringent orders within the Department which call out Occupational Safety and Health and Environmental protection requirements. These requirements are also rigorously followed.

The Department's definition of terms throughout the Environmental Assessment is consistent with that of Federal, State and local laws. The Final Environmental Impact Statement, Pantex Plant Site (DOE/EIS-0098, October 1983) contains a full glossary of terms as does the Environmental Assessment.

The Department of Energy Orders are self-implemented mandatory guidelines.

Document #: *1032* **Comment #:** *9* **Date:** *2/19/93*

Betty E. Barnard
Citizen comments

Comment:
Though this is a letter drafted by STAND of which I am a member, it expresses my concerns as you may know, worker contract negotiations are in progress (health issues & insurance as main concern). There is much at stake, and much could go wrong.

Response #: G.36

While this issue is outside the scope of the National Environmental Policy Act Environmental Assessment process, it should be noted that the work force labor negotiations referred to in the comment between Mason & Hanger (the Management and Operating contractor of the Pantex Plant) and the Metal Trades Council, Amarillo Chapter are complete.

Document #: *1009* **Comment #:** *1* **Date:** *2/22/93*

Tom Millwee, Chief

Texas Dept. of Public Safety, Div. of Emergency Management,

Comment:

While the statistical probabilities may conclude that there is no increased risk to the local population as a direct result of the increased storage of plutonium pits, the public perception of increased risk must be considered in addressing this issue.

Pantex has not had a public information program in effect to educate and prepare the population on the hazards posed by a radiological release. DOE is now preparing to tell the local population that an increase in the number of plutonium pits stored in zone 4 igloos will pose no additional risk to the local populace. Unless a public information program is in place, the result may be public hysteria. The increased level of plutonium storage must be accompanied by a comprehensive public information program that will withstand public and political scrutiny. We remain unconvinced that the public will believe that an increased storage level of plutonium pits will not cause additional risk.

Document #: *1019* **Comment #:** *7* **Date:** *1/20/93*

W. H. O'Brien

Operation Commonsense

Comment:

We want first and foremost to assure that the risks to the community are acceptable. The dangers that have been brought to many communities by the weapons plants have been clearly established, and it is only reasonable that we consider that history in our own assessment of this operation. The community's confidence in assurances of safety can only be confirmed with independent monitoring and the willing acceptance by DOE of applicable laws of our land. We must all be comfortable that a supervisory structure is in place that will provide technical oversight as well as community liason (sic). A clear delineation of this need will require a cooperative effort involving DOE, the State, and our community.

Document #: *1021* **Comment #:** *2* **Date:** *1/25/93*

Lawrence D. Egbert, MD

Physicians For Social Responsibility

Comment:

We are planning to store 84,000 pounds of a deadly poison which will remain deadly for thousands of years. While Pu is stored at Pantex, it should be very visible and under close scrutiny by Federal Government officials, Texas officials, and local Amarillo and neighboring county officials as well as concerned citizens. Personally, I would hope the Governor would really stress citizen involvement.

Document #: *1021* **Comment #:** *12* **Date:** *1/25/93*

Lawrence D. Egbert, MD

Physicians For Social Responsibility

Comment:

This same DOE has supported legislation to relax environmental protection laws governing the removal of toxic wastes. Change the words and the problem goes away. The same DOE has stifled research and whistle-blowing among employees. Secretary Watkins has said he "never got his arms around" the problems at DOE. DOE now plans for some oversight by outside organizations, the Department of Health and Human Services and the Department of Health for the State of Texas, for example, which sounds great but the DOE is not accustomed to outside scrutiny so this should be spelled out very carefully. In their text it is not spelled out at all.

Document #: *1025* **Comment #:** *1* **Date:** *2/16/93*

William and Mary Klingensmith

Citizen Comments

Comment:

As residents of Amarillo, Texas, we are deeply concerned about the activities at the DOE Pantex Plant near our city. To have bombs assembled there was at best very worrisome but to have a massive disassembly of these bombs and the storage of the highly toxic plutonium plus other fissionable material seems intolerable. We are most anxious that the activities at Pantex be examined and monitored and that the storage of plutonium be especially studied. Proper environment studies are crucial and the plant should be open to outside expert inspection.

Does the Panhandle want the title of Plutonium Storage for the western world? Just how much is known about the storage, how long can it be stored here and why can't this whole subject be opened to public scrutiny?

Response #: G.37

There are numerous agencies which provide technical oversight of Department operations. Internally, several offices such as the Office of Environment, Safety and Health, Office of Security Affairs, Inspector General, and others provide assessment of the safety operations to the Secretary independent of Defense Programs.

External to the Department, several agencies routinely evaluate safety of the Pantex Plant such as the Defense Nuclear Facilities Safety Board and the General Accounting Office, which both report to Congress. The Defense Nuclear Facilities Safety Board maintains a staff member at the Pantex Plant during normal working hours.

The State of Texas has several agencies (including the Texas Water Commission, the Texas Department of Health, Bureau of Radiation Control, and the Texas Air Control Board) that routinely access and observe operations at the Pantex Plant and have access to Department management and documents.

To include the local governments and citizens, an extensive outreach program has been instituted at the Pantex Plant. Examples of programs that provide public access to information and the ability to express concerns are:

- General plant briefings are regularly provided to elected officials, civic, fraternal, and educational groups throughout the region. Specially organized briefings and tours for elected and/or appointed officials are conducted as frequently as needs arise. General public tours and plant briefings are conducted twice daily each Wednesday. The Department of Energy, Amarillo Area Office and plant management hold open dialogue public meetings four times per year.

- Two Department of Energy Public Reading Rooms are in full operation with a goal of making all unclassified documents pertaining to the Pantex Plant available to the public.

- Environmental Restoration/Waste Management Five-Year Plan public meetings are conducted twice yearly, and the Pantex Plant Environmental Restoration activity update public meetings are held at least four times a year. An Environmental Restoration Public Information Coordinating Group, composed of eleven area citizens with a broad spectrum of backgrounds, was organized to serve as an information link between the Pantex Plant and the public.

- A Citizens' Advisory Group is in the process of being developed for the Pantex Plant. This group will be funded by the Department of Energy and will focus on environmental restoration and waste management, environemental monitoring, and public/worker safety and health issues.

The motto, "Safety First," is integral to operations at the Pantex Plant. Secretarial safety policy emphasizes this as a guiding principle. Numerous oversight elements, including those responsible for programmatic operations at the Pantex Plant, are committed to ensure that safety to the environment, worker, and public is maintained.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.38) FOLLOWS.

Document #: *1010* **Comment #:** *9* **Date:** *2/8/93*

Walt Kelley

City of Amarillo, Emergency Management

Comment:

These comments are submitted with the intent to obtain additional information to enhance our planning efforts. I see no reason why DOE should not be allowed to increase the amount of plutonium at the plant as long as:

The data used to prepare the assessment is validated by the State agencies that are part of the AIP.

DOE continues to include local government in all phases of emergency planning.

State and Local agency inspections continue.

Response #: G.38

The Department of Energy expects to continue its participation in the Agreement-in-Principle. Furthermore, the Department will continue to involve and cooperate with State and local agencies in emergency planning and inspection activities.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.39) FOLLOWS.

Document #: *1035* **Comment #:** *12* **Date:** *2/19/93*

Karen Son

Citizen Comments

Comment:

#3 Pantex - Amarillo ...

c. stores plutonium which may be emitting harmful or deadly radiation into our air and water - which may also be contaminating the $5 billion of agricultural produce which affects the whole nation.

Document #: *1048* **Comment #:** *26* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

DOE says they are committed to the environment, safety and health of workers and surrounding communities! Why push to dismantle warheads and expose the population to health and death risks?

Response #: G.39

The Environmental Assessment evaluates the proposed action of interim storage of plutonium pits and addresses protection of the environment. The Department does not expect any releases that would contaminate the agricultural products or water resources of the area. However, if such an incident were to occur, emergency management plans are in place to minimize the effects on the public and environment.

Document #: *1036* **Comment #:** *4* **Date:** *3/1/93*

Arjun Makhijani, Ph.D.

Institute for Energy & Environmental Research

Comment:

The EA also makes the inappropriate comment that plutonium pits from warheads that are no longer needed in the U.S. arsenal are "valuable national assets." (p. 2-1) Such a conclusion prejudges a possible decision in the Reconfiguration of PEIS that the surplus plutonium is a waste, due to the security and environmental threats it poses. Due consideration must be given to the proliferation implications of any decision to treat it as an asset in the United States, since that would result in reinforcing corresponding decisions in the former Soviet Union, other nuclear weapons powers, and aspiring nuclear weapons powers.

Document #: *1041* **Comment #:** *6* **Date:** *3/12/93*

Beverly Gattis

Military Production Network

Comment:

4) The predecisional EA inappropriately refers to plutonium components from retired warheads as "valuable national assets." (p. 2-1)

The decision whether to treat plutonium from retired warheads as an asset or a waste is critical to plans for its long-term storage and disposition. This decision should be arrived at through an open process with ample opportunity for meaningful public participation. DOE should not -- in this EA or any other document -- presuppose this important national policy decision.

Document #: *1048* **Comment #:** *7* **Date:** *2/28/93*

Doris & Phillip Smith

Panhandle Area Neighbors and Landowners (PANAL)

Comment:

Justification needs to be made as to why they are referred to as national assets and not liabilities? To presume "assets" and not to address liabilities is in appropriate (sic).

Response #: G.40

Pits are described in the Environmental Assessment as "valuable national assets" based on their expense of production. The Department is continuing to study the question of the future of plutonium and other special nuclear material. Other groups outside of the Department of Energy, such as the Office of Technology Assessment and the National Academy of Sciences, are also studying the issues surrounding the future of plutonium reserves. Until the results of these studies are thoroughly reviewed and understood, the description of pits as "valuable national assets" is a fair characterization. This current description in no way prejudices any future characterization based on updated analyses.

In regard to the disposition of plutonium, on September 27, 1993, the President established an interagency task force to determine the disposition of plutonium surplus to national defense requirements. This task is being led by the National Security Council and the Office of Science and Technology Policy.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.41) FOLLOWS.

Document #: *1014* **Comment #:** *1* **Date:** *1/15/93*

Sam Day, Director
Nukewatch

Comment:

Paradoxically, Nukewatch's goal of educating the public about nuclear dangers would best be served by the Department of Energy's proposal to store 20,000 or more nuclear weapon plutonium pits at Pantex. The concentration of so much destructive and deadly material in one place would facilitate our job, especially in the Amarillo area, of educating the public about the local impact of nuclear weapons production. Such an outcome would help us in our work of making Amarillans (sic) and other Texans more aware of the use to which their soil is being put in the manufacture and storage of weapons of mass destruction.

We believe, however, that6 (sic) the public interest would be better served by taking an alternative step more likely to lead from storage to destruction of plutonium residues of the nuclear weapons now earmarked for disassembly. Rather than store the plutonium pits at Pantex, where they could readily be used later for new nuclear 8weapons (sic) or for plutonium-based breeder reactors, it would be better to store them at the Savannah River Plant, where facilities now exist for vitrification of the plutonium in a way which makes recovery of the plutonium virtually impossible.

We strongly suggest as part of this proposal that plutonium storage capacity not be increased anywhere and that plutonium reprocessing/vitrification capacity be expeditiously enhanced at the Savannah River Plant or some other appropriate site so that non-retrievable disposal of the plutonium can keep pace with retirement of the weapons. Thus, we can "lock in" the results of current and future SALT agreements and nuclear disarmament accords.

When ratified by the U.S. Senate, SALT and other nuclear weapons reduction treaties will constitute a clear mandate to destroy nuclear weapons, not to hold their key elements--the plutonium pits--in indefinite "interim storage" for possible later reassembly into nuclear weapons. Any storage proposal which fails to provide for simultaneous non-retrievable disposal appears to border on negation of the START agreements.

Document #: *1021* **Comment #:** *16* **Date:** *1/25/93*

Lawrence D. Egbert, MD
Physicians For Social Responsibility

Comment:

Let me repeat that research on the disposal and security of Pu and Pu pits should have been under way for decades. This problem is chronic and is not going to go away. Therefore, we should slow the DOE down and demand more thorough preparations and research before doing anything. I know that this will leave us with bombs sitting in their silos but, if the State of Texas can make these silos public and keep the Pu pits in the minds of alert citizens, we will have performed a real service for all the world. Keep in mind that storing these pits at Pantex permits the Government to restart making bombs again before anyone had time to wonder why trucks were carrying Pu pits back to Texas again.

Response #: G.41

This comment is outside the scope of this Environmental Assessment. The Department is continuing to study the question of the future of plutonium and other special nuclear material, as discussed in Response #: G.40.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.42) FOLLOWS ON PAGE G-49.

Document #: *1010* **Comment #:** *8* **Date:** *2/8/93*

Walt Kelley

City of Amarillo, Emergency Management

Comment:
(At a minimum, the following areas should be covered in the study or unclassified supporting documents:)
Possibility of terrorist of (sic) actions involving an aircraft.

Document #: *1015* **Comment #:** *19* **Date:** *2/20/93*

Addis Charless, Jr.

Panhandle Area Neighbors and Landowners (PANAL)

Comment:
If so large a number of pits is to be stored at PX, does that fact not make PX a prime target for terrorists bent on having Pu at any cost?

Document #: *1016* **Comment #:** *21* **Date:** *2/16/93*

Jeri Osborne

Citizen Comments

Comment:
Appendix A-1 does not mention a possible terrorist or high priority military attact (sic). With the storage of Pu, manufacturing of HE, and capability of assembling weapons, would not Pantex be a prime site for these events?

Document #: *1017* **Comment #:** *10* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:
Missiles -- How about guided missiles from enemy forces or from terrorists? It appears to me that 20,000 pits would make the storage area a very high priority target.

Document #: *1017* **Comment #:** *14* **Date:** *2/15/93*

Jim Osborne

Citizen Comments

Comment:
C 1.2 - SAC Magazines -- What if a terrorist dropped an explosive such as a grenade down the ventilation pipe?

Document #: *1019* **Comment #:** *5* **Date:** *1/20/93*

W. H. O'Brien

Operation Commonsense

Comment:
The risk assessment analysis also appears to have overlooked the most likely danger, that of an attack on the arsenal by an enemy or terrorist.

Document #: *1021* **Comment #:** *7* **Date:** *1/25/93*

Lawrence D. Egbert, MD

Physicians For Social Responsibility

Comment:
DOE writes that radiation exposure of workers will be controlled as currently done with procedures and monitioring to insure DOE present standards are maintained so therefore no adverse health effects among workers should be expected. In their search for the possibility of accidents, they mention aircraft crashes, forklift accidents, earthquakes, tornadoes and missiles, all of which are listed as requiring quantitative analysis. There is no mention of a psychotic terrorist or a thief wishing to sell Pu to the Japanese.

Document #: *1021* **Comment #:** *15* **Date:** *1/25/93*

Lawrence D. Egbert, MD
Physicians For Social Responsibility

Comment:

There is no mention of security, yet Pantex has had security problems in the past. What are their plans to prevent a terrorist attack? Or a thief who wishes to steal a Pu pit? I am sure the black market would have good prices for Pu pits.

Document #: *1024* **Comment #:** *3* **Date:** *3/10/93*

Jay R. Roselius, County Judge
Carson County

Comment:

... request that authorities from these different agencies be assembled together in their area of expertise and address and formulate the best possible response to the following areas which seem to me to be the areas of most concern when considering all of the various comments...

3. The question of sabotage/terrorist attack on a bunker/magazine or other strategic location. This could cause a release that would make an environmental impact.

Response #: G.42

The Department of Energy recognizes the terrorist threat and has planned accordingly. It is Departmental policy not to address this issue in Environmental Assessments so that security of the plant is not compromised.

STAKEHOLDER COMMENTS TO ENVIRONMENTAL ASSESSMENT. DEPARTMENT OF ENERGY RESPONSE (G.43) FOLLOWS.

Document #: *1042* **Comment #:** *42* **Date:** *3/12/93*

Beverly Gattis

Save Texas Agriculture and Resources (STAR)

Comment:

9. Pages 3-3 to 3-8. All the figures are deficient for several reasons:

- no scale is given

- the containers are not specified (AL-R8 or others)

- the figures are inconsistent with the narrative. For example, Figure 3-6 shows the bounding single-layer configuration in the SAC magazines is 420 containers, whereas page 3-1, footnote 2 says maximum packed capacity is 406 pits. Figure 3.2 shows 336 pits as the "operationally preferred" configuration for Modified-Richmond magazines, whereas page 3-1 says that storage would increase from existing 378 pits to 440 pits. In contrast Figure 3.5 shows 378 pits as the "bounding" configuration.

Clearly, either the figures are wrong, the text is wrong, or both are wrong. In any case, the discrepancies must be resolved and explained.

Response #: G.43

Information on figure scales can be found in the Final Safety Analysis Report, Pantex Plant Zone 4 Magazines (Issue D, April 1993). The figures in the referenced section of the Environmental Assessment are included as a visual aid and are not engineering specifications.

Section 3.0 of the Environmental Assessment states that "The majority of the pits in Zone 4 will continue to be packaged in AL-R8 containers ... but other approved containers such as Type B containers may be used." This statement specifies the types of container to be used in the proposed action and therefore it did not appear necessary to specify it in the referenced figures.

On the third point, Figure 3.6 of the Environmental Assessment shows the bounding single layer configuration of 406 containers, which is consistent with the maximum packed capacity mentioned in the second footnote of Section 3.0. Figure 3.2 shows 336 pits as the operationally preferred configuration for vertical single-layer storage; whereas Section 3.0 explains that the maximum or bounding limits would increase from 378 pits (bounding vertical single-layer storage configuration) to 440 in the horizontal palletized multiple stacking configuration. Table G-1 clarifies these issues.

While fewer pits are typically stored in the magazines than the stated bounding vertical single-layer configuration, these values bound the Final Safety Analysis Report, Pantex Plant Zone 4 Magazines (Issue D, April 1993) and the Environmental Assessment and therefore are a valid depiction of the maximum changes expected as a result of the proposed action. The Operationally Preferred vertical single-layer configuration is provided to illustrate typical configurations used in Zone 4. (For additional information on storage configurations, refer to Response D.23.)

Table G.1 - Pit Storage Capacity

Magazine Type	No-Action Alternative (vertical single-layer configuration)		Proposed Action* (vertical single-layer configuration)		Proposed Action* (horizontal palletized multiple stacking configuration)
	Operationally preferred	"bounding" configuration	Operationally preferred	"bounding" configuration	
Modified-Richmond	336	378	336	378	440
Steel Arch Construction	Not in use for pit staging or storage		384	406 (will not be considered for use)	392

* No-Action storage configurations may also be used during interim storage activity (either during transition to horizontal palletized multiple stacking configuration or as necessary) since the No-Action configurations are bounded within the current Safety Analysis Report analyses

SECTION H - SUMMARY

Comments from the Defense Nuclear Facilities Safety Board

On October 1, 1993, the Board stated concerns regarding the lack of uniform approach within the Department of Energy in analyzing aircraft crash probabilities. In a letter to the Department, specific issues were cited with the Zone 4 aircraft crash analysis, including accident probabilities, aircraft impact analytical methodology, consequence analysis, and documentation adequacy. Department of Energy representatives met with the Board staff to discuss these concerns on two occasions. On October 26, 1993, the Department prepared a formal response to the Board letter of October 1, 1993. This response contains a summary of the meetings information presented to support the Zone 4 aircraft crash analysis. In addition, a position paper was prepared to address the consequence of plutonium dispersal from a fire resulting from an aircraft crash into a Zone 4 magazine. On October 29, 1993, the Board concluded that the results shown in the Environmental Assessment Report and the Final Safety Analysis Report for the Pantex Plant Zone 4 do meet the Nuclear Regulatory Commission assessment criteria for evaluating aircraft hazards. The Department must yet resolve issues related to basic data, aircraft impact analytical methodology, analysis of consequences, and analysis documentation in connection with documentation of the safety analysis for Zone 4.

This section contains the studies and correspondence relating to the Board reviews, in chronological order to date.

John T. Conway, Chairman
A.J. Eggenberger, Vice Chairman
John W. Crawford, Jr.
Joseph J. DiNunno
Herbert John Cecil Kouts

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

625 Indiana Avenue, NW, Suite 700, Washington, D.C. 20004
(202) 208-6400

October 1, 1993

The Honorable Victor H. Reis
Assistant Secretary for
Defense Programs
U.S. Department of Energy
Washington, DC 20585

Dear Dr. Reis:

The Defense Nuclear Facilities Safety Board, its staff and outside experts have been reviewing the analyses done to assess aircraft crash accidents for certain DOE Defense Nuclear Facilities. This review has included aircraft crash analyses for the DP-West Facility at the Los Alamos National Laboratory, the Rocky Flats Plant, and Zone 4 at the Pantex Plant. Our review and evaluation indicate that the methodologies employed in these studies are not consistent and vary significantly. Further, the methodologies are not consistent with accepted commercial nuclear industry practices regarding aircraft crash risks. Areas of inconsistencies noted by the Board staff include assessment of the probability of an aircraft crash, aircraft impact analytical methodology, and analysis of consequences of the crash.

The Board believes that such differences in approach to aircraft crash analyses at DOE defense nuclear facilities result from lack of uniform guidance by DOE. Since such guidance is being developed for evaluations of other external hazards, such as seismic and tornado events, the Board believes that the concerns noted above would be addressed if technically appropriate guidance for conducting analyses of aircraft crash accidents were developed by the Department.

The Board is particularly concerned with the accident analyses covering possible aircraft crashes at the Pantex Zone 4 which we have recently reviewed. Our review included the Environmental Assessment Report, the Final Safety Analysis Report (FSAR) and its supporting classified document, and the August 3, 1993 Sandia National Laboratory Report. Additionally, the Board's staff has met with DOE and its contractors on several occasions to discuss details of the accident analyses for Pantex Zone 4. As a result of this review, the Board considers that specific issues exist related to the probability of a crash, the impact analytical methodology, the consequence analysis, and the adequacy of analyses documentation. These issues are discussed in the enclosure to this letter. The Board is aware of DOE's plan for interim storage of increasing amounts of plutonium from disassembled weapons in Modified-Richmond and Steel Arch Construction magazines in Zone 4 at Pantex. Such actions warrant that proper analyses of the aircraft crash hazard be performed and the issues be resolved expeditiously.

Pursuant to 42 U.S.C. § 2286B(d), the Board requests that DOE provide the following reports:

- A report comparing the various approaches used to assess aircraft crash accidents in the DOE complex and evaluating the approaches against industry standards, methodologies, and practices. The report should address the need for development of a guidance document and any other action planned in this area.

- A report evaluating the existing Pantex Zone 4 analyses against the issues of probability of a crash, impact analytical methodology, and consequence analysis discussed in the enclosure. The report should include any planned corrective actions with regard to interim storage of plutonium in the Modified-Richmond and Steel Arch Construction magazines.

The Board requests the above reports be submitted within 60 days of receiving this letter. If you need any further information, please let me know.

Sincerely,

John T. Conway

John T. Conway
Chairman

c: M. Whitaker, Acting DOE/EH-6

Enclosure

DNFSB Issues Regarding the Pantex Zone 4 Aircraft Crash Analysis

1. **Probability of the Accident:**

   a. DOE's analysis has used a criterion according to which a probability of an aircraft crash exceeding 10^{-6} per year would lead to defining this as a credible event. The U.S. Nuclear Regulatory Commission (NRC) requires a more stringent criterion for determining if an aircraft crash is to be considered credible. Specifically, NRC considers the aircraft crash accident to be credible if the probability is greater than 10^{-7} per year. Additionally, if the facility is located less than 10 miles from an airport and the projected annual number of operations at the airport is greater than 500 D^2, the aircraft crash accident is considered by the NRC to be credible. (D is the distance in miles from the airport runway to the facility, see NUREG 0800 Section 3.5.1.6).

   b. A number of other factors affecting the probability of a crash are not routinely considered for the Pantex Zone 4 aircraft crash analyses:

      (1) Back course instrument approaches to runway 22 at the Amarillo International Airport (AMA). These published approaches, that are used for both take-off and landing, result in aircraft flying directly over the Pantex facility. Due to the meteorological conditions at Pantex, this flight path is used for landing about 70 percent of the time, and takeoff about 30 percent of the time.

      (2) Visual Flight Rule (VFR) flights near Pantex.

      (3) Air traffic from nearby private airports.

      (4) Military operations at AMA.

   c. The methodology employed for determining the design basis missile for aircraft crash into a Zone 4 magazine utilizes the concept of subdivision and compartmentalization of aircraft by specific type. For example, if the probability of a crash by a specific aircraft type (large military aircraft, commercial airliner, etc.) was less than 10^{-6} per year, then that component of the aggregate aircraft crash probability was declared incredible, and dismissed from consideration as a source of a possible design basis missile.

2. **Aircraft Impact Analytical Methodology:**

   a. The methodology used for the Zone 4 impact analysis insofar as missile mass, impact velocity and angle, is not consistent with current commercial practice and methodology, such as that found in "Report of the ASCE Committee on

Impact and Impulsive Loads", Vol. V, Civil Engineering and Nuclear Power Specialty Conference, September 1980. Nor is it apparent that the initial conditions and assumptions in the Pantex FSAR impact analysis are conservative. A slight change in the assumptions regarding the impact velocity or the weight of the missile would result in significantly different conclusions regarding penetration of a magazine by the missile generated from the aircraft.

b. DOE recently submitted a revised evaluation of the effects of an aircraft crash on Pantex Zone 4, entitled, "Vulnerability of the Zone 4 Magazines to Impact by General Aviation Single Engine Aircraft." The methodology used in this report for evaluation of the consequences of a missile generated from the event is similar to that discussed in Item 1.c above. The report, utilizing the concept of deaggregation of probability by aircraft type, concludes that generated missiles with sufficient weight, velocity, and angle of attack to collapse a magazine, are incredible. In commercial industry practices, if an accident is credible and considered to be a Design Basis Event (or in DOE Order 5480.23 terminology, "Evaluation Basis Event"), then the controlling parameters such as weight, velocity, and angle of attack are defined using a conservative set of assumptions.

3. **Analysis of Consequences:**

a. The consequences of plutonium dispersal from a fire following an aircraft crash into a storage facility do not appear to envelope the following bounding conditions:

(1) The respirable release fraction used in the analysis for Zone 4 at Pantex does not appear to realistically represent the accident conditions and is not technically justified or supported by test results.

(2) Sandia National Laboratory performed a comparison of the results of their atmospheric dispersion computer program, ERAD, with results from the NRC code, MACCS. Based on this comparison, it appears that the ERAD computer program does not correctly model the fire scenario and significantly underestimates the consequences compared to the results from MACCS analysis.

b. The effect of dispersal of plutonium in particle sizes larger than 10 microns on the population or the environment has not been addressed in the Pantex Zone 4 analysis.

c. The on-site consequences of such an accident have not been evaluated with respect to safety of the workers and other operations at other facilities at Pantex.

d. The consequences of aircraft impact into a Steel Arch Construction magazine at Pantex have not been addressed.

4. Adequacy of Analysis Documentation: The detailed analyses performed by Sandia and Ogden Energy & Environmental Company to support their Zone 4 results and conclusions have not been made available in a form that would support a corroborative review. This is apparently due to the analyses and documentation not being developed in accordance with quality assurance requirements, such as DOE Order 5700.6C, *Quality Assurance*, including proper development of documents and records, with independent review.

Department of Energy
Washington, DC 20585

October 26, 1993

Honorable John T. Conway
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, N.W.
Suite 700
Washington, D.C. 20004

Your October 1, 1993, letter regarding Defense Nuclear Facilities Safety Board staff review of analyses to assess aircraft crash accidents for certain DOE facilities raises specific issues about Zone 4 at the Pantex Plant. We have met with Board staff on two occasions regarding the Pantex issues.

On October 8, 1993, the discussion focused on aircraft accident probabilities and the issues raised regarding the application of Nuclear Regulatory Commission (NRC) criteria and their implications for design basis accident considerations. Representatives from the NRC attended the meeting and explained how the Standard Review Plans (SRP) for Evaluation of Potential Accidents (2.2.3) and Aircraft Hazards (3.5.1.6) are applied. The NRC staff has provided a summary regarding the application of the SRPs. This summary is provided as an attachment to this letter (Attachment 1). From a reading of the NRC staff summary you will find that our treatment of the aircraft crash analysis is consistent with SRPs, including issues raised regarding the concept of subdivision and compartmentalization. Also at the October 8, 1993 meeting information was provided regarding the frequency and conditions for use of runway 22 at the Amarillo International Airport. This information was based on a letter provided by the Amarillo Air Traffic Control, Federal Aviation Administration (Attachment 2).

The second meeting took place on October 15, 1993. This meeting was dedicated to the technical bases for the respirable release fraction used in the consequence analyses of postulated aircraft crashes into a Zone 4 storage magazine. It should be noted that this analysis was undertaken to follow through on a commitment made to the State of Texas and not for the purpose of design basis considerations. Design basis concerns were considered in terms of aircraft crash probabilities consistent with the NRC criteria previously discussed.

I would appreciate confirmation if the foregoing satisfactorily resolves the issues raised in your October 1, 1993 letter regarding Pantex Zone 4.

Your letter also contains a request for a report comparing the various approaches used to assess aircraft crash accidents in the DOE complex and evaluating the approaches against industry standards, methodologies, and practices. This report will be provided under separate cover.

You also requested that I identify plans for development of a guidance document for airplane accident analysis. In that regard, I have tasked my Deputy Assistant Secretary for Weapons Complex Reconfiguration to incorporate the guidance developed from the preparation of the report into the design criteria manual for reconfiguration of the Weapons Complex. This information will be provided for your review prior to finalization.

Sincerely,

Victor H. Reis
Assistant Secretary
for Defense Programs

Attachments

cc:
M. Whitaker, EH-6

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

October 18, 1993

Victor Stello, Jr.
Principal Deputy Assistant Secretary for Facilities
Department of Energy
1000 Independence Avenue, S. W.
Washington, D.C. 20585

Dear Mr. Stello:

This is in response to your request to provide a brief description and interpretation of the current NRC criteria regarding aircraft hazards. In assessing the risk associated with potential aircraft accidents on nuclear facilities licensed by the NRC, we use the criteria and methodology described in the NRC Standard Review Plan (SRP). Enclosed is a brief characterization of how NRC applies the above review guidance and criteria in assessing aircraft risks with respect to nuclear power plants. We trust that this information will be useful in your consideration of aircraft hazards with respect to DOE nuclear facilities. If we can be of any further assistance, please let us know.

Sincerely,

AC Thadani

Ashok C. Thadani, Director
Division of Systems Safety and Analysis
Office of Nuclear Reactor Regulation

Enclosure: As stated

cc: JTaylor
TMurley
WRussell

NRC ASSESSMENT OF AIRCRAFT HAZARDS

hapter 2.2.3 of the NRC Standard Review Plan (SRP) provides acceptance riteria with respect to potential accidents involving hazardous materials or ctivities in the vicinity of a nuclear power plant. The criteria are in erms of the likelihood of an accident leading to a 10 CFR Part 100 release. hey apply to a number of site hazards, including those posed by aircraft. pecifically, SRP 2.2.3 indicates that the risk posed by an activity in the icinity of a plant is acceptable if the probability of exposures exceeding 0 CFR Part 100 is approximately 10^{-7} per year.

ypically, sufficient data are not available to make a precise estimate of the isk. Lack of data precision is addressed by using conservative estimates. lence, the criterion of 10^{-6} per year is acceptable if reasonable qualitative irguments can be used to show that the realistic probability is lower.

:hapter 2.2.3 also indicates that the above criteria are to be applied to the iggregate probability of an outcome from a particular hazard. This calls for the consideration of the sum total of all hazards posing a particular type of threat to a facility. In the case of aircraft, this pertains to all aircraft activity in the vicinity of a site.

In practice, some initial screening is performed so that aircraft that do not pose a threat to the facility are excluded from the analysis. For example, since all nuclear plants are required to be protected against tornado missile damage, the safety-related plant systems typically are protected, as a minimum, by eighteen inches of reinforced concrete. Hence, most light general aviation aircraft can be screened out from the analysis on design basis considerations. Section II.2 of SRP Chapter 3.5.1.6 refers to General Design Criteria 3 and 4 of 10 CFR Part 50 as an acceptable basis for dismissing specific aircraft from further consideration if it can be shown that the safety related plant systems, structures, and components are capable of withstanding the effects of aircraft fires or impacts, respectively.

The remaining ensemble of aircraft identified with the site (i.e., those that have the potential for causing loss of safe shutdown capability of causing a release of radioactivity in excess of 10 CFR Part 100) are considered in the analysis by estimating the aggregate probability of an on-site crash. In order to simplify the analysis, the staff conservatively assumes that an aircraft impact on safety-related plant structures results in a 10 CFR Part 100 release. If the probability of this is less than about 10^{-6} per year, the aircraft hazard is considered to be acceptable.

If not, there remains the option of extending the analysis to include aircraft impacts and their effects on plant structures and equipment. To do this it is necessary to consider each type of aircraft separately in terms of flight frequency, crash rate statistics, and aircraft size, weight, and flight characteristics (e.g., speed, direction, distance, altitude). Ultimately, however, the contribution from each type of aircraft is summed and the estimated total probability of a 10 CFR Part 100 release is compared with the acceptance criteria in SRP 2.2.3.

SRP 3.5.1.6 provides additional review and evaluation guidance that is specific to aircraft hazards. For example, it describes screening criteria for nearby airports. Also, it gives guidance on evaluating crash probabilities due to air traffic on federal airways, aviation corridors, civilian and military airports, designated airspaces, and holding patterns.

It should be noted that the above staff guidance and criteria have been developed for use in regulatory actions involving nuclear plant license applicants. If the NRC staff were to consider applying different criteria than those discussed above, there is a requirement for a backfit analysis (10 CFR Part 50.59). Specifically, the backfit rule requires that a proposed change a) provide substantial additional protection, and b) be cost-effective.

In addition, the Commission's Safety Goals (particularly the large release guideline of 10^{-6} per reactor year, and the subsidiary objective of limiting core damage frequency to less than 10^{-4} per reactor year) are used to assess if the proposed requirement would provide substantial additional protection to the public health and safety. Since the intent of the Safety Goals is to address societal risks, these guidelines typically are not applied to individual plant actions and are considered to be more suitable for addressing issues involving groups of plants (e.g., a class of plants of a particular design).

ATTACHMENT 2

U.S. Department
of Transportation

Federal Aviation
Administration

Amarillo Air Traffic Control
Rt 3, Box 579
Amarillo, Texas 79107

October 7, 1993

Bret Simpkins
Battelle Pantex
Section Manager
Safety Programs

At the request of Mr. Simpkins, the following are my comments regarding Section 1.b of the Pantex Zone 4 Aircraft Crash Analysis.

1.b (1) Amarillo International Airport does have a Localizer Backcourse Instrument Approach to Runway 22, This approach is used only for landing aircraft and is not intended, or ever used, for departing aircrft. If aircraft are flying the Backcourse Approach to Runway 22, they will fly directly over Pantex restricted to an altitude of 5000MSL until reaching the Amrillo VOR before beginning decent. The Amarillo VOR is outside the Pantex prohibited area.

Using the DOE's assumption that meteorological conditions in the Amarillo area require the use of Runway 22 seventy per cent (70%) of the time in no way reflects that 70% of Amarillo's landing traffic flys over the Pantex Plant. The only time the Backcourse Approach would be used is during actual (IFR) Instrument Flight Rules weather conditions and the winds dictated Runway 22 or practice approaches.

Using the figurrs of the Amarillo Chamber of Commerce that 73 percent of the year is under sunny skies and the conservative figure of Amarillo Tower that 85 percent of year is under (VFR) Visual Flight Rules, you must remember that aircraft landing Runway 22 are not overflying the Pantex prohibited area at all. Most aircraft are flying visually and will turn their base legs within the 7 mile distance between Pantex and the Amarillo Airport.

All aircrft departing Amarillo Airport during the control towers hours of operation (0600 AM - 1200 AM local time), regardless of the runway they depart, are assigned headings to expedite their climb on course. It would be a rare occasion for a departing aircraft to overfly the Pantex prohibited area.

Edward Warren· First American Aloft

Also. please keep in mind that runways 04, 13, and 31 are often used and have no bearing on Pantex what so ever.

1.b(2) All VFR aircraft landing or departing Amarillo are required to be in two-way radio communication with Air Traffic Control. This also includes all overflying VFR aircraft within 10 nautical miles of Amarillo International Airport. If these aircraft are not aware of the Pantex prohibited area, Air Traffic Control will provide vectors around the area or ensure their altitude is above 4800 MSL.

1.b(3) Nearby private airports include Panhandle Airport, Stampa Field (crop dusters) and Eagle Airport (gliders).

1.b(4) See attached.

C. Ross Schulke

C. Ross Schulke
Air Traffic Manager
DOT/FAA
Amarillo Air Traffic Control Tower
Amarillo, Texas

TABLE 4 • FISCAL YEAR 1992

AIRPORT OPERATIONS AT AIRPORTS WITH FAA-OPERATED TRAFFIC CONTROL TOWERS BY REGION AND BY STATE AND AVIATION CATEGORY-CONTINUED

State and Location Name	Location Identifier	Hub	Total	Air Carrier	Air Taxi	General Aviation	Military
TENNESSEE—Continued							
MEMPHIS INTERNATIONAL	(MEM)	M					
ITINERANT OPERATIONS			343908	185449	114130	38905	5425
LOCAL OPERATIONS			950			718	131
TOTAL OPERATIONS			344858	185449	114130	39494	5556
NASHVILLE METROPOLITAN	(BNA)	M					
ITINERANT OPERATIONS			301733	132715	102921	59618	8481
LOCAL OPERATIONS			297			278	22
TOTAL OPERATIONS			302030	132715	102921	59891	8503
STATE TOTAL TENNESSEE							
ITINERANT OPERATIONS			900621	332940	274186	260637	32956
LOCAL OPERATIONS			62516			54893	7625
TOTAL OPERATIONS			963139	332946	274186	315830	40678
TEXAS							
ABILENE	(ABI)	N					
ITINERANT OPERATIONS			34460	107	14107	32681	7365
LOCAL OPERATIONS			46010			24471	10530
TOTAL OPERATIONS			80470	107	14107	57162	17904
AMARILLO	(AMA)	S					
ITINERANT OPERATIONS			49635	12199	8754	21130	7042
LOCAL OPERATIONS			39788			9878	29960
TOTAL OPERATIONS			89423	12199	8754	31008	37002
AUSTIN	(AUS)	S					
ITINERANT OPERATIONS			178785	83827	18030	69648	8282
LOCAL OPERATIONS			8011			7770	241
TOTAL OPERATIONS			186796	83827	18030	77418	8523
BEAUMONT PORT ARTHUR	(BPT)	N					
ITINERANT OPERATIONS			32795	0	16706	15653	436
LOCAL OPERATIONS			16839			16366	473
TOTAL OPERATIONS			49634	0	16706	32019	909
BROWNSVILLE INTERNATIONAL	(BRO)	N					
ITINERANT OPERATIONS			35550	1081	1215	31761	1493
LOCAL OPERATIONS			27594			23562	4032
TOTAL OPERATIONS			63144	1081	1215	55313	5525
COLLEGE STATION	(CLL)	N					
ITINERANT OPERATIONS			49585	29	14371	27068	4116
LOCAL OPERATIONS			14785			9950	4835
TOTAL OPERATIONS			64370	29	14371	37018	8951
CORPUS CHRISTI	(CRP)	S					
ITINERANT OPERATIONS			80107	14841	13148	38174	13938
LOCAL OPERATIONS			60690			24861	36834
TOTAL OPERATIONS			140797	14841	13148	61035	51773
DALLAS ADDISON	(ADS)	L					
ITINERANT OPERATIONS			163709	0	364	163280	65
LOCAL OPERATIONS			12323			12318	5
TOTAL OPERATIONS			176032	0	364	175598	70
DALLAS LOVE FIELD	(DAL)	L					
ITINERANT OPERATIONS			212045	89174	24110	97404	1357
LOCAL OPERATIONS			4			4	0
TOTAL OPERATIONS			212049	89174	24110	97408	1357
DALLAS REDBIRD	(RBD)	L					
ITINERANT OPERATIONS			92388	0	77	91847	464
LOCAL OPERATIONS			91929			91445	484
TOTAL OPERATIONS			184317	0	77	153292	948
DALLAS/FT WORTH INTERNATL	(DFW)	L					
ITINERANT OPERATIONS			763372	571200	175338	15793	961
LOCAL OPERATIONS			0			0	0
TOTAL OPERATIONS			763372	571200	175338	15793	961
EL PASO INTERNATIONAL	(ELP)	M					
ITINERANT OPERATIONS			127022	56926	4319	62098	3679
LOCAL OPERATIONS			32688			30030	2658
TOTAL OPERATIONS			159710	56926	4319	92128	6337
FORT WORTH MEACHAM	(FTW)	L					
ITINERANT OPERATIONS			165370	353	626	163615	574
LOCAL OPERATIONS			159842			159702	140
TOTAL OPERATIONS			325212	353	626	323317	714
FT WORTH/ALLIANCE	(AFW)	L					
ITINERANT OPERATIONS			56789	744	52	55213	771
LOCAL OPERATIONS			87205			86842	1363
TOTAL OPERATIONS			146065	744	52	148055	2134
HARLINGEN INDUSTRIAL AP	(HRL)	N					
ITINERANT OPERATIONS			37401	13505	4340	16772	2784
LOCAL OPERATIONS			18329			12933	5395
TOTAL OPERATIONS			55730	13505	4340	29705	8120

AIRCRAFT OPERATIONS SUMMARY

AMARILLO INTERNATIONAL AIRPORT

January, 1993

	1988	1989	1990	1991	1992	% Change 1991-92
CIVILIAN						
Itinerant	21,646	21,410	20,173	19,052	20,477	7.5%
Local	9,122	5,211	7,349	9,387	8,657	-7.8%
Subtotal	30,768	26,621	27,522	28,439	29,134	2.4%
Scheduled Air Carrier	15,247	13,339	13,174	12,126	12,334	1.7%
Air Taxi	2,652	3,799	5,177	6,662	9,005	35.2%
TOTAL CIVILIAN	48,667	43,759	45,873	47,227	50,473	6.9%
MILITARY						
Itinerant	9,023	8,390	7,913	7,305	6,999	-4.2%
Local	28,761	31,958	31,529	29,432	31,517	7.1%
TOTAL MILITARY	37,784	40,348	39,442	36,737	38,516	4.8%
TOTAL ALL OPERATIONS	86,451	84,107	85,315	83,964	88,989	6.0%

INSTRUMENT APPROACHES - IFR CONDITIONS

	1988	1989	1990	1991	1992	% Change 1991-92
CIVILIAN						
Civil	377	526	683	672	603	-10.3%
Scheduled Air Carrier	551	651	629	674	559	-17.1%
Air Taxi	179	263	419	417	464	11.3%
TOTAL CIVILIAN	1,107	1,440	1,731	1,763	1,626	-7.8%
MILITARY	208	310	270	358	430	20.1%
TOTAL INSTRUMENT APPROACHES. . .	1,315	1,750	2,001	2,121	2,056	-3.1%

INSTRUMENT OPERATIONS*

	1988	1989	1990	1991	1992	% Change 1991-92
Primary(to/from AMA)	47,831	49,051	49,593	50,619	51,861	2.5%
Secondary(other airports)	3,543	2,995	3,310	3,410	2,992	-12.3%
TOTAL INSTRUMENT APPROACHES. . .	51,374	52,046	52,903	54,029	54,853	1.5%

*Civilian and military combined

OTHER RADAR OPERATIONS

	1988	1989	1990	1991	1992	% Change 1991-92
IFR Overflights controlled by Amarillo Approach Control. . . .	2,748	3,169	3,776	4,049	3,803	-6.1%
Stage III VFR Operations by aircraft arriving/departing AMA.	16,696	12,364	14,079	14,937	17,070	14.3%
Stage III VFR Operations of aircraft operating to/from secondary airports or overflying AMA	17,752	18,055	15,019	14,398	14,018	-2.6%
TOTAL OTHER RADAR OPERATIONS . . .	37,194	33,588	34,604	33,384	34,891	4.5%
TOTAL RADAR OPERATIONS HANDLED BY AMA APPROACH CONTROL.	88,568	85,643	91,283	87,413	91,800	5.0%

SOURCE: FAA Control Tower, Traffic Activity Report, FAA Form 7230#-1

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

625 Indiana Avenue, NW, Suite 700, Washington, D.C. 20004
(202) 208-6400

October 29, 1993

The Honorable Victor H. Reis
Assistant Secretary for Defense Programs
Department of Energy
Washington, DC 20585

Dear Dr. Reis:

The Board has reviewed your letter of October 26, 1993, which discusses assessment of aircraft accidents at the Pantex Plant. The information provided in your transmittal also includes attachments from the Nuclear Regulatory Commission (NRC) and the Federal Aviation Administration (FAA).

Based on the above, the Board has concluded that the results shown in the Environmental Assessment Report and the Final Safety Analyses Report (FSAR) for the Pantex Plant Zone 4 do meet the NRC assessment criteria for evaluating aircraft hazards. The issue of compatibility with NRC probability criteria was detailed in the enclosure to our October 1, 1993, letter to you. The Board's staff will continue to discuss the remaining sections of the enclosure with your staff. These sections are related to basic data, aircraft impact analytical methodology, analysis of consequences, and analysis documentation in connection with documentation of the safety analysis for Zone 4. Additionally, the Board awaits the report concerning the generic evaluation and assessment of aircraft crash accidents.

If you have any questions on these matters, please call me.

Sincerely,

John T. Conway
Chairman

c: Mark Whitaker, Acting EH-6

November 3, 1993

"Airborne Release Fraction (ARF) and Respirable Fraction (RF) as a Result of a Fire Following Impact of Aircraft into Storage Igloo at Pantex Facility"

by

Jofu Mishima, SAIC-Richland
Bob Luna, Sandia National Laboratory
Doug Stephens, Lawrence Livermore National Laboratory

The amount of material suspended as a result of an accident is dependent upon the physicochemical properties and the physical configuration of the material impacted, the type and level of stress imposed, the responses of materials involved, and the aerodynamic flow that carries the suspended materials aloft. For safety analyses, this information is provided by the postulated accident scenarios, the engineering analysis/assumptions that describes the abnormal environments and material responses and, dictates the choice of the applicable ARF (total airborne release) and RF (fraction of airborne material in the respirable size range*) for the stresses imposed. Under accident conditions where the metal is not closely surrounded by detonating High Explosives, very little metal is suspended from surfaces of relatively large pieces (subsect. 4.2.1.1.1, Mishima July 1993). Conversion to an oxide will generate and release particulate materials from metals.

For the specific scenario under consideration, it is postulated that an aircraft impacts a storage igloo in the Pantex Zone 4 area. Engineering analysis indicates that the roof of the Modified-Richmond type igloo containing the largest number of Pu components could fail by collapse of some of the 1-ft thick, reinforced concrete panels overlaid with 3-ft of soil that has weathered in place for years. The estimated damage to the contained materials from this scenario exceeds that estimated for the penetration of the Steel Arch Construction igloos. It is assumed that the crush-impact of the debris from the roof failure and penetration of some parts of the aircraft (e.g. engine spools) damages some fraction of containers releasing the "pits" and damaging the pit cladding sufficiently to expose the metal underneath to the post-accident environment. The debris from the limited roof collapse would bury much of the material that is at floor level. (The presence of large amounts of dust generated by the collapse would tend to increase the agglomeration of airborne particles present and increase the removal by gravitational settling as occurred in operation Roller Coaster.)

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*Respirable fraction - commonly defined as all particles 10 micrometer or less Aerodynamic Equivalent Diameter [a sphere with a density of 1 g/cm^3 that has the same aerodynamic characteristics (same terminal velocity) as the particle].

Since the "pits" are balls of heavy metal, they would have a tendency to fall to the lowest level that would support/hold the mass. Whether any of the "pits" can be split by the impact of the edge of a container or other debris is dubious but, the interaction with an engine spool might shred the package and pit cladding to expose/damage the Pu shape. If such is assumed, some pieces of metal may be suspended on debris above the floor level. In either case, stripping of the cladding or tearing of Pu metal, only the surfaces of large pieces of Pu metal would be exposed to the post-impact accident generated conditions.

The remnants of the igloo would provide at least partial confinement that would contain the debris; although, the doors of the igloo would not be water-tight and liquid could leak via openings around the doors and the air vents at floor level on either side of the doors. The aircraft fuel released by the impact would most likely spread over a large area, but for this scenario is assumed to collect at the floor level of the igloo and be ignited. A substantial amount of scattered fuel could form a "fire ball" (an explosive, rapid burning of vaporized/aerosolized fuel) but the fire would be above the igloo. Fireball overpressures are unlikely to enhance damage to the packages or "pits" caused by the impact. Such a "fire ball" would have little impact upon the suspension of plutonium since little if any finely divided Pu or PuO_2 is present at this time. Any loss of containment prior to the fire would result in the formation of oxide on the exposed surfaces of the metal.

The fuel would burn above the debris surface and radiate heat to the fuel to evaporate the fuel required to sustain combustion. The temperature of the debris including the Pu would vary from the boiling point of the fuel at the lower end of the range to temperatures appropriate to the radiation from the fuel-rich hydrocarbon fuel combustion at the upper end of the range. The atmosphere within the damaged igloo structure would be fuel-rich, oxygen depleted (concentration of $>13\%$ oxygen are required for flaming combustion) and oxidation would be limited by the oxygen availability. Pu is such an efficient oxygen-getter that reducing conditions would only produce substoichiometric Pu oxides. Materials covered by the debris would be shielded from the radiant heat and insulated by the air pockets formed by the debris. Therefore, much of the Pu would be exposed to temperatures less than those experienced in fires free-burning hydrocarbon fuel.

The metal suspended in the flames and exposed to the radiant heat would oxidize at an accelerated rate with the increase in temperature and, if the large pieces with surface to mass ratios greater than 10 cm^2/g attain a temperature of $>500^\circ$ C for the entire metal mass, the metal could achieve self-sustaining oxidation (Stakebake June 1992). Experiments involving ignition and self-sustained oxidation for large pieces of plutonium showed that pieces heated in flowing air or in contact with substantial metal surfaces (glovebox floor) could not be heated to achieve self-sustained oxidation even with a welding torch (Felt 1967). Metal heated to self-sustained oxidation formed oxide coats on their exterior surfaces (except the surface in contact with the insulating material) that periodically split to allow flow of molten metal (Felt 1967). For one experiment reported by Stewart (1960) in the Vixen A Trials where plutonium metal rods were suspended in a chimney above a petroleum fire, only 44% of the metal was oxidized during a 30-minute fire indicating that even under these conditions the plutonium metal did not achieve self-sustained oxidation. However, in a second Vixen A experiment, Stewart (1960) reported 100% oxidation for 200-grams of Pu suspended in a 50-minute fire under controlled temperature increase conditions. The material suspended above the surface in flowing air would only oxidize at accelerated rates while being heated and, since oxidation of substantial pieces could take hours, the suspended metal may not be completely oxidized in the 40-min fire duration postulated for the scenario. (The mass of Pu in "pits" is in kilograms.) Thus, assuming self-sustained oxidation that assures complete oxidation of the metal is a conservative assumption.

Mechanisms for conversion of plutonium into powder form prior to the loss of containment (such as minor breaches in the cladding) do not appear to be capable of generating any significant quantity of powder. Any small quantities of such powder present initially would most likely be buried under debris or fuel and not be available for suspension at the surface until very late in the fire. The gas flow in the igloo remnants would be primarily due to the mass flux of fuel vapors (the igloo remnants form a vessel to contain the fuel and debris) and, are less in the latter stages of the fire when greater quantities of oxide are present. Furthermore, oxides formed by the high temperature oxidation of plutonium metal are relatively coarse - see Figure 3 "Size Distributions Produced by Oxidation of Metallic Plutonium" (Mishima December 1965, attached). The ordinate is *Particle Size in Equivalent Spheres (Geometric Diameter)* for the residues collected from high temperature oxidation measured by sieve. The oxide was friable and, therefore, sieving may have caused addition size reduction by abrasion. The only measured value at 3 micrometers in the figure (approximately equivalent to 10 micrometers AED) is approximately <0.001 Wt/o of the initial mass. Although the respirable fraction implied by Stewart's proposal is twice the value suggested here (~0.1%), the distribution is for residues, not aerosolized material. There are many additional factors that reduce the fraction of <3 micrometer particles being suspended.

In the opinion of the authors and others knowledgeable on the airborne release of plutonium under various accident conditions, the airborne release of 5E-4 fraction (0.05%) of the mass of plutonium metal exposed as particles in the respirable size fraction (10 micrometers Aerodynamic Equivalent Diameter or less)(designated the Respirable Release Fraction, RRF) is a technically supportable, conservative RRF for the case of Pu release during a fire resulting from the impact of an aircraft into storage igloos at Pantex for the following reasons:

A. based on a review of ARF and RF values proposed by the authors who developed the values performed for a tri-lab "delphi" estimate of the airborne release of plutonium from weapons components involved in various types of severe accidents including

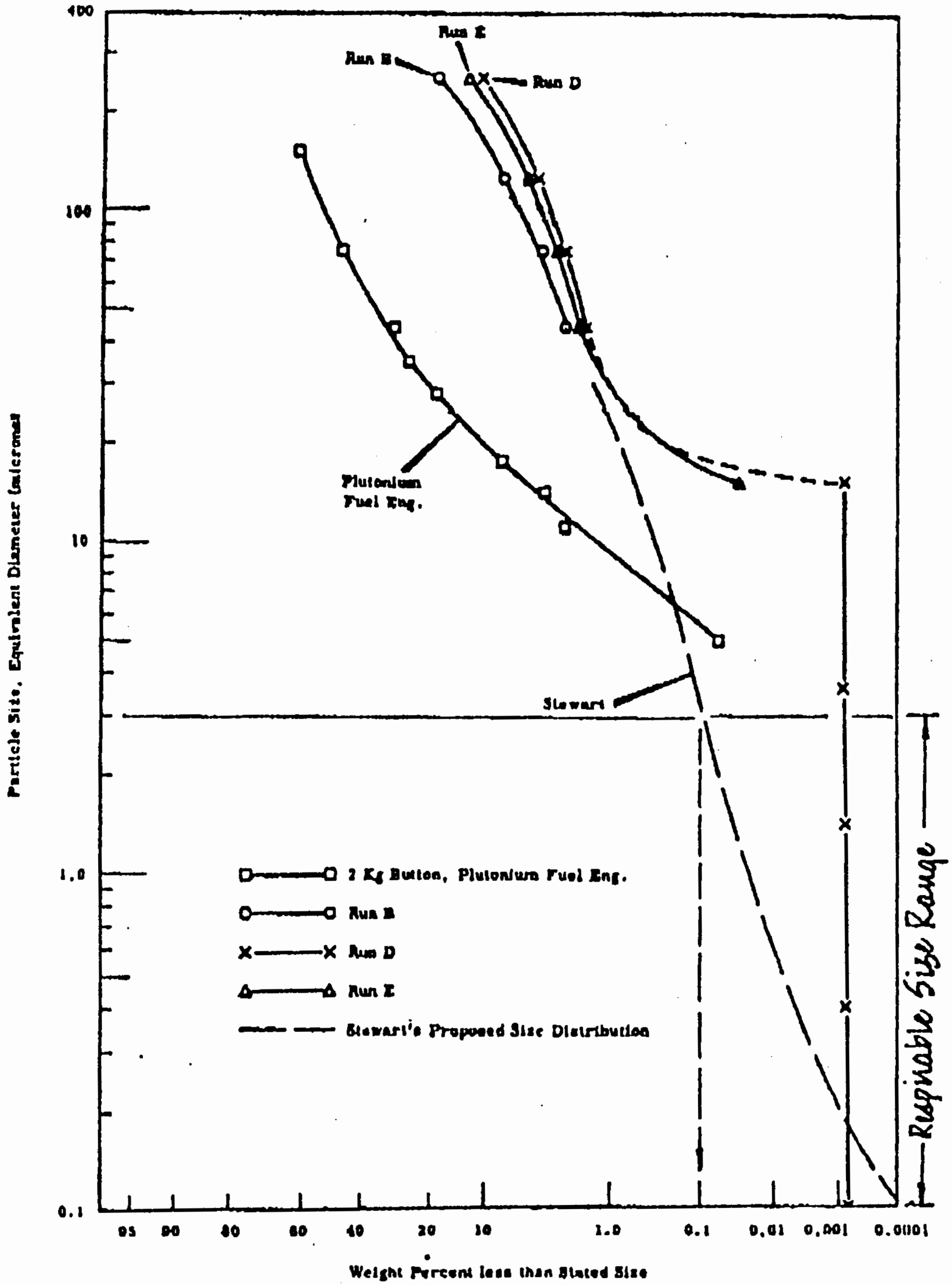

FIGURE 3

Size Distributions Produced by Oxidation of Metallic Plutonium

4

aircraft impacts, a RRF of 5E-4 is appropriate (Stephens 1993) and is the same as currently recommended by the French (Ballereau 1987).

B. a RRF of 5E 4 envelopes the respirable size fraction release derived by a reevaluation the 2 Vixen "A" Trials performed by R.E Luna (1993) based upon the published data for airborne material samples taken downwind of the source and considering the normal atmospheric transport conditions. The metal was not completely oxidized in one of the two events (30-minute fire at ~1000° C). Based on the total mass of materials exposed, the ARF/RF for the two tests were 1E-2/0.02 (RRF 2E-4) and 3E-2/0.008 (RRF 2.4E-4) during 30- and 50-minute fires. The enhanced flow and test configuration favorable to suspension relative to most laboratory test arrangements (oxidizing metal suspended in a chimney over a petroleum fire) appears to have suspended a substantial fraction of larger particles that deposited a short distance from the source. Based on the RRFs from these experiments, the RRF applied in these analyses is conservative.

C. the RRF used in these analysis is equal to the bounding Airborne Release Fraction, 5E-4, shown by Mishima (DRAFT July 1993) to bound all published experimental measurements of the airborne release during self-sustained oxidation, natural convection. The RF associated with the ARF is 0.5 and yields a RRF of 2.5E-4 that is the essentially the same as the two values in B above for the respirable airborne release fraction from the large scale outdoor tests by Stewart (1959). The data cited includes experimental measurements of ARF and RF during the self-sustained oxidation of plutonium metal pieces ranging in mass from 500 to 1700 grams (exceeds the mass used in other experimental study by up to a factor of ~100). Therefore, the RRF used for the scenario is conservative.

D. the value exceeds the Respirable Fraction for high temperature oxidation estimated by Haschke (Table III, July 1992). The data actually presented in the table is in Geometric Diameter (the linear dimensions of the particle) and must be multiplied by the square root of the density of the oxide (11.5 g/cm^3) to approximate the Aerodynamic Equivalent Diameter. Thus, the values listed in the table for 3.0 micrometer particles (4.6 X 10^{-5} cumulative mass fraction) are equivalent to the Respirable Fraction. Using an untested, unvalidated fragmentation model, Haschke estimated that a cumulative mass fraction of 0.25% could be generated by the oxidation. Suspension of 10% of the particle generated by aerodynamic stress is difficult under most circumstances and Haschke's data in Table III indicates the suspension of ~2% of the respirable particles that could be formed.

In a telecom with John Haschke, 10/18/93, he supported use of the RRF of 5E-4 for the situation described. His concerns about the data uncertainties expressed in the document prompted the development of the fragmentation model and his concerns lessened by the results of the calculations.

Based upon the above scenario, no other release mechanism appear tenable. Concerns of the possible flow of molten metal and the formation of droplets that fall over great distances do not appear realistic based upon the observations indicating the lack of molten metal during the Vixen "A" Trials - an experimental configuration that appears to exceed the fire environment that is postulated for the igloo fire event.

In conclusion, the most significant point is that the RRF applied by DOE in the Zone 4 analyses exceeds both the bounding RRF for all the experimental measurements during self sustained oxidation, natural convection and the RRFs measured from the Vixen A Trials. The value applied is very conservative for a number of reasons:

* the difficulty of damaging the pits clad in stainless steel and held in various packages to expose the metal.

* the difficulty in obtaining the conditions to achieve self-sustained oxidation in large pieces (both intense heat must be applied to heat the entire metal to >400° C and the unheated surface must be insulated to prevent significant heat loss). Metal standing in pools of fuel would be cooled by the evaporation of fuel.

* due to its mass, the metal would require substantial support to be held in a flame and would probably not achieve self-sustained oxidation as shown in one of the Vixen A Trials.

If any of these conditions are not fulfilled, the airborne release would be substantially less and be limited to the fraction of metal oxidized.

Notwithstanding the special problems with sample collection and interpretation, the data from the Vixen A Trials are the only measurements from a large scale outdoors release of Pu under conditions that equal or exceeds those expected for aircraft impacts. The results reflect the "real world" without the special scaling concerns that may be present in some experimental configurations. That the RRF applied agrees within a factor of two with the value derived from both types of experimental results gives added confidence in its use.

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SANDIA NATIONAL LABORATORIES
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date: December 11, 1992

to: David E. Rosson, Jr
DOE/AL/WMOSD

from: R. E. Smith 0333

subject: Plutonium Dispersal Consequence Analysis of Hypothetical Aircraft Crash into Pantex Zone 4

This memo provides an unclassified version of the final results of the consequence analysis of the Pantex Plant Zone 4 magazines. The results are expressed in terms of peak dose at the site boundary and offsite and latent cancer fatalities (LCF) from the site boundary to both 16 and 80 km. The results should be considered as upper-bound estimates. A discussion of pit storage scenarios, consequence methodology, Pu release scenarios, and final results is given here. Also presented in this memo is a discussion of the preliminary analysis, as submitted to DOE in October 1992 [1]. This memo supersedes Reference 1.

1. Storage Scenarios

A conservative approach was taken to model the consequences arising from a potential aircraft crash into a Zone 4 magazine. Two magazine designs are present in Zone 4: the Modified Richmond (MR) and the Steel Arch Construction (SAC). A generic type of large (commercial or military) or high performance (military) aircraft was assumed to impact a magazine, collapse or penetrate the structure, and cause significant damage to the contents. No attempt was made to further discriminate between the types of aircraft that could impact a magazine. This is conservative and consistent with the aircraft crash probability estimate generated in Appendix F of the Safety Analysis Report (SAR) [2]. Although any magazine may potentially be penetrated or collapsed by an aircraft impact, the amount of plutonium (Pu) release depends on the contents in the magazine.

1.1 Inventory

To bound the various types of scenarios that could result from an aircraft crash event, bounding case scenarios were considered. These considered a pit storage magazine that is penetrated, a fraction of the containers is breached, and a fuel fire involving the exposed Pu ensues.

The cases that involve pit storage are estimated conservatively as a function of impact dynamics. The conservative approach inherent in these scenarios is discussed in Section 1.2.

1.2 Worst-Case Plutonium Dispersal Source Term for Pit Storage

Several analyses have been performed to assess the credibility of various aircraft types penetrating the MR and SAC magazines [4 - 8]. These analyses and engineering judgments of the analysts associated with the Pantex Zone 4 SAR were significant in developing the rationale given in this section.

The basic scenario for this discussion is a hypothetical aircraft crash into one of the magazines. Severe magazine damage and resulting fire are hypothesized. The fire is caused by the fuel on board the aircraft. The progression of this scenario ultimately results in the exposure of Pu to the fuel fire and the production of aerosols that then could be carried offsite by the wind.

Parameters that effect the consequence source terms are:

Pit: ruggedness of design, heat resistance, amount of Pu

Container: resistance to breaching by impact, crush, puncture, or fire

Storage Configuration: location and number of items, stacking arrangement, intervening materials, existence of sandbagged components

Magazine: design, size, structural strength, earth overburden

Site Layout: magazine spacing, orientation

Scenario Parameters: specifics associated with the scenario.

Scenario specific parameters are:

Aircraft: type, size, weight, fuel load, accident rate, frontal surface area, location, and size of engines

Flights: frequency, location

Crash: impact point, angle, speed, orientation

Pilot: target avoidance.

The scenario specific parameters and the site layout parameters are the dominant parameters used in evaluating crashes into a magazine. The SAR contains a detailed analysis of the frequency of crashes into magazines. The starting point was the penetration of a magazine. The pit, container, storage configuration, magazine, and aircraft parameters all influenced release quantities.

Crash scenarios have been grouped into six bounding cases as a function of magazine type and penetration location and are identified below:

Magazine Type: SAC or MR

Magazine Penetration Location: front doors, roof, sides or back.

Penetration of the front doors and the roof of both the MR and SAC magazines is assessed to be credible for some of the larger and faster commercial carriers and some types of military aircraft. The worst-case release scenario for the SAC magazine was assessed to be penetration of the front doors; for the MR magazine, it was assessed to be penetration of the roof. Penetration of the sides or back of either magazine type is not considered credible because they are protected by massive amounts of earth overburden and concrete walls.

1.2.1 Aircraft Crash into Front of Magazines. An aircraft crash into the front of a SAC or MR magazine could result in the large concrete block security barriers being shoved into the doors. This could either shear the entire front wall around the magazine perimeter or cause the magazine doors to collapse. The resultant debris from the walls, doors, concrete blocks, the aircraft, and possible collapsed roof could then impact the contents in the magazine. Since spilled aircraft fuel is likely to cause a fire in a crash of this severity, it is conservatively assumed that a fire will occur. Whether or not the fire involves the interior of the magazine is a significant consideration; in this analysis, it is assumed that it does.

If a pit container is damaged and the fire is of sufficient duration, the Pu metal can ultimately be aerosolized and released to the environment in a fire plume. Therefore, it is conservatively assumed that Pu release will occur when a pit storage container is damaged and exposed to fire. If a container is undamaged, thermal tests indicate it will maintain its fire resistance for a minimum of 30 minutes. Based on the thermal tests, it was estimated that at least 40 minutes is required for eventual combustion and atmospheric release of the Pu.

The likelihood of a fire lasting 40 minutes or longer is assessed to be less likely than the likelihood of a short duration fire by an order of magnitude [9]. Note that the SAR assessed the likelihood of any aircraft crash penetrating the magazine as less than one-in-a-million per year. Since this fire-only container damage scenario is an order of magnitude less likely, it is clearly not credible and is not further assessed. For this study, damage of the pit storage containers and fire was the only scenario considered to result in a Pu release. Given pit storage container damage and fire involving combustion of Pu, the amount of Pu released in aerosol form would be small and the respirable amount would be even smaller. These values are given in Section 4.

1.2.1.1 Structural Analysis of the MR Magazine. Structural consideration of the MR magazine indicates that in an aircraft impact on the front of the MR, the mid-wall would be displaced and the roof sections adjacent to the front of the magazine would collapse when the front wall fails [4]. This would result in significant additional debris from the one-foot thick concrete roof and a minimum of three feet of dirt overburden falling onto the stacked containers. The likelihood that any damaged container would be exposed to the resultant aircraft fire is reduced by this type of roof collapse. For this analysis, this scenario is not further assessed since direct impact into the roof is assessed as a more serious scenario.

1.2.1.2 Structural Analysis of the SAC Magazine. It is assumed that the SAC magazine roof will not collapse from a front wall crash. In this assumption, a larger number of damaged containers are exposed to fire. An estimate is made of the number of containers that could be damaged when debris is pushed into the stacked containers. The containers have significant resistance to impact. They have been tested to survive ground transportation criteria associated with the shipment of radioactive materials and have a demonstrated design capability to survive impact into a flat hard surface at 30 feet per second.

While the containers are resistant to impact, it does not follow that they have significant resistance to penetration, especially resistance to sharp massive puncture probes. The test sequence, however, does indicate some resistance. It is important to consider that the stacking and storage array of the containers also provides a yielding and energy-absorbing configuration.

These factors, along with the energy-absorbing characteristics of the debris and the reduced velocity of the aircraft crash due to moving the concrete blocks and collapsing the front wall, indicate that it is unlikely that many of the containers would be damaged enough to lose container integrity. It is estimated that 5% to 50% of the containers would be damaged. For this analysis, 50% damage will be used. Next, we assume that a fire occurs (80% to 90% estimate). Additional likelihoods for whether the container is exposed to the fire, how close it is to the fire, and how long the fire lasts must be considered for eventual combustion of Pu. A detailed analysis of these parameters is not available. An estimate of 50% is used for their likelihood of occurrence. Thus, an overall bounding estimate of 25% (50% damaged containers x 50% sufficiently exposed to fire) is obtained for the percentage of stored pits that contribute to a release of Pu aerosols resulting from an aircraft crash into a SAC magazine.

1.2.2 Aircraft Crash into Roofs of Magazines. The other credible magazine penetration point is through the roof. Although the roof has at least three feet of earth overburden, it still has the least amount of overburden when compared to the sides and back of the magazine. Several analyses have been conducted to predict impact velocity thresholds for collapse and puncture of both the SAC and MR magazines for different aircraft types [4 - 8]. These analyses form the basis for determining the worst-case consequence scenario.

1.2.2.1 Roofs of the MR Magazines. The MR magazines are vulnerable to collapse of large roof sections due to mass loading from the aircraft. The roof is also vulnerable to puncture from larger aircraft engines. Puncture scenarios are not expected to expose many containers in the magazine to a fire severe enough to cause a release of Pu aerosols into the environment, since the damage would likely be more localized than a more massive collapse of large roof sections.

For the MR magazine, it was determined that the worst-case consequence scenario results from the collapse of several roof sections. A large aircraft could potentially cause collapse of half of the roof on one side of the magazine [4]. Collapse would result in debris from the one-foot thick concrete roof, from the three-foot-thick (or more) dirt overburden, and from the aircraft and cargo falling onto the stacked containers. This debris could damage the containers. As many as 50% of the containers in that half of the magazine are directly below the collapsed structure and are at risk. The containers, however, have significant resistance to impact and the stacking and storage array further provides a yielding and energy-absorbing environment. From these considerations, an estimate for container loss of integrity is taken to be from 20% to 70%. For this analysis, the 70% estimate was used.

Assume a fire occurs (100% versus 80% to 90% estimate). If a fire does occur, fire duration, view factors of the damaged containers to the fire, container damage, and pit resistance to the fire all reduce the likelihood of a Pu aerosol release. An estimate for the percentage of exposed pits that contribute to an aerosol release, assuming damaged containers and a fire, is 10% to 70%. The value of 70% was used for this analysis.

From this presentation, an overall bounding estimate of 25% of the containers in one side of the MR magazine is used for the percentage of pits that contribute to a Pu aerosol release. The 25% is determined by the following formula: 50% of the containers are at risk x 70% of the containers are damaged x 70% of the damaged containers are exposed to the fire. The fire occurs 100% of the time.

1.2.2.2 Roofs of the SAC Magazines. For the SAC magazines, the worst case roof penetration scenario is similar to the MR roof collapse scenario except that the corrugated metal roof would likely result in less irregularly shaped roof debris and less opportunity for puncture of the pit containers. If the conservative assumption is made that the SAC results are the same as the MR results, 25% of the stored pits can be estimated to contribute to the Pu aerosol release. This value is the same as that obtained for a crash into the front of the SAC magazine.

2. Consequence Methodology

This section describes the methodology used to estimate the maximum Pu-caused health affects on the population surrounding the Pantex Plant resulting from a postulated aircraft crash into Zone 4. Assessments are given for a release of Pu aerosol into the environment from the burning of nuclear weapon pits. Sections 3 and 4 give a more detailed description of scenario input parameters and assumptions.

2.1 Cloud Generation and Transport Model

ERAD is a three-dimensional numerical simulation of atmospheric dispersion from high explosive detonations [10]. An integral method for estimating plume rise is used to provide a description of the physical and thermodynamic properties of the cloud of warm gases formed when the explosive detonates. Particle dispersion is treated as a stochastic process that is simulated using a discrete time Lagrangian Monte Carlo method.

Version 3.0 of ERAD [10] was used to simulate the cloud formation and aerosol transport phases for this analysis. One of the ERAD outputs is the time-integrated, airborne concentrations of the respirable size particulate reported in the physical units of microgram-seconds per cubic meter. Estimates of an averaged value of this parameter are provided in a user-defined rectangular coordinate grid system. The positive x axis is the downwind direction during cloud passage. The number of grid points used for this analysis was 40 in the crosswind direction and 40 in the downwind direction.

The boundaries for the grid were determined by executing the ERAD code using estimated extreme values for the boundaries to ensure capture of the 0.1 rem values. A simple screening code was written to examine the ERAD output and the minimum and maximum grid values were reassigned as necessary. The screening code also provided diagnostics if the original grid did not capture the 0.1 rem values. The ERAD code was then executed again using the new minimum and maximum grid boundaries. In all cases, the maximum downwind distance was set at 80 km. This downwind distance relates to the methods described in Reference 11.

2.2 Pantex Meteorological Data

Fourteen sets of meteorological data were generated for the Pantex site to represent conditions that range from very unstable to very stable. Each meteorological condition has an associated frequency of occurrence and a set of 36 downwind directional frequencies based on observed data. Each directional frequency covers a ten-degree segment of the total 360 degrees possible.

2.3 Population Data

The 1990 Census Bureau population data was used in this analysis. Urban population cells (with at least 25,000 persons) as well as rural cells were used. The rural cells were assigned radii of 1.0 km to model small communities.

2.4 Health Effects

A FORTRAN computer code, PROCON, was written to convert the grid of ERAD calculated values of time-integrated Pu concentrations from mass units to 50-year, whole-body inhaled doses. The doses were assumed to be constant for each cell in the rectangular grid and were integrated with population data to obtain estimates in terms of person-rem. The integration routine was written to be independent of cell width, cell length, and population cell radius.

To estimate the health effects for the pit storage scenarios described in Section 3, fourteen meteorological conditions representing stable to unstable conditions were used with ERAD to produce 14 grid maps containing time-integrated airborne concentrations or doses.

For each grid map, downwind centerline peak dose curves were generated and weighted by the frequency of occurrence of each meteorological condition. At each range of interest, the doses were ranked with their meteorological frequencies, and estimates were made of the expected, 50%, and 95% downwind centerline dose.

Each of the 14 grid maps was integrated with the population density at one-degree intervals, for a total of 360 integrations. The average values were calculated every ten degrees to coincide with the 36 wind-directional frequencies. The frequency of the wind blowing in a certain direction under a particular meteorological condition was calculated by multiplying the downwind direction frequencies with the meteorological frequencies. The person-rem values were then ranked to generate cumulative distribution curves. This data was then used to obtain the expected, 50th, and 95th percentile LCF values for ranges from 0 to 16 km and 0 to 80 km.

3. Scenarios

Two different pit storage scenarios that could potentially lead to Pu release and transport offsite by the wind have been identified. These scenarios should be considered as bounding cases that could expose the public to maximum amounts of Pu particulate.

The scenarios postulate an aircraft crash and fire that results in the release of Pu from pit containers in a Zone 4 magazine. It is postulated that an aircraft impacts and collapses the magazine, and subsequently, damages a portion of the stored pit containers. The impact by the aircraft is accompanied by a fuel spill and fire.

In order to determine the consequences of this type of Pu fire, it is necessary to make a conservative estimate of the number of pit containers that will be damaged and the amount of Pu that will be at risk. It is assumed that 25% of the Pu pits are involved in the release. This was discussed in more detail in Section 1. Based on current understanding [12], it is assumed that in a fire 0.05% of the Pu at risk is released in respirable form.

The release from a fire is modeled using the ERAD code. An energy source of 10 lbs of TNT is used to generate the cloud into which the Pu is injected. This is considered to be conservative in that the Pu is released instantaneously, while in a fire, even of short duration, the release is spread over time.

Case 1 is based on a quantity of pits. This case is representative of what would be obtained if the average amount of Pu per pit were stored in each magazine. The information in this case could provide insight for determining administrative controls for limitimg the amount of Pu in each magazine if limits are necessary.

Case 2 is based on the maximum number of pit containers a SAC magazine can accommodate and the type of pit with maximum amount of Pu stored.

4. Assumptions and Parameter Values

The assumptions for these calculations are intended to provide maximum bounding case expected values; therefore, parameter values were chosen as upper bound point estimates. For the Pu fire cases, the respirable amount of Pu was taken as 0.05% [12].

New understandings of health effects have developed and new interpretations of the data have occurred [13]. As noted in Reference 13, the dose conversion factor from person-rem to expected LCF has recently undergone changes. Current values range from a committed effective dose equivalent (CEDE) of 1 LCF/4000 person-rem to 1 LCF/1250 person-rem. For this set of calculations, a CEDE value of 1 LCF/2000 person-rem is used.

An airborne particulate integration boundary dose of 0.1 rem is used. The output option of the ERAD code used in this study produces results in units of μg-sec/m^3 that must be converted to rem CEDE. An integration threshold boundary value of 10.2 μg-sec/m^3 approximates to 0.1 rem on the basis of the following factors:

3.3×10^{-4} m^3/s standard man-breathing rate (light activity) [14]

0.085 Ci/g-Pu calculated for 10-yr-old Pu-239 [15]

an inhalation dose at 50 years of 350 rem/μCi [16] was used and corresponds with the current value of 330 rem/μCi [17]. These values are based on a 1 μ activity mean aerodynamic diameter (AMAD).

Other assumptions made in performing the calculations are:

sheltering is not considered

resuspension of radioactive materials is not considered the only pathway considered for estimating health effects is through inhalation

only 10 year old Pu-239 is analyzed

all the respirable material is released instantaneously

no changes in wind direction or meteorological conditions occur during the time of cloud movement out to 80 km.

The net effect of these assumptions is to obtain results that tend to overpredict both the individual dose values and the integrated population dose.

5. Results

At the beginning of this study, preliminary results were obtained by calculating doses in larger grid cells than those calculated in this report. The preliminary results were submitted to DOE [1] and are discussed in Section 6. This report deals only with subsequent results obtained using smaller grid cells. All values are rounded to 1 or 2 significant figures as is appropriate for the precision of input information available here.

Table 1 contains peak dose values at the nearest site boundary (2.2 km) and beyond (>2.2 km). The expected, 50th percentile, and 95th percentile values are reported.

Table 1. Downwind Centerline Doses

Case	Doses at Site Boundary			Peak Offsite Doses		
	Exp.	50th	95th	Exp	50th	95th
1	2	3	4	2	3	4
2	4	5	7	4	5	7

Table 2 contains LCFs for the two cases studied. Again, the expected, 50th percentile, and 95th percentile values are provided for the 0 to 16 km radius around the plant and also for the 0 to 80 km radius.

Table 2. Latent Cancer Fatalities

Case	0 - 16 Km Radius			0 - 80 Km Radius		
	Exp	50th	95th	Exp	50th	95th
1	0.01	0	0.1	0.4	0.01	1.4
2	0.02	0	0.2	0.8	0.05	4

Using the bounding case estimate of Pu in the accident, the expected or mean 50-year LCF value for the affected area within 16 km radius is 0.02. The 50th percentile or median value is 0 and the 95th percentile value is 0.2.

For this bounding case, the expected or mean 50-year LCF value for the affected area within 80 km radius is 0.8. The 50th percentile or median value is 0.05 and the 95th percentile value is 4.

The expected 50-year peak offsite dose (> 2.2 km) is 4 rem. The 50th percentile value is 5 rem; the 95th percentile value is 7 rem.

6. Discussion of Preliminary Results

For each of the scenarios described in Section 3, the ERAD code was used to estimate the amount of radioactive materials that would be dispersed after a postulated aircraft crash into a storage magazine at the Pantex Plant in Amarillo, Texas. As a first step in using the code, the area surrounding the plant was divided into areas of interest, called cells. Cell size as well as a number of other factors including the amount of material dispersed, particle size distributions, weather and meteorological conditions, and atmospheric dispersion phenomena were used by ERAD to obtain a value for the average amount of radioactive materials present in each cell.

One of the outputs from the ERAD code is the time integrated airborne concentrations of the respirable size particulate. Average values are reported in physical units of microgram-seconds per cubic meter and are tracked in a user defined rectangular coordinate system. Distance from the accident location zero is measured in meters, using an X-Y coordinate system. The Y-axis is the crosswind direction and the X-axis is the downwind direction. The accident location is defined as (0,0). The preliminary determinations of radioactive materials present in the area surrounding the Pantex Plant were calculated using a large cell size and a 100 x 100 cell grid.

The ERAD code, written for a 40 x 40 grid, was modified to accommodate a larger affected area. The boundaries for the grid were determined by executing the ERAD code two times. The first execution used estimated extreme values for the boundaries to insure capture of the 0.1 rem (CEDE) values. The ERAD output was examined and reassigned the minimum and maximum values of the grid as necessary. The ERAD code was then executed a second time using the new minimum and maximum grid boundaries. In all cases, the maximum downwind distance was set at 80 km.

To simulate a fire scenario, using the ERAD code, an estimate of the amount Pu released in the fire and an energy source to represent the fire are necessary. At the time of preliminary evaluation, the maximum number of pits involved in a Pu release was assessed incorrectly. The preliminary results as reported to DOE [1] used inappropriate source terms and cell size, to calculate the consequences of Pu released in a fire. The preliminary results were in error. The results as presented in this memo supersede the preliminary results.

7. Summary and Conclusions

The Department of Energy Albuquerque Field Office (DOE/AL) requested that Sandia National Laboratories/New Mexico determine the radiological consequences from an aircraft crash into an MR or SAC magazine containing stored Pu pits in Zone 4 of the Pantex Plant. This memo summarizes in an unclassified form the requested information. It further describes the methods used in quantifying the highest anticipated source term and documents the cloud transport model and the important parameter values used to obtain the results. Data to support the analysis are abstracted from formal and informal reports. Results from the analysis consist of distributions of dose and health effects from site boundary to 16 km and 80 km from the boundary.

Major conclusions are:

For the upper limit of source term release from fire scenarios, the peak offsite doses have an estimated expected value of 4 rem and 95% of the peak doses calculated are 7 rem. Estimated increase in LCFs within a radius of 16 km from the site has a mean of 0.02 and 95% of the LCFs are calculated to be less than 0.2 persons. The increase in LCFs to a radius of 80 km from the site has an expected value of 0.8 and 95% of the LCFs are calculated to be 4 persons.

The total population in the ten-mile radius is about 3800. Based on SEN-35-91 [18], the risk can be compared to the criteria by calculating the sum of the product of credible scenario probabilities multiplied by the expected LCFs for each scenario divided by the total population and then comparing this value with two-in-a-million that is the implied SEN-35-91 criterion for individual LCF maximum allowable risk. Given a scenario probability bounded by one-in-a-million, an LCF value of .02, and a population of 3800 yield a value of $6x10^{-12}$. This value is more than five orders of magnitude less than the allowable maximum risk. Thus, the contribution to the overall risk, according to the criteria given in SEN-35-91, from these operations is negligible.

No early fatalities due to radiation exposure are expected from the Pu fire cases studied.

No attempt was made to address what positive measures could reduce the risk, how much the risk could be reduced, and what costs would be involved.

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Copy to:

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MEMORANDUM DATED APRIL 30, 1993
ATTACHMENT TO APPENDIX I

Sandia National Laboratories
Albuquerque, New Mexico 87185

date: April 30, 1993

to: Dave Rosson, Jr., DOE/AL

Y. T. Lin

from: Y. T. Lin, N. R. Grandjean, and R. E. Smith, 0333

subject: Plutonium Dispersal Deposition Area Estimates of a Hypothetical Aircraft Crash into Pantex Zone 4

Department 0333 was requested by DOE/AL to continue the consequences analysis resulting from a hypothetical aircraft crash into a Zone 4 magazine. Previously, the health effects were reported in terms of whole body rem and latent cancer fatalities. This memo documents the estimates of the deposition area for bounding case scenario as previously reported[1, 2].

Previous studies have used 14 sets of meteorological data (A to N) for the Pantex site to represent various meteorological conditions. Each meteorological condition has an associated frequency of occurrence and a set of 36 downwind directional frequencies based on observed data. Each directional frequency covers a ten-degree segment of the total of 360 degrees possible [2,3]. The meteorological conditions, the frequencies of occurrence and the wind directional frequencies used in this analysis are the same as those previously used to estimate the health effects calculations in references 1 and 2. Attachment A lists these 14 sets of data.

The source term for this study is the same as in the Case 2 pit storage fire scenario listed in Attachment B-2 of Reference 2. The aerosolization release fraction used for this analysis is one percent of the total exposed Pu material; and the respirable amount of the Pu aerosol is taken as 0.05%[4]. This number represents what was believed by experts as an upper bound estimate at the time of the study[1]. The release from a fire is modeled using ERAD code. An energy source of 10 lbs of TNT is used to generate the cloud into which the Pu is injected. This is conservative in that the Pu is released instantaneously, while in a fire, even of short duration, the release is spread over time. The reader should be cautioned that the results are sensitive to the particle size distribution which is a function of various parameters and could change (likely be reduced with new data). The results from the ERAD simulations are documented in Reference 2. Plots of the deposition contour for each of the 14 meteorological conditions were developed and are illustrated in Attachment B.

The Environmental Protection Agency (EPA) proposed guidance on dose limits for person exposed to transuranium elements [5] suggested that a soil contamination level of 0.2 micro curie per square meter would establish a reasonable "screening level" for cleanup purpose. Table 1 summarizes the area that needs to be evaluated using the EPA screening level and the frequency of occurrence for the 14 meteorological conditions. The average area that needs to be evaluated around Pantex is 54 square kilometers. The median or 50 percentile area that needs to be evaluated is 58 square kilometers; and the 90 percentile area that needs to be evaluated is 64 square kilometers.

Table 1. Summary of the Area That Needs to Be Evaluated Around Pantex Area.

Meteorological Conditions	Frequency of Occurrence (in percent)	Area (in sq. km)
A	0.6531	41
B	2.8204	75
C	3.2162	45
D	6.4720	36
E	6.5809	48
F	5.1361	55
G	18.1296	47
H	7.3231	64
I	8.4117	59
J	12.4790	64
K	8.1148	58
L	8.6987	58
M	9.5596	63
N	2.4048	49
	100.0	

Three geographical areas near the Pantex plant are of primary concern. The city of Amarillo located west-southwest from Pantex; Lake Meredith located north-northwest from Pantex; and the fifty foot unsaturated zone area [6] located south-southwest from Pantex. A map of the Pantex area [7] is shown in the Attachment C. Due to time and resource constraints the actual intersection of the deposition area with these areas of interest was not calculated. The results reported in this memo are total area that needs to be evaluated in the sector or segment that contains the area of interest. The values given are, therefore, calculated upper bounds of the area that needs to be evaluated based on the 14 meteorological conditions and the frequencies of the wind direction downwind towards the areas of interest.

Table 2 summarizes the area that needs to be evaluated and the frequencies of the wind direction downwind toward the sector containing Amarillo. The city occupies only a portion of the sector in the downwind direction between 215 and 265 degrees clockwise. The assumption of using the total deposition areas for each meteorological condition instead of the deposition area intercepted by the city boundary is very conservative. However, the estimates provide an upper bound calculation. The chance of depositions occurring in the sector containing Amarillo is about 15%.

Table 2. Summary of the Area That Needs to Be Evaluated in the Sector Containing Amarillo

Meteorological Conditions	Area (in sq. km)	Frequency of Occurrence (in percent) Downwind Direction (degree from North) 215	225	235	245	255	265	Sub-Total (in percent)
A	41	0.0026	0.0046	0.0066	0.0085	0.0098	0.0243	0.0564
B	75	0.0881	0.0400	0.0243	0.0380	0.0405	0.0344	0.2652
C	45	0.1617	0.0973	0.0644	0.0672	0.0260	0.0219	0.4386
D	36	0.4005	0.2424	0.1313	0.1144	0.0707	0.0438	1.0003
E	48	0.3717	0.1454	0.1131	0.1454	0.2020	0.0727	1.0504
F	55	0.2003	0.2699	0.2264	0.4267	0.1480	0.0784	1.3497
G	47	1.1239	0.9132	0.8991	0.4496	0.2248	0.2248	3.8354
H	64	0.3691	0.2768	0.2399	0.0554	0.0369	0.0554	1.0334
I	59	0.6547	0.3791	0.1838	0.0574	0.0689	0.0345	1.3784
J	64	0.5745	0.3018	0.4759	0.2785	0.0929	0.1160	1.8396
K	58	0.1502	0.1871	0.2041	0.1069	0.0992	0.0454	0.8928
L	58	0.1198	0.1651	0.1837	0.1678	0.0772	0.0799	0.7935
M	63	0.0961	0.1441	0.2191	0.2477	0.1966	0.1636	1.0672
N	49	0.0437	0.0400	0.0486	0.0486	0.0480	0.0486	0.2774
							Total	15.28

Similarly, the area that needs to be evaluated and the frequencies of the wind direction downwind toward Lake Meredith is summarized in the Table 3. The lake area is a small portion of the sector between the downwind direction from 215 to 265 degrees clockwise. The chance of depositions occurring in the sector containing Lake Meredith is about 28%.

Table 3. Summary of the Area That Needs to Be Evaluated in the Sector Containing Lake Meredith

Meteorological Conditions	Area (in sq. km)	Frequency of Occurrence (in percent) Downwind Direction (degree from North) 295	305	315	325	335	345	355	5	Sub-Total (in percent)
A	41	0.0301	0.0360	0.0321	0.0249	0.0190	0.0203	0.0295	0.0177	0.2097
B	75	0.0400	0.0531	0.0719	0.0784	0.1063	0.1159	0.1468	0.2065	0.8189
C	45	0.0219	0.0302	0.0260	0.0348	0.0973	0.0864	0.1288	0.2577	0.6867
D	36	0.0404	0.0438	0.0707	0.0909	0.1447	0.1818	0.2996	0.3602	1.2319
E	48	0.0404	0.0404	0.0808	0.1374	0.1616	0.1212	0.2343	0.3232	1.1393
F	55	0.0784	0.0610	0.0261	0.0784	0.0871	0.1045	0.2351	0.2525	0.9231
G	47	0.1124	0.1545	0.3231	0.2529	0.3934	0.5479	0.6884	0.8149	3.2875
H	64	0.0001	0.1107	0.3875	0.2030	0.2399	0.1845	0.2030	0.6090	1.9377
I	59	0.0804	0.1723	0.3561	0.2872	0.4365	0.4135	0.6432	0.4595	2.8486
J	64	0.1973	0.2785	0.3134	0.3772	1.0736	1.0271	0.8240	0.7196	4.8107
K	58	0.1077	0.2069	0.2806	0.4223	0.7058	0.7625	0.6009	0.5924	3.6791
L	58	0.1012	0.1651	0.2104	0.4234	0.5059	0.6231	0.0687	0.6204	3.7182
M	63	0.1606	0.2206	0.3167	0.3692	0.3362	0.3722	0.5794	0.7114	3.0664
N	49	0.0326	0.0308	0.0474	0.0517	0.0560	0.0781	0.1009	0.1150	0.5123
									Total	27.87

Finally, the area that needs to be evaluated and the frequencies of the wind direction downwind toward the 50-ft unsaturated zone area is summarized in the Table 4. The area is in the sector of the downwind direction from 175 to 225 degree clockwise. The chance of depositions occurring in the sector containing the 50-ft unsaturated zone area is about 29%.

Table 4. Summary of the Area That Needs to Be Evaluated in the Sector Containing 50-ft Unsaturated Zone

Meteorological Condition	Area (in sq. km)	Frequency of Occurrence (in percent) Downwind Direction (degree from North)						Sub-Total (in percent)
		175	185	195	205	215	225	
A	41	0.0210	0.0170	0.0111	0.0098	0.0026	0.0046	0.0662
B	75	0.0688	0.1184	0.1367	0.1260	0.0881	0.0400	0.5780
C	45	0.0548	0.2042	0.2001	0.1631	0.1617	0.0973	0.8814
D	36	0.1447	0.4073	0.5789	0.4039	0.4005	0.2424	2.1778
E	48	0.1454	0.3959	0.9131	0.6222	0.3717	0.1454	2.5937
F	55	0.0435	0.2003	0.4964	0.5486	0.2003	0.2699	1.7590
G	47	0.4496	1.3909	2.7958	2.3181	1.1238	0.9132	8.9914
H	64	0.0923	0.7935	0.8858	0.9042	0.3691	0.2768	3.3217
I	59	0.0919	0.4709	0.8960	0.6662	0.6547	0.3791	3.1588
J	64	0.1625	0.4817	0.4759	0.7254	0.5745	0.3018	2.7216
K	58	0.0624	0.2778	0.1842	0.1814	0.1502	0.1871	1.0431
L	58	0.0746	0.2050	0.2024	0.1465	0.1198	0.1651	0.9134
M	63	0.0765	0.1621	0.1891	0.1936	0.0961	0.1441	0.8615
N	49	0.0424	0.0387	0.0492	0.0461	0.0437	0.0400	0.2602
							Total	29.33

Table 5 Summary of the Cumulative Frequency of the Area That Needs to Be Evaluated

Area in sq. km	Cumulative Frequency Around Pantex	Amarillo Sector	Lake Meredith Sector	50-Ft Unsaturated Zone Sector
35.8	6.5	6.6	4.4	7.4
40.7	7.1	6.9	5.2	7.7
44.7	10.3	9.8	7.6	10.7
46.5	28.5	34.9	19.4	41.3
48.3	35.1	41.8	23.5	50.2
48.5	37.5	43.6	25.4	51.0
54.6	42.6	52.4	28.7	57.0
57.5	50.7	58.3	41.9	60.6
58.3	59.4	63.5	51.6	63.7
58.5	67.8	72.5	61.9	74.5
62.6	77.4	79.5	72.9	77.4
63.7	89.9	91.5	90.1	86.7
63.9	97.2	98.3	97.0	98.0
75.1	100.0	100.0	100.0	100.0

Table 5 summarizes the normalized cumulative frequency of the area that needs to be evaluated for the areas of primary concern. The median or 50 percentile area that needs to be evaluated is about 48 to 58 square kilometers; and the 90 percentile area that needs to be evaluated is 64 square kilometers for all the area of primary concern. In other words, 50% of the time the area that needs to be evaluated is about 48 to 58 sq. km or less; and 90% of the time the area that needs to be evaluated is 64 sq. km or less. The deposition areas which need to be evaluated are reported here as the bounding case calculations.

References

1. R. E. Smith (SNL/0333) Memorandum to David E. Rosson, Jr (DOE/AL/WMOSD), Subject: Plutonium Dispersal Consequence Analysis of Hypothetical Aircraft Crash into Pantex Zone 4, December 11, 1992.

2. Y. T. Lin, N. R. Grandjean, and S. A. Kalemba (SNL/0333) Memorandum to R. E. Smith (SNL/0333), Subject: Pantex Zone 4 Consequence Analysis Source Data, UCNI, Memo, December 21, 1992.

3. This reference is removed for classification purposes.

4. J.M.Haschke, Evaluation of Source-term Data for Plutonium Aerosolization, La-12315-MS, July 1992, Los Alamos National Laboratory, Los Alamos, N. M.

5. Proposed Guidance on Dose Limits for Persons Exposed to Transuranium Elements in the General Environment, EPA 520/4-77-016, U. S. Environmental Protection Agency, September, 1977.

6. H. J. Turin, I. R. Triay, W. R. Hansen, and W. J. Wenzel, "Potential Ogallala Aquier Impacts of a Hypothetical Plutonium Dispersal Accident in Zone 4 of the Pantex Plant", November, 1992, Los Alamos National Laboratory, Los Alamos, N. M. 87545

7. Final Environmental Impact Statement, Pantex Plant Site, Amarillo, Texas, U. S. Department of Energy, October, 1983.

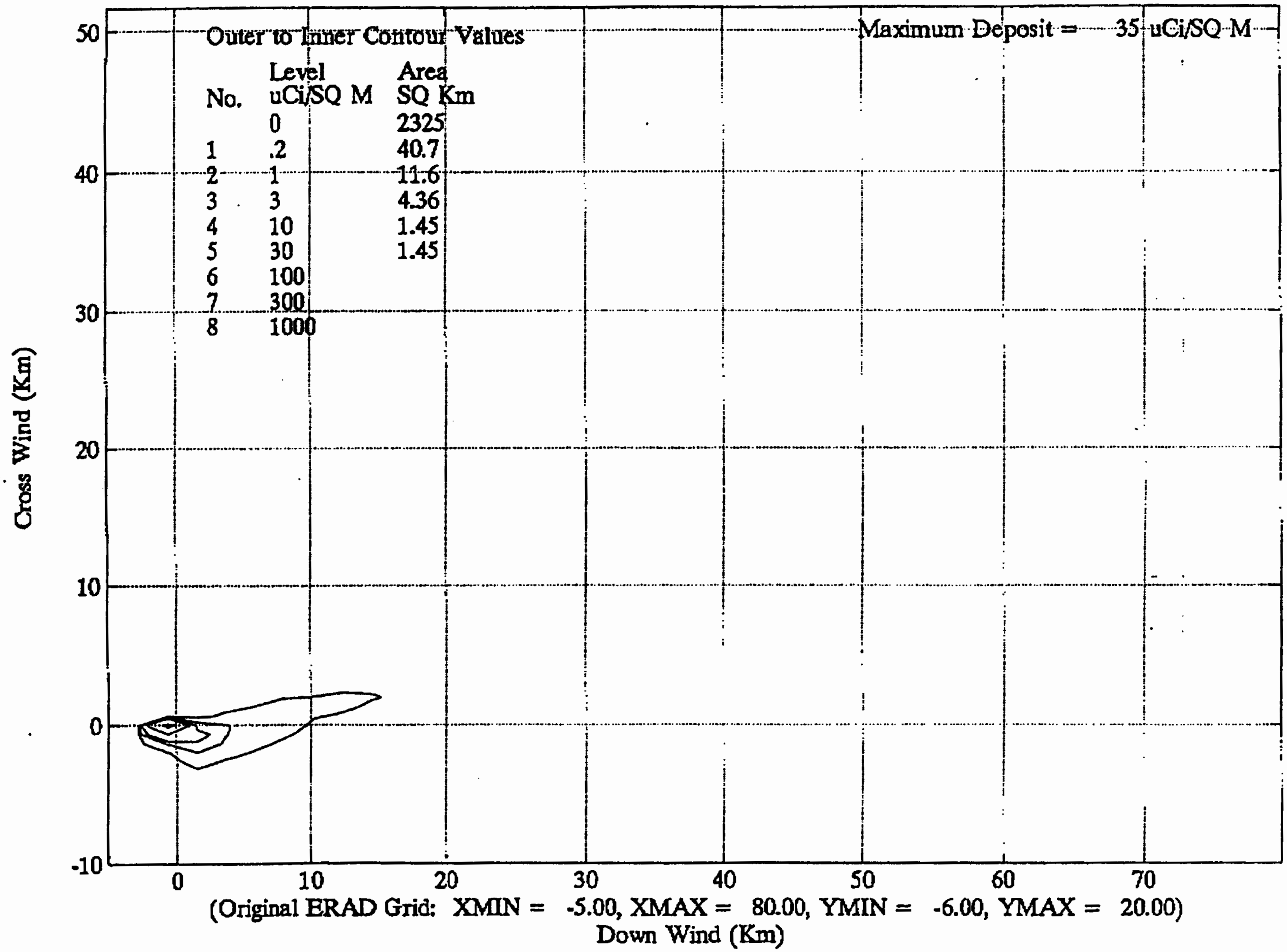
0333 File - Zone 4 EA, P-2B

Attachment A: The Frequencies of the Downwind Direction for Various Meteorological Conditions

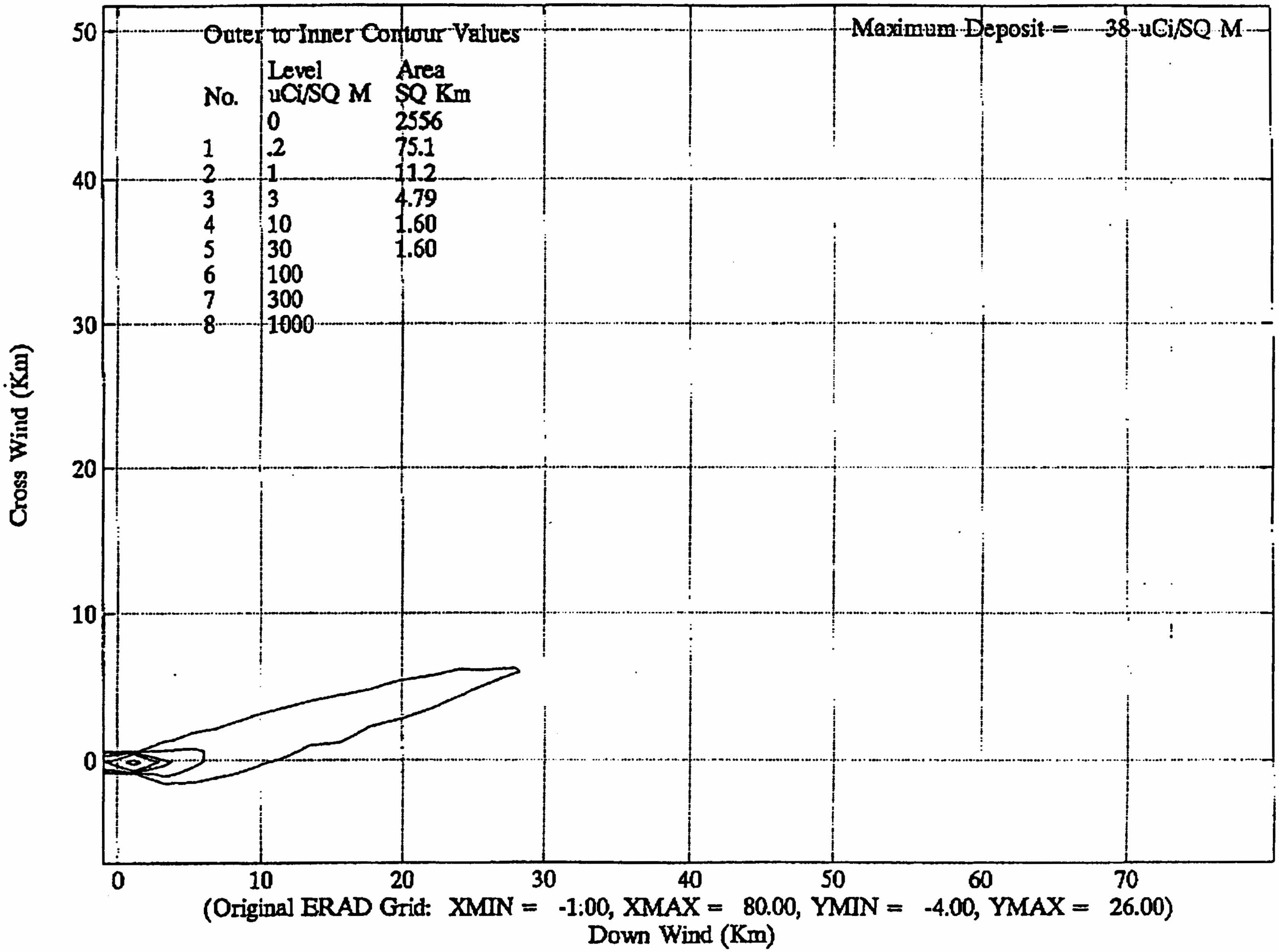
Downwind Direction (Degree from North)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
5	0.026812	0.072456	0.079292	0.055069	0.048603	0.048657	0.044479	0.082294	0.054054	0.057064	0.072244	0.078637	0.073648	0.04733
15	0.032771	0.072279	0.07423	0.05507	0.036452	0.038591	0.027607	0.032419	0.047297	0.04878	0.04701	0.053662	0.062928	0.039483
25	0.023833	0.056117	0.069591	0.058157	0.051033	0.026846	0.037577	0.0399	0.051352	0.057524	0.061528	0.057711	0.066811	0.046318
35	0.03277	0.045996	0.064108	0.059187	0.030376	0.021812	0.018405	0.037407	0.014865	0.021629	0.043899	0.049275	0.059199	0.053657
45	0.023834	0.041911	0.054407	0.048379	0.034022	0.03859	0.01457	0.01995	0.024324	0.028993	0.041133	0.046574	0.037911	0.04733
55	0.02284	0.031788	0.039224	0.034483	0.021871	0.020135	0.018405	0.022444	0.018919	0.02531	0.032493	0.025987	0.039621	0.046317
65	0.017875	0.016516	0.026993	0.02316	0.017011	0.016778	0.013037	0.009976	0.008108	0.027152	0.017974	0.026325	0.034649	0.037712
75	0.010923	0.013496	0.021932	0.037056	0.032807	0.031879	0.017638	0.017456	0.02027	0.023469	0.02074	0.030037	0.02253	0.036953
85	0.018868	0.010833	0.023196	0.025733	0.026732	0.018457	0.019172	0.014963	0.013514	0.020249	0.01832	0.0189	0.020354	0.040243
95	0.017875	0.017049	0.025306	0.02316	0.010935	0.016778	0.015337	0	0.008108	0.003682	0.009333	0.00675	0.017247	0.030119
105	0.029791	0.020422	0.021932	0.011323	0.014581	0.013423	0.010736	0	0.002703	0.009664	0.011752	0.007087	0.021908	0.034675
115	0.029792	0.024688	0.010544	0.012352	0.00486	0.021812	0.011503	0.004987	0.005405	0.008442	0.006222	0.010125	0.022685	0.03999
125	0.03575	0.017226	0.010122	0.005661	0.010936	0.008389	0.006902	0.004968	0.004054	0.005983	0.005185	0.010462	0.016314	0.031384
135	0.028798	0.016161	0.005061	0.005662	0.008505	0.006712	0.000767	0.007481	0.002703	0.002301	0.003111	0.0054	0.009944	0.024551
145	0.040715	0.015095	0.003378	0.004117	0.003645	0.003356	0.002301	0.002494	0	0.002301	0.003111	0.0054	0.01041	0.023538
155	0.054618	0.016693	0.003374	0.005147	0.013366	0.003355	0.003067	0	0.001351	0.006903	0.00795	0.006078	0.011498	0.022273
165	0.035749	0.020778	0.003796	0.008234	0.010936	0.005034	0.005368	0.007481	0.012162	0.014266	0.008988	0.00675	0.009789	0.020501
175	0.031778	0.024152	0.01687	0.022131	0.021871	0.008389	0.02454	0.012469	0.010811	0.012885	0.007604	0.00945	0.007924	0.017464
185	0.025819	0.041556	0.062843	0.062275	0.059538	0.038591	0.07592	0.107232	0.055405	0.038196	0.033875	0.025987	0.016781	0.015945
195	0.016882	0.047949	0.061577	0.088523	0.137303	0.095637	0.152608	0.119701	0.105406	0.037736	0.022468	0.02565	0.019577	0.020248
205	0.014896	0.044219	0.05019	0.06176	0.09366	0.105705	0.126533	0.122194	0.078378	0.057524	0.022122	0.018562	0.020044	0.018983
215	0.003972	0.0309	0.049768	0.061245	0.055893	0.038591	0.06135	0.049876	0.077027	0.045559	0.01832	0.015187	0.009944	0.01797
225	0.006951	0.01403	0.029945	0.037057	0.021871	0.052013	0.049847	0.037406	0.044595	0.02393	0.022814	0.020925	0.014916	0.016452
235	0.009931	0.008524	0.019823	0.020072	0.017011	0.043624	0.049079	0.032419	0.021621	0.037736	0.024888	0.023287	0.022685	0.019995
245	0.01291	0.013319	0.020666	0.017498	0.021871	0.082215	0.02454	0.007481	0.006757	0.022089	0.025233	0.021263	0.025637	0.019994
255	0.014895	0.014207	0.008014	0.010808	0.030377	0.028523	0.01227	0.004988	0.008108	0.007364	0.012098	0.009787	0.020354	0.019742
265	0.036743	0.012076	0.006748	0.006691	0.010936	0.015101	0.01227	0.007481	0.004054	0.009203	0.005531	0.010125	0.016936	0.019995
275	0.024826	0.011544	0.002531	0.002059	0.014581	0.010067	0.003835	0.004988	0.00946	0.010585	0.008296	0.013837	0.020199	0.013668
285	0.02582	0.013141	0.00253	0.004632	0.015795	0.011745	0.005368	0.009975	0.008108	0.011044	0.009333	0.016538	0.023772	0.013667
295	0.04568	0.01403	0.006748	0.006176	0.006076	0.015101	0.006135	0	0.009459	0.015647	0.013135	0.012824	0.016626	0.013414
305	0.054617	0.018646	0.009279	0.00669	0.006075	0.011745	0.008435	0.014962	0.020271	0.022089	0.025233	0.020926	0.02284	0.012655
315	0.04866	0.025218	0.008014	0.010808	0.012151	0.005033	0.017638	0.052369	0.041892	0.024851	0.034221	0.026662	0.032784	0.019489
325	0.037736	0.027526	0.011809	0.013896	0.020656	0.015101	0.013804	0.027432	0.033783	0.029912	0.051503	0.053662	0.038223	0.021261
335	0.028798	0.037294	0.029945	0.022131	0.024301	0.016779	0.021472	0.032419	0.051352	0.085136	0.08607	0.064124	0.034804	0.023032
345	0.030785	0.040667	0.026571	0.027792	0.018226	0.020134	0.029908	0.024937	0.048648	0.081454	0.092983	0.078974	0.038533	0.032144
355	0.044687	0.061501	0.039646	0.045806	0.035237	0.045302	0.037577	0.027432	0.075676	0.065348	0.07328	0.087074	0.059975	0.041508

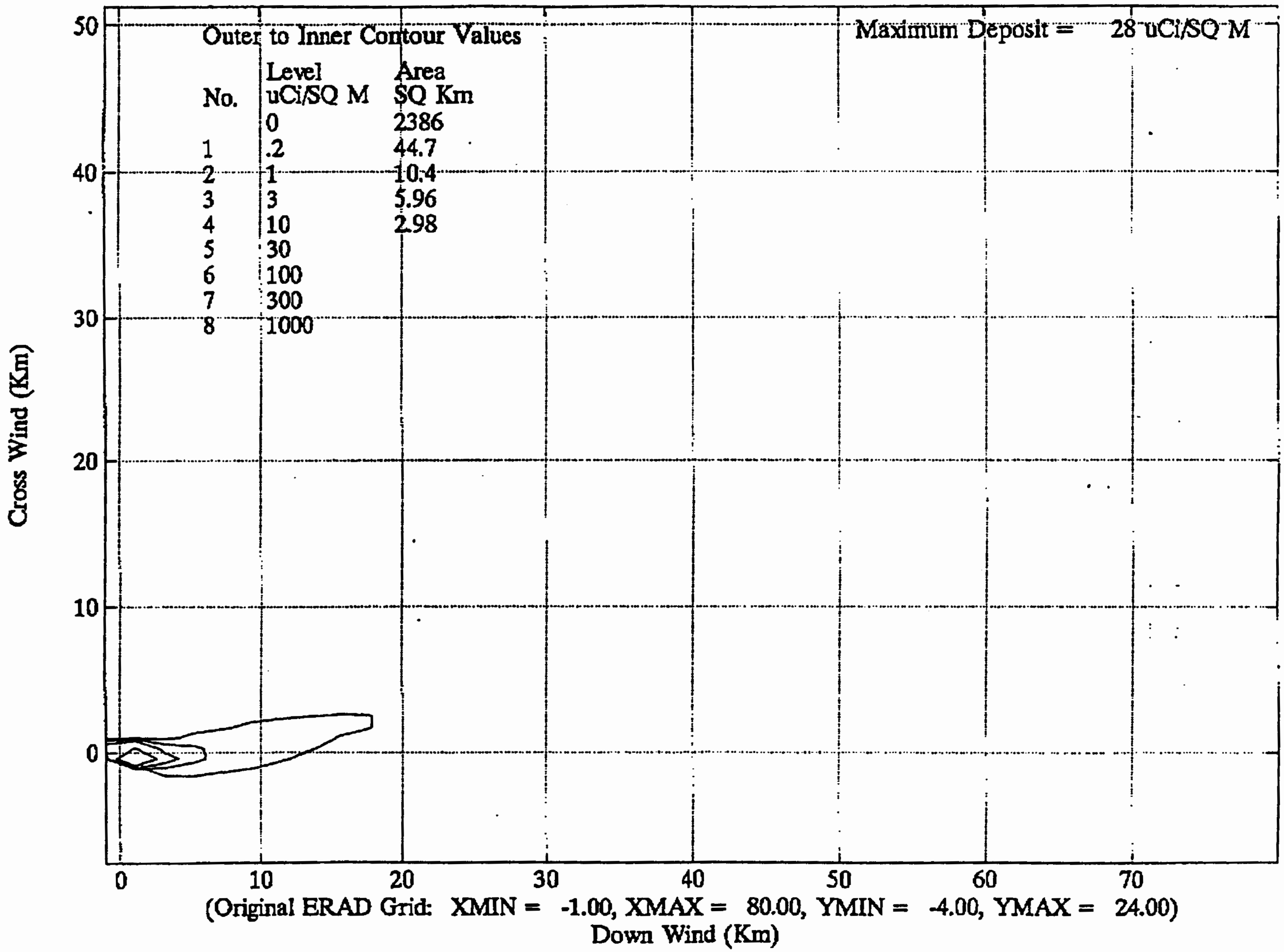
Attachment B: The Deposition Contours of the Meteorological Condition A



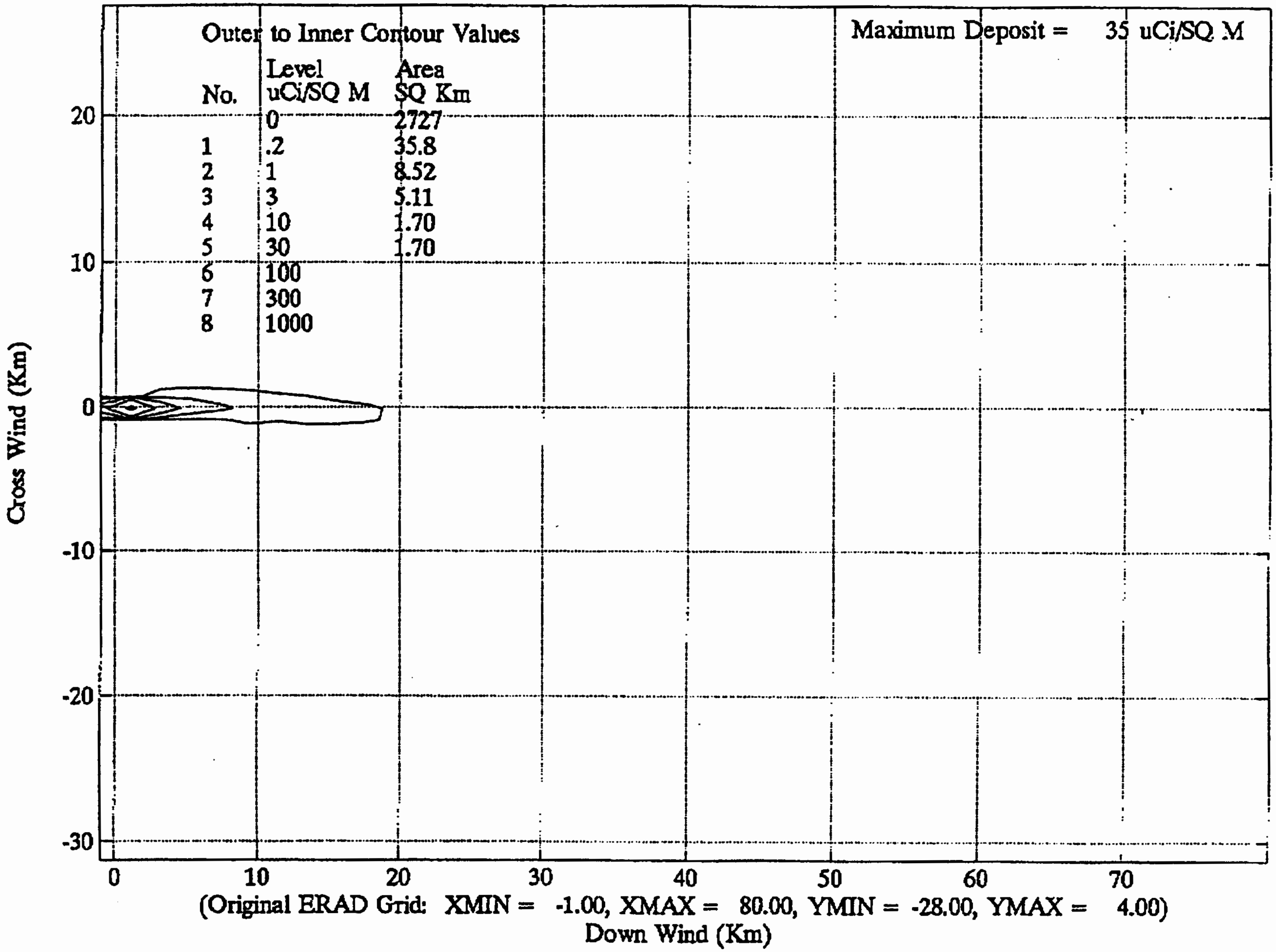
Attachment B: The Deposition Contours of the Meteorological Condition B



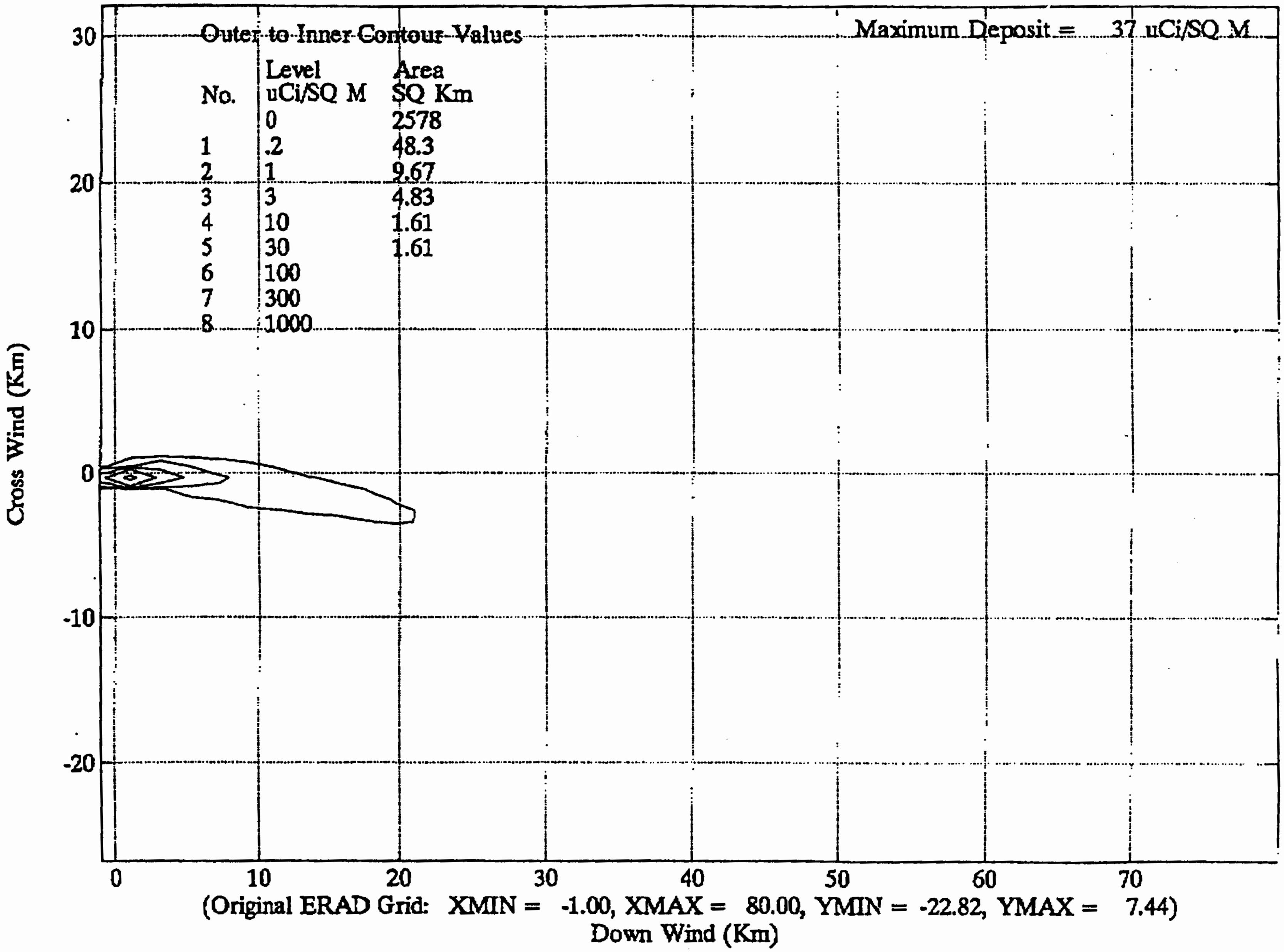
Attachment B: The Deposition Contours of the Meteorological Condition C



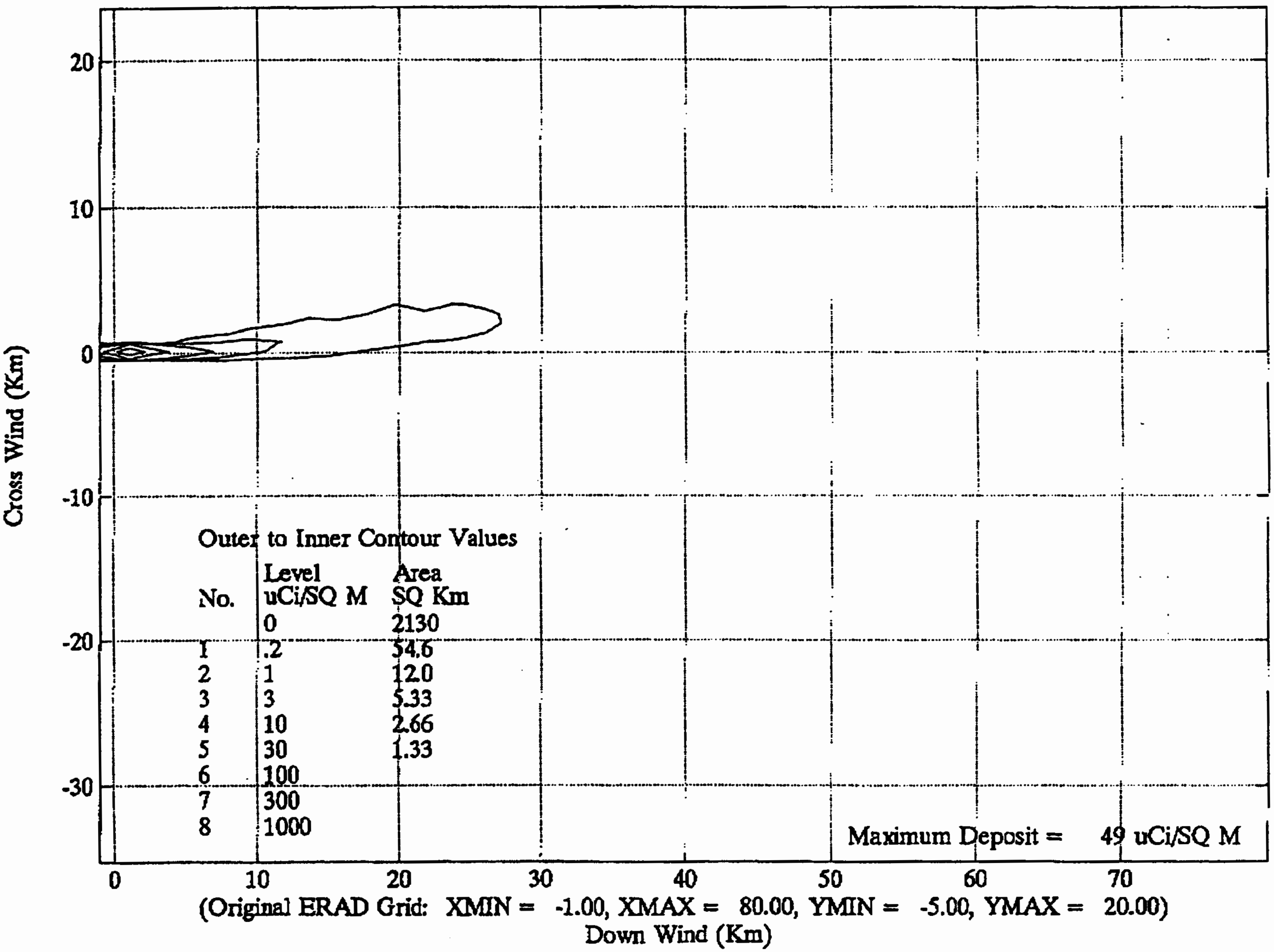
Attachment B: The Deposition Contours of the Meteorological Condition D



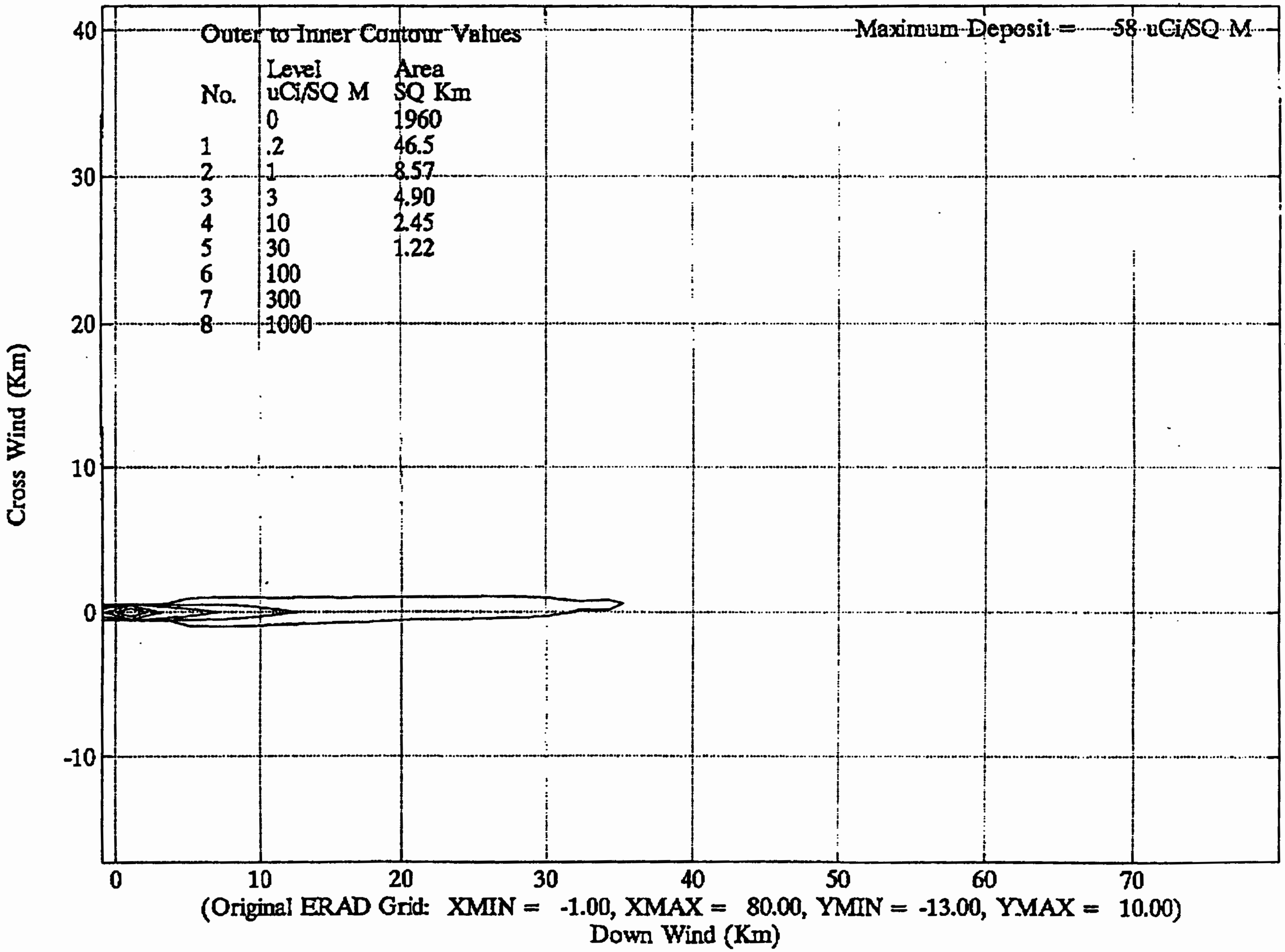
Attachment B: The Deposition Contours of the Meteorological Condition E



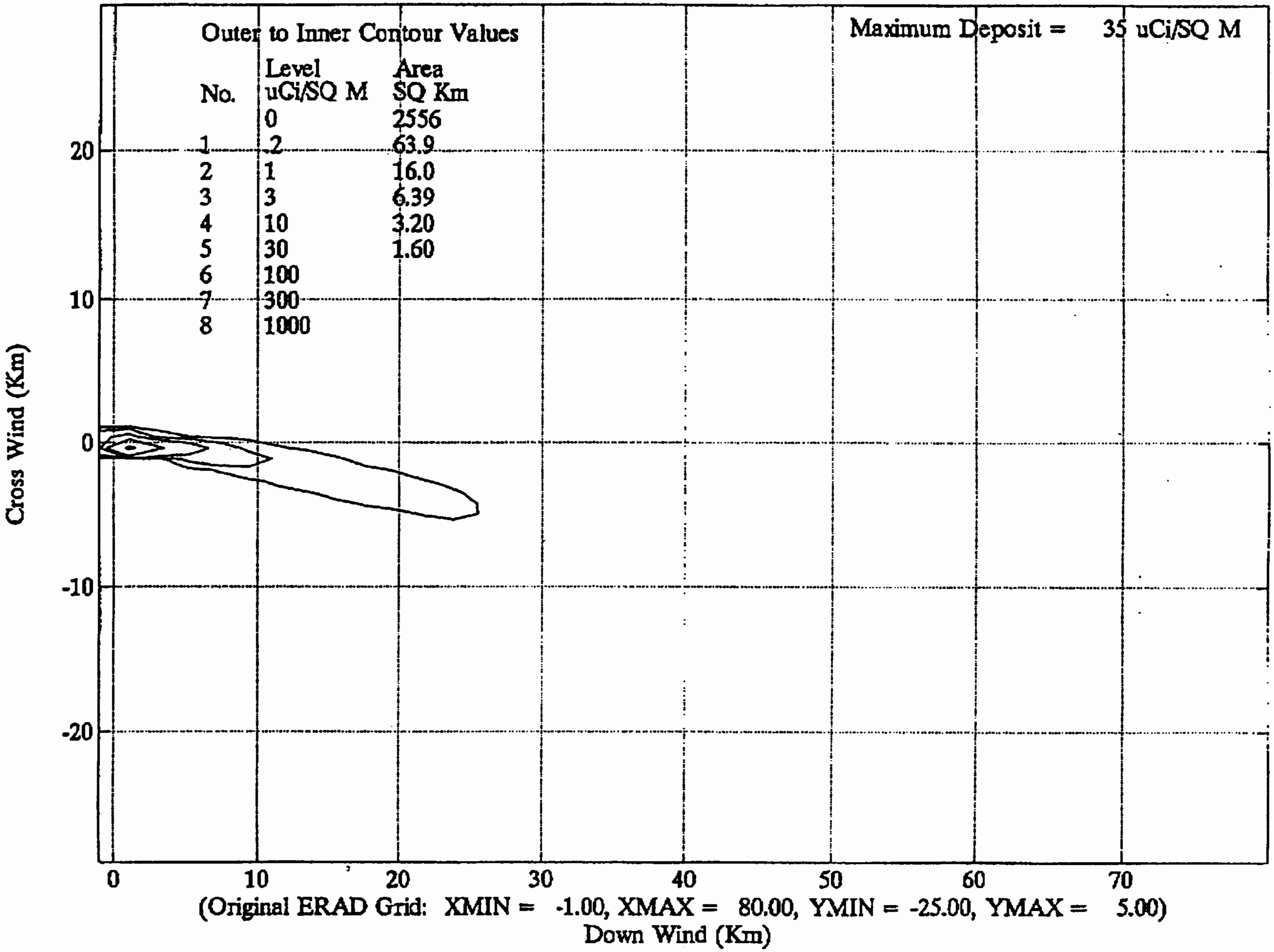
Attachment B: The Deposition Contours of the Meteorological Condition F



Attachment B: The Deposition Contours of the Meteorological Condition G



Attachment B: The Deposition Contours of the Meteorological Condition H



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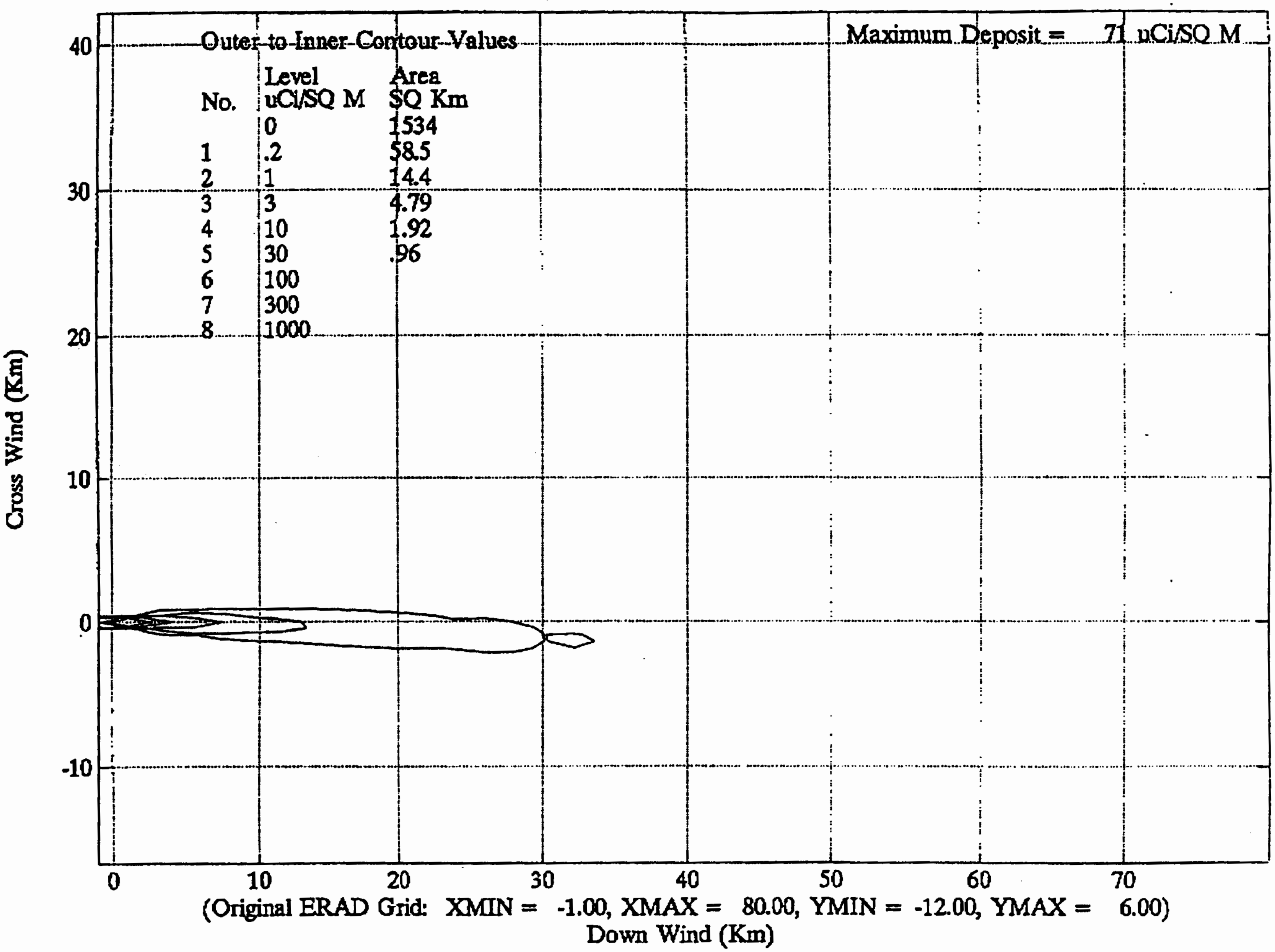

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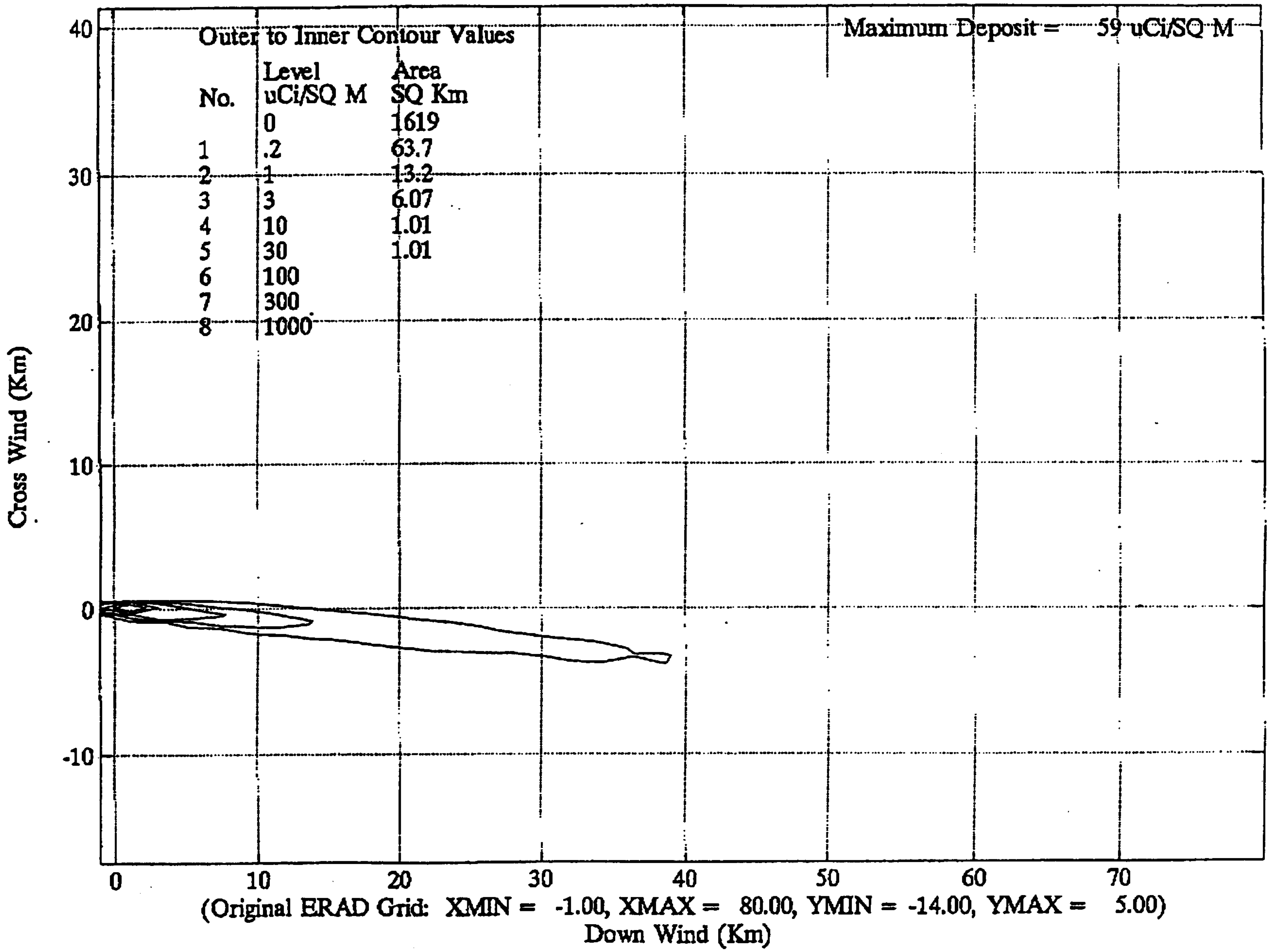
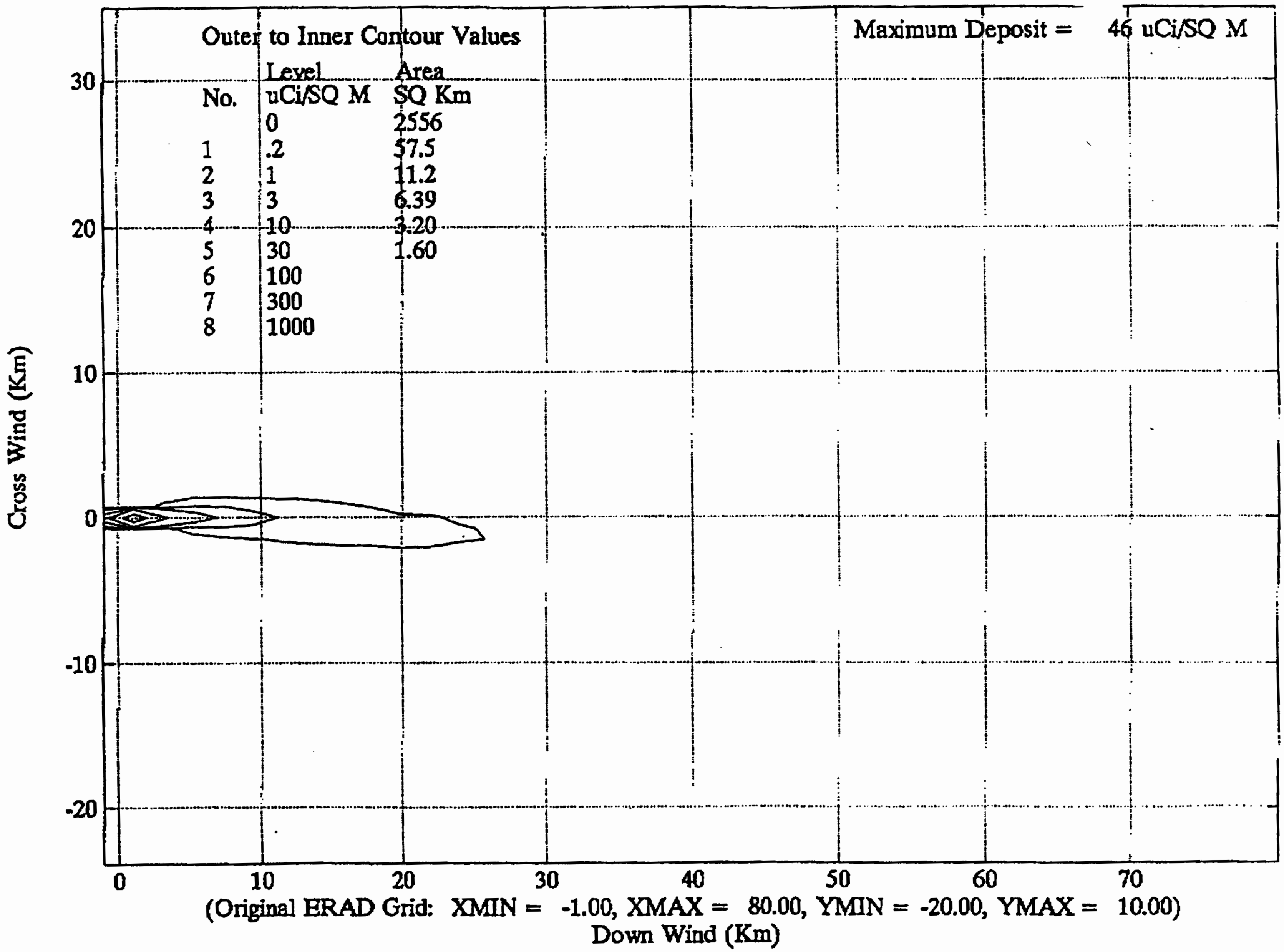
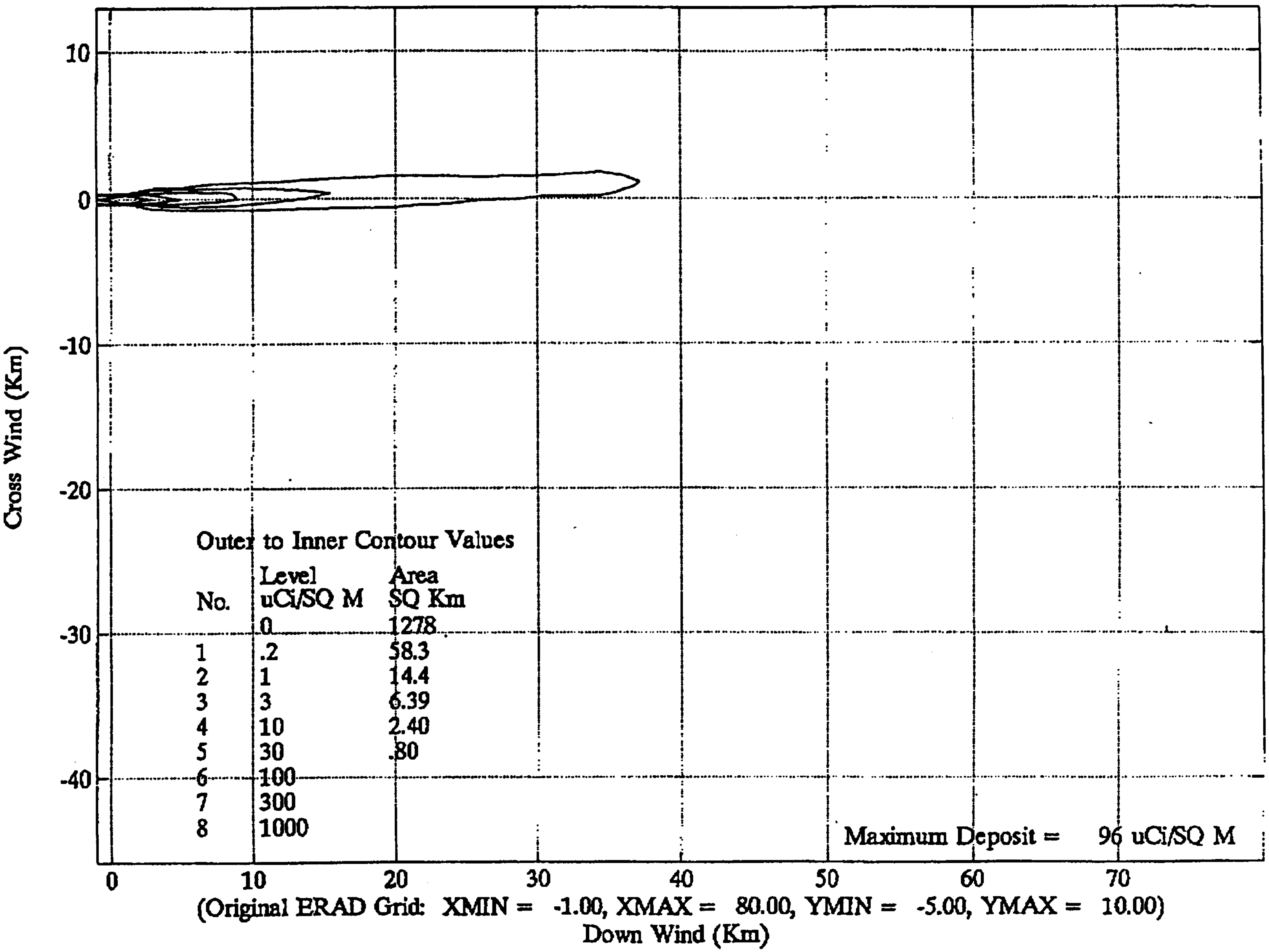


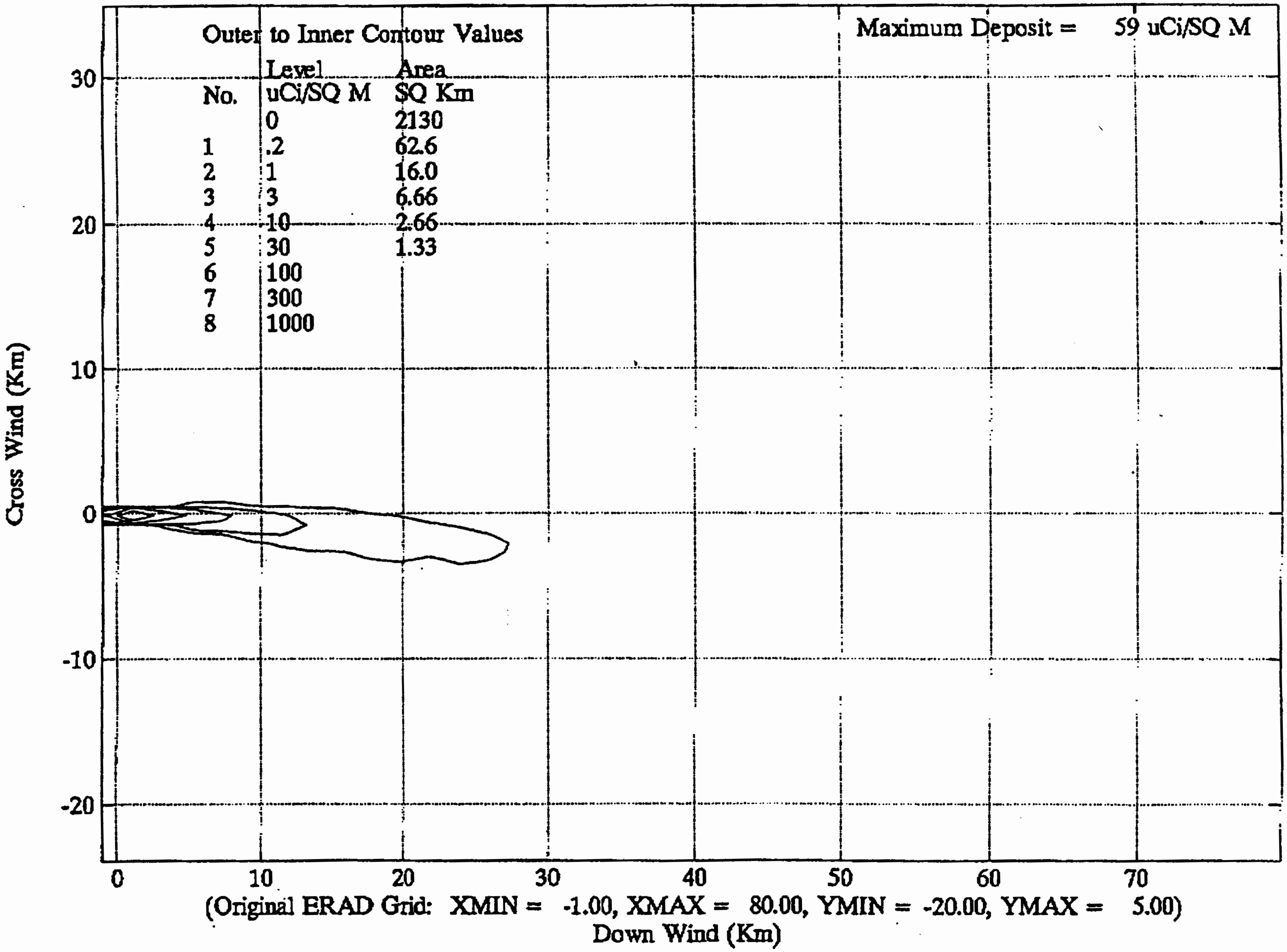
Attachment B: The Deposition Contours of the Meteorological Condition K



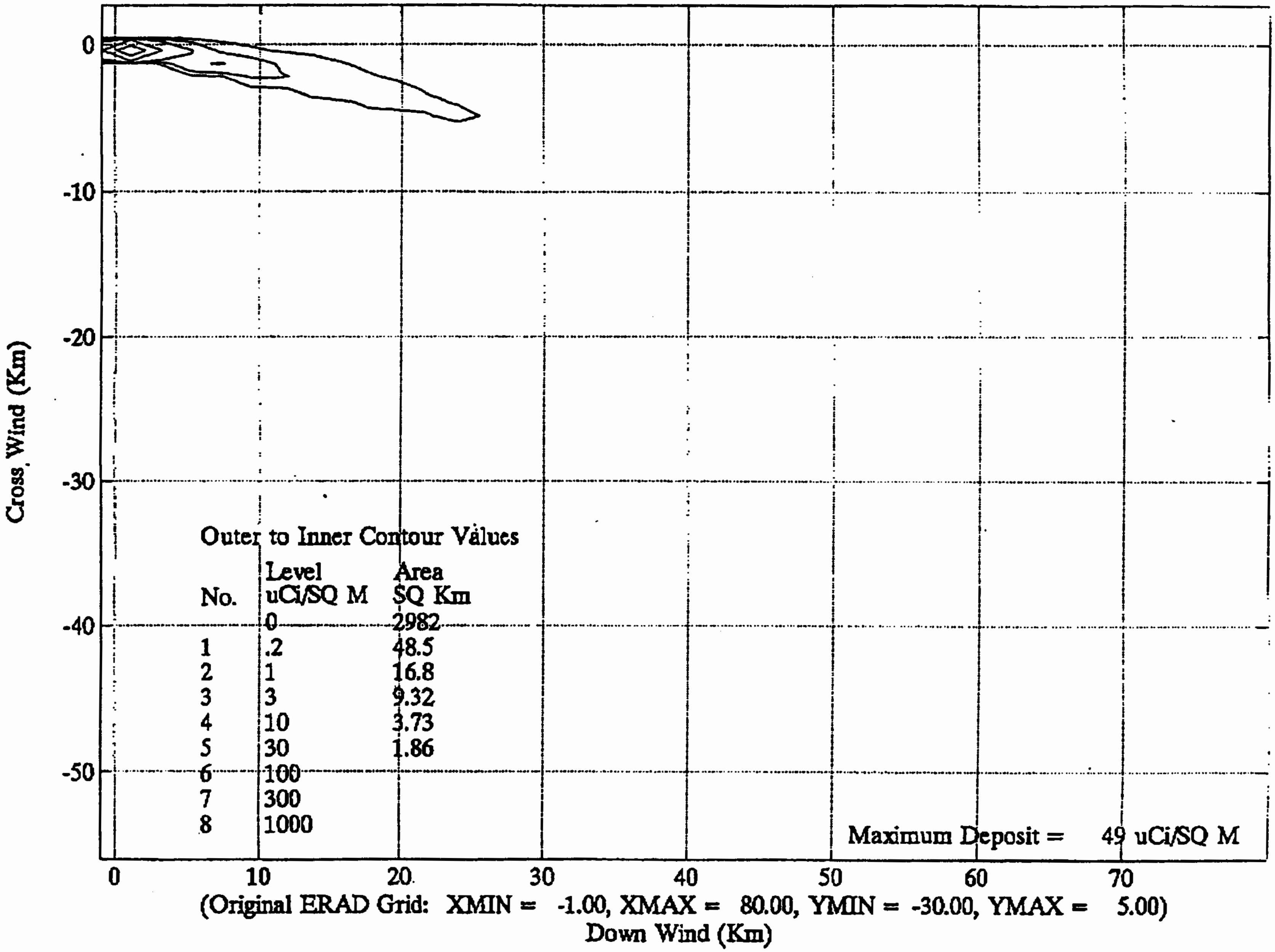
Attachment B: The Deposition Contours of the Meteorological Condition L



Attachment B: The Deposition Contours of the Meteorological Condition M



Attachment B: The Deposition Contours of the Meteorological Condition N



Attachment C: A Map of the Pantex Plant Region

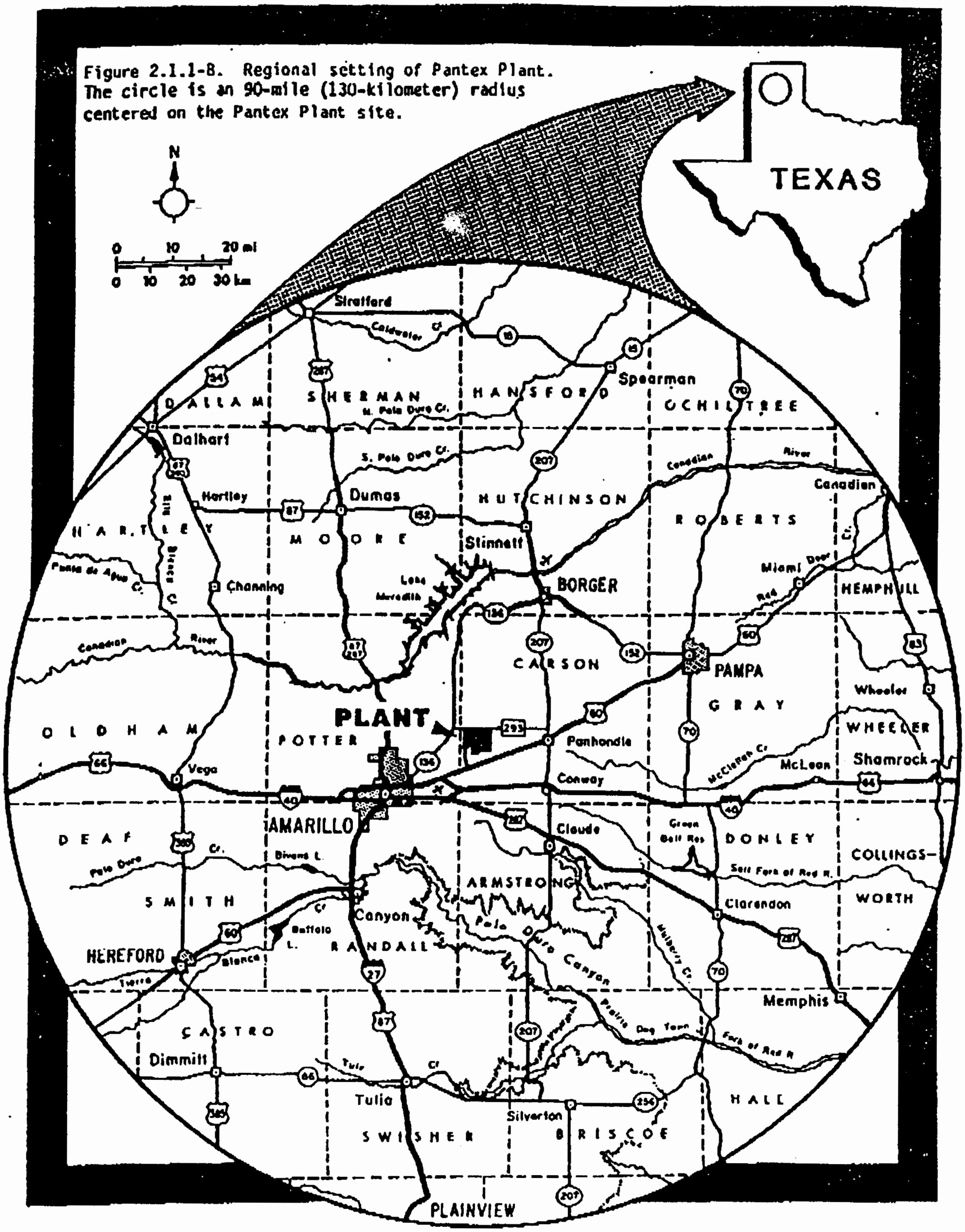


Figure 2.1.1-8. Regional setting of Pantex Plant. The circle is an 90-mile (130-kilometer) radius centered on the Pantex Plant site.

Sandia National Laboratories
Albuquerque, New Mexico 87185

date: August 3, 1993

to: D. E. Rosson, Jr., DOE/AL

Y. T. Lin, J. L. Tenney, R. E. Smith

from: Y. T. Lin, J. L. Tenney, and R. E. Smith, SNL/0333

subject: Vulnerability of Zone 4 Magazines to Impact by General Aviation Single Engine Aircraft

This study supports the DOE/AL and DOE/DP6.2 by providing an independent assessment of Section E.2.4 in the Environmental Assessment (EA) for Interim Storage of Plutonium Components at Pantex [1]. One potentially credible scenario identified in the EA is an aircraft crash into any magazine in Zone 4. The general aviation aircraft crash rate has been identified as the most dominant factor because of the large number of such flights near Pantex. We were asked to perform an independent validation concerning the approach taken in the EA to identify the number of general aviation single-engine aircraft having potential to damage the magazines such that subsequent plutonium release may be possible. In our study, we have estimated the crash frequencies for general aviation single-engine aircraft away from an airport as a function of aircraft weight, airspeed at impact, and impact angle. We then assessed the frequency of single-engine aircraft accidents that exceeded the threshold of magazine collapse. These calculations provide an alternative method to the assessment in the EA by considering aircraft weight, crash velocity, angle variability versus average stall/impact velocities, and aircraft weights.

Crash frequencies were estimated from the National Transportation Safety Board (NTSB) Aviation Accident/Incident Factual Report database. The NTSB database was queried to determine the fraction of the accidents that exceed the threshold for magazine collapse. The threshold in terms of weight and impact velocity was derived from Appendix C.8 of the FSAR [2] and a recent study[3]. With this information, the conditional impact probability for general aviation can be calculated and compared to the somewhat simpler approach of the EA.

Currently, in our NTSB database there are 19,723 total aircraft accident records listed from 1983 through 1990. There is no convenient method to filter out the general aviation aircraft from air taxis, commuters, and air carriers because the same plane can fly under different registrations and regulations. We can, however, filter the single-engine aircraft data by using the number of engines listed in the NTSB data fields. We decided to use all single-engine aircraft less than 12,500 lbs weight category (small size) to represent single-engine general aviation aircraft. Next, single-engine aircraft destroyed or substantially damaged in an accident were retrieved for our study. This left 2,581 aircraft accidents for evaluation (787 aircraft had substantial damage; 1794 aircraft were destroyed). A list of these accidents is presented in Attachment 1.

Another filter applied in our study was the accident distance from the airport. Accident distance is defined as the distance from the aircraft crash site to the center of the closest airport. The closest airport is not necessarily the origin or destination airport. Of the 2,581 cases, 152 were located greater than 5 mi. from the closest airport. These 152 accidents representing the general aviation single-engine inflight accident scenario are tabulated in Table 1. A summary of single-engine aircraft crashes inflight is tabulated in Table 2 as a function of aircraft weight and airspeed at impact.

An aircraft impacting a magazine may result in the collapse of the structure due to total loading created by the aircraft or penetration of the magazine due to massive aircraft parts such as engines. Previous analyses indicated that collapse is the most credible scenario for small aircraft. The analyses presented in reference [2] indicate that single-engine aircraft may have the ability to collapse an MR or a SAC magazine provided that the combination of mass and speed is sufficiently great. Table 3 shows composite aircraft combinations of weight and speed that have the potential to collapse either the MR or the SAC magazine at 90 degree impact angle (a vertical impact into the top of the magazine). Using these values, the number of inflight single-engine aircraft accidents in which the combination of weight and impact speed exceeded this threshold (shown as ### in the Table 2) were counted. Of 152 accidents, 46 are above the threshold.

Preliminary study of the 46 accidents above the threshold revealed that 19 had records on the actual impact angle. Of these 19 accidents, only two had a flight path angle greater than 45 degrees. A threshold of 45 degrees impact angle was selected to filter out crashes sufficiently different from a direct vertical impact into a magazine so as not to result in a magazine collapse. Since a data set of 19 incidents is relatively small, we checked the larger set of the 152 single-engine aircraft accidents greater than five miles from an airport. From these 152 accidents, 46 had kinematics impact angle data and seven of these 46 exceeded 45 degrees. This gives a ratio 7/46=0.15 instead of 2/19=0.11 for aircraft impact angles greater than 45 degrees. Further investigation of the larger set of 2581 single-engine aircraft accidents with aircraft destroyed or substantially damaged indicates that 1135 accidents had impact angles listed, and 277 of these 1135 exceeded 45 degrees. These simple statistics indicate that only a fraction of the accidents would be expected to have the conditions sufficient to collapse a magazine. These flight path angle distributions are summarized in Table 4.

Table 1 - Brief Listing of Inflight Single-Engine Aircraft Accidents

NTSB NBR	AIRCRAFT WGT	AIRSPEED IMPAC	FLT PATH ANGL	DISTANCE AIRPO	AIRCRAFT DAMA
ANC83FA122	4300	3	10	10	4
ANC83FA126	3000	3	0	6	3
ANC83FA152	3320	6	0	15	4
ANC83FAA07	900	6	9	15	4
ANC84FA176	2050	4	3	75	3
ATL83FA117	2550	7	5	6	4
ATL83FA129	2950	0	3	6	4
ATL83FA161	2800	8	2	15	4
ATL83FA176	3325	8	3	20	4
ATL83FA198	3600	0	0	25	4
ATL83FA340	3800	6	0	12	3
ATL83FKG11	4000	5	0	12	3
ATL83FU006	517	2	0	6	3
ATL84AA053	3600	0	3	7	4
ATL84FA028	3600	8	0	8	4
ATL84FA068	2300	7	3	9	4
ATL84FA075	2740	4	0	17	4
ATL84FA088	4000	6	-0	7	4
ATL84FA106	3600	7	4	6	4
ATL85FA060	2200	6	0	10	4
ATL85FA071	2300	4	0	25	3
CHI83FA080	1950	5	0	9	4
CHI83FA334	2550	8	5	12	4
CHI83FA366	3272	0	0	8	4
CHI83FA407	1670	3	0	7	4
CHI84AA016	925	7	0	8	4
CHI84FA073	2500	8	0	8	4
CHI84FA282	3350	5	0	20	4
DEN83FA122	3200	1	0	45	3
DEN83FA203	1500	5	0	25	4
DEN83FA222	1750	5	2	13	4
DEN83FTE12	2900	5	0	8	3
DEN83FTM05	550	3	11	25	3
DEN84FA011	2550	0	2	28	4
DEN84FA106	4850	2	0	20	3
DEN84FA142	2100	0	0	10	3
DEN84FA144	2450	3	0	15	4
DEN85FA035	2800	6	0	15	4
FTW83FA134	2550	4	3	10	4
FTW83FA144	2150	7	3	8	4
FTW83FA222	2200	6	8	11	4
FTW83FA226	2800	4	0	10	4
FTW83FA311	2450	2	0	10	4
FTW83FA343	1670	3	0	7	4
FTW83FA361	2900	9	3	19	4
FTW83FA373	2500	8	0	10	4
FTW84FA060	1670	6	0	9	4
FTW84FA102	2850	0	0	10	4
FTW84FA121	3600	6	0	9	3
FTW84MA069	4000	8	0	8	4
FTW85FA084	3600	6	0	35	4
LAX83FA455	2150	5	0	12	4
LAX83FUJ12	2650	5	0	10	3
LAX83FVG10	1650	0	0	8	4
LAX83LUQ01	1670	6	0	45	4
LAX84FA032	1450	1	0	12	3
LAX84FA047	2300	7	8	35	4
LAX84FA055	1700	6	0	11	4
LAX84FA444	3800	4	0	63	3
LAX85FA048	2300	6	7	7	4
LAX85FA086	2300	7	0	9	4
LAX85FA093	2950	9	0	8	4

Table 1 - Brief Listing of Inflight Single-Engine Aircraft Accidents (continued)

NTSB NBR	AIRCRAFT WGT	AIRSPEED IMPAC	FLT PATH ANGL	DISTANCE AIRPO	AIRCRAFT DAMA
LAX85FVW01	1600	2	0	12	3
MIA85FA038	3900	4	0	16	4
MKC84FA262	790	0	0	10	3
NYC83FA085	2750	7	0	10	4
NYC83FA086	3800	3	0	6	3
NYC83FA087	3600	8	0	8	4
NYC83FA091	2300	7	0	16	4
NYC83FA107	2800	7	2	7	4
NYC83FA125	1950	7	0	7	4
NYC83FA187	2400	7	0	10	4
NYC83FA242	3600	0	0	6	4
NYC83FHA03	2000	0	0	13	3
NYC84FA269	4118	0	0	10	4
NYC84FGM01	2325	0	7	10	4
SEA83FA037	4000	8	3	7	4
SEA83FYA02	1650	6	0	10	3
SEA84FA015	1600	4	0	14	4
SEA84FA020	1300	2	0	20	4
SEA84FA058	3000	7	0	11	4
SEA84FA078	3125	4	0	7	4
ANC86FA130	2800	7	0	35	3
ATL85FA081	2800	4	0	13	4
ATL85FA143	2650	5	0	12	4
ATL85FA170	4000	1	4	8	4
ATL85FLT12	1600	3	3	12	3
ATL86FA003	2300	6	0	10	4
ATL86FA028	3400	7	0	13	4
ATL86FA084	12499	1	0	10	3
ATL86FA126	2450	7	0	13	4
ATL86FA259	1600	6	11	8	4
ATL86FKG03	2950	0	0	7	4
ATL87FA004	2550	4	0	10	3
ATL87FA021	3800	0	0	17	3
BFO85FA025	2150	5	0	15	3
BFO85FA070	1450	6	0	7	4
BFO86FA002	3600	0	4	6	4
BFO86FIA01	1560	4	0	7	4
BFO87FA004	2750	7	0	8	4
CHI85FEI02	2300	0	0	7	3
CHI86FA100A	2300	7	0	14	4
CHI86FEX06	3400	5	3	8	4
CHI87FA048	2650	5	6	33	3
DEN85FA067	4150	7	0	15	4
DEN85FA097	2740	8	9	26	4
DEN85FA202	2200	6	5	10	4
DEN85FA203	2550	7	3	27	4
DEN86FA028	2900	7	8	45	4
DEN86FA071	2800	5	0	15	4
DEN86FA115	4000	4	0	15	3
FTW85FA180	1670	5	0	8	4
FTW85FA220	3100	6	11	8	4
FTW85FA331	1804	5	0	6	4
FTW86FA046	1450	4	8	12	4
FTW86FA092	3800	9	11	31	4
FTW86FQG04	1560	0	0	9	4
FTW86FRD10	2150	4	3	8	3
FTW86FRD24	2350	0	0	15	3
FTW86FRG02	2900	5	0	25	3
FTW86MA010	3400	5	9	20	4
FTW87FA017	1670	4	6	61	4
FTW87FA029	2650	8	0	15	4
LAX85FA102	3400	4	0	25	4

Table 1 - Brief Listing of Inflight Single-Engine Aircraft Accidents (continued)

NTSB NBR	AIRCRAFT WGT	AIRSPEED IMPAC	FLT PATH ANGL	DISTANCE AIRPO	AIRCRAFT DAMA
LAX85FA115	9500	5	4	25	4
LAX85FA178	1600	6	8	10	4
LAX86FA038	2000	0	0	28	4
LAX87FA066	2740	0	0	26	3
LAX87MA018	2250	0	0	9	4
LAX87MA068A	2325	0	0	16	3
LAX87MA068B	2900	0	3	16	3
MKC85FA089	3200	7	0	15	4
MKC85FA189	2850	1	0	10	3
NYC85FA227	1600	0	0	15	4
NYC86FA057	2800	0	9	6	4
NYC87FA023	2550	7	3	7	4
ANC88FA021	3200	8	0	7	4
ATL88FA068	2750	7	0	7	4
ATL88FA073	4000	5	0	10	4
ATL88FA109	1600	0	0	6	4
ATL88FA233	3400	0	0	12	4
CHI88DEE07	2050	1	0	8	3
DEN87FA064	4000	8	3	11	4
DEN88FA016	3600	9	3	12	4
FTW87FA123	3600	4	11	8	4
FTW88DPJ08	1670	2	7	13	3
FTW88DRD20	1450	8	11	10	4
FTW88FA011	2300	4	0	16	4
LAX87FA087	7000	10	3	46	4
LAX88FA278	3800	5	0	6	4
KC87DCQ02	3800	0	0	9	4
A87FA185	3300	0	0	7	4

Table 2 - Single Engine Aircraft Crash Frequencies for Various Weights and Speed

AIRCRAFT_WGT	Airspeed At Impact (mph)										
	Other	0-17	17-35	35-52	52-69	69-86	86-104	104-138	138-173	173-207	207-242
	0	1	2	3	4	5	6	7	8	9	10
500 to 999	1		1	1			1	1			
1000 to 1499		1	1		1		1		1		
1500 to 1999	4		2	3	3	5	6	1			
2000 to 2499	8	1	1	1	4	2	5	8			
2500 to 2999	7	1			5	6	1	9	6	2	
3000 to 3499	3	1		1	2	3	2	3	2		
3500 to 3999	6			1	3	1	3	1	2	2	
4000 to 4499	1	1		1	1	2	1	1	3		
4500 to 4999			1								
7000 to 7499											1
9500 to 9999						1					
12000 to 12499		1									
Total :	30	6	6	8	19	20	20	24	14	4	1

Table 3 - Thresholds for Potential Collapse of Magazine at 90 Degree Impact

Aircraft Weight (lbs.)	Airspeed At Impact (fps)	Airspeed At Impact(mph)
500	407	278
1000	320	218
1500	235	160
2000	206	140
2500	182	124
3000	166	113
3500	154	105
4000	143	98
4500	136	93
5000	130	88
5500	125	85
6000	120	82
6500	112	76
7000	104	71
7500	97	66
8000	92	63
8500	85	58
9000	80	55
9500	75	51
10000	70	48
10500	67	46
11000	64	44
11500	61	42
12000	58	40
12500	56	38

Table 4 - Single-Engine Crash Flight Path Angle Distribution

Flight Path Angle		Destroyed/Damaged Accidents(2581 Cases)	Inflight Accidents (152 Cases)	Accidents Exceeded Threshold (46 Cases)
(0)	Other	1431	103	25
(1)	Up	3	0	0
(2)	Down	12	3	2
(3)	0-5 deg.	310	18	10
(4)	5-10 deg.	147	4	2
(5)	10-15 deg.	111	3	2
(6)	15-20 deg.	69	2	0
(7)	20-25 deg.	40	3	0
(8)	25-30 deg.	65	5	2
(9)	30-45 deg.	116	4	1
(10)	45-60 deg.	84	1	0
(11)	60-90 deg.	193	6	2
No. of accidents(45-90 deg)		277	7	2
No. of accidents (0-90 deg)		1135	46	19

To actually assess the effects of impact angle on the impact threshold, we used the most recent calculations presented in reference [3]. The reference addressed the revisions to the aircraft impact analysis in accordance with the ASCE method [4] and the USAF method [5]. The most significant change resulting from this revision was that the ASCE method predicts shorter natural periods (as a result of larger effective moments of inertia), a lower allowable ductility ratio, and shorter load duration [3]. The loading was modified from that used in the original FSAR [2] in that the duration of the load was shortened. The response of the structure was estimated for load duration based on the estimated stopping distance of the aircraft and its length. The results of this assumption make a significant difference in the anticipated response. The effective loaded area was estimated using two methods for distributing the load. These two methods result in significant differences at only fairly low angles of impact. Both methods result in a distributed load over a span. A unit width of the roof was then analyzed for the response. In the original FSAR calculations a four foot wide strip was assumed to carry the entire impact load. The vulnerability curves from reference [3] are plotted in Figures 1 and 2.

Based on the 152 accidents listed in Table 1, 39 accidents had actual kinematics impact speed and impact angle data listed. Each of 39 accidents was then tested against the vulnerability curve to identify the accidents that had the potential to collapse an MR magazine. Of those 39 accidents, only one accident was above the threshold using the ASCE method and none of the accidents was above the threshold using the USAF method. This gives the fraction of the accidents with conditions sufficient to cause collapse as 1/39 = 0.025. Further filtering of the large data set of 2581 single-engine aircraft accidents listed in Attachment 1 indicates that 1060 accidents had both impact angle and impact speed listed. Again, each of the 1060 accidents were tested against the aircraft weight, impact speed, and impact angle given in the vulnerability curve to identify the accidents with conditions sufficient to collapse a magazine. Thirty-three accidents were above the impact threshold by the ASCE method and 20 accidents were above the impact threshold by the USAF method. Thus, the fraction of accidents with conditions sufficient to cause collapse is 33/1060 = 0.03. This ratio was selected because it has a larger data base and provides a larger value which should be more defensible.

Data reported in the EA, Section E.4.2, indicates that approximately 77% (0.77) of general aviation flights are single-engine and 23% (0.23) are not single-engine. Therefore, the impact probability for general aviation (1.52E-06) reported in Table E-11 of the EA can be written:

(1.52E-06*0.23)*(3.3E-08/7.1E-08) + (1.52E-06 * 0.77)* 0.03*(9.1E-08/7.1E-08)

or 1.62E-07 + 0.45E-07 = 2.07E-07

The first term above (1.62E-07) accounts for the 23% of the impact probability attributable to all general aviation except single-engine aircraft, which is also modified by updating the crash rate to account for deletion of the single-engine aircraft. The number, 3.3E-08, is the general aviation crash rate per mile without single-engine aircraft and the number, 7.1E-08, is the average general aviation aircraft crash rate per mile in Table E-6 of the EA. The second term accounts for that fraction of the single-engine aircraft that have sufficient weight and speed to have the potential to collapse a magazine. The number,

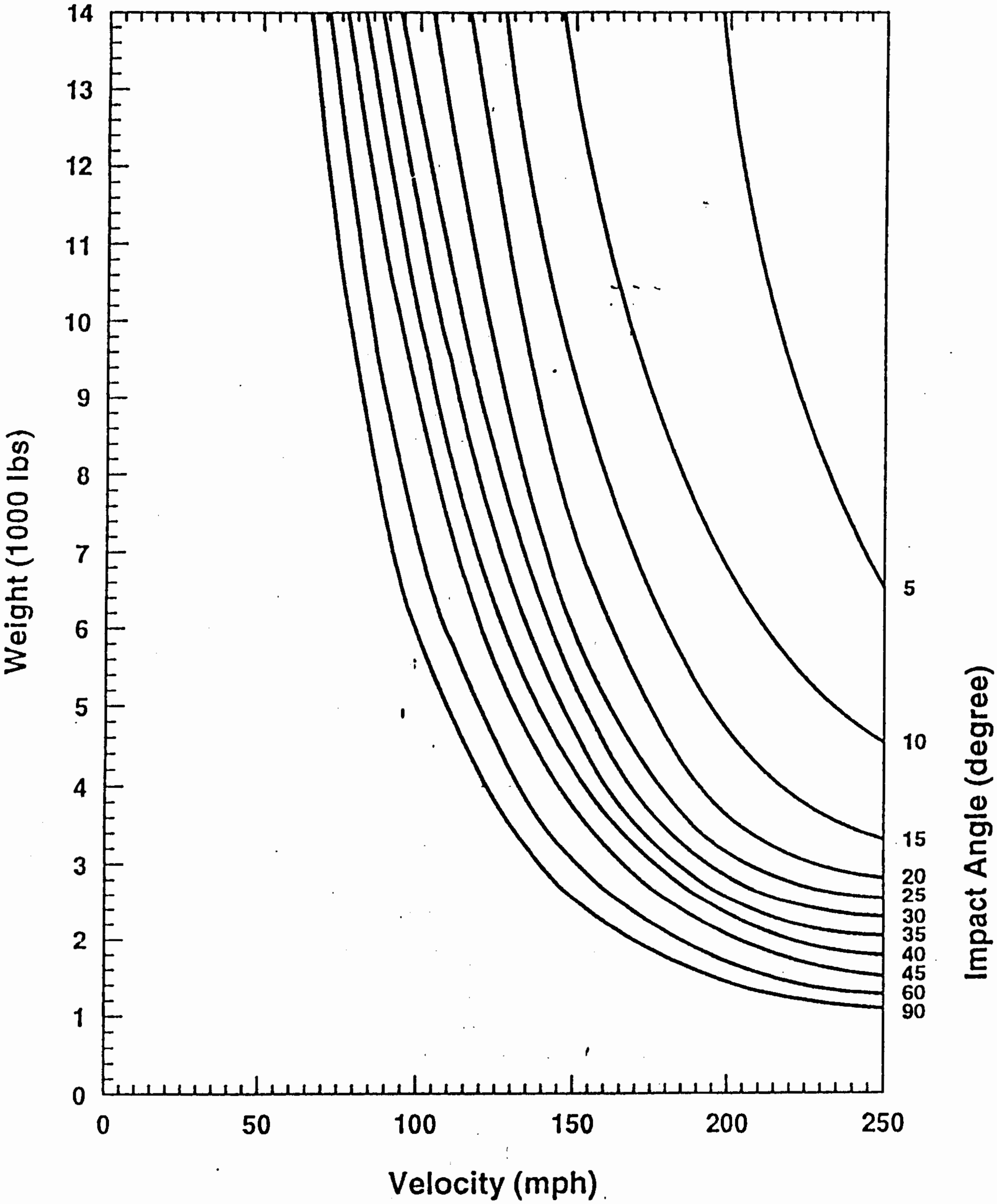


Figure 1 - Vulnerability Curves Generated By ASCE Method.

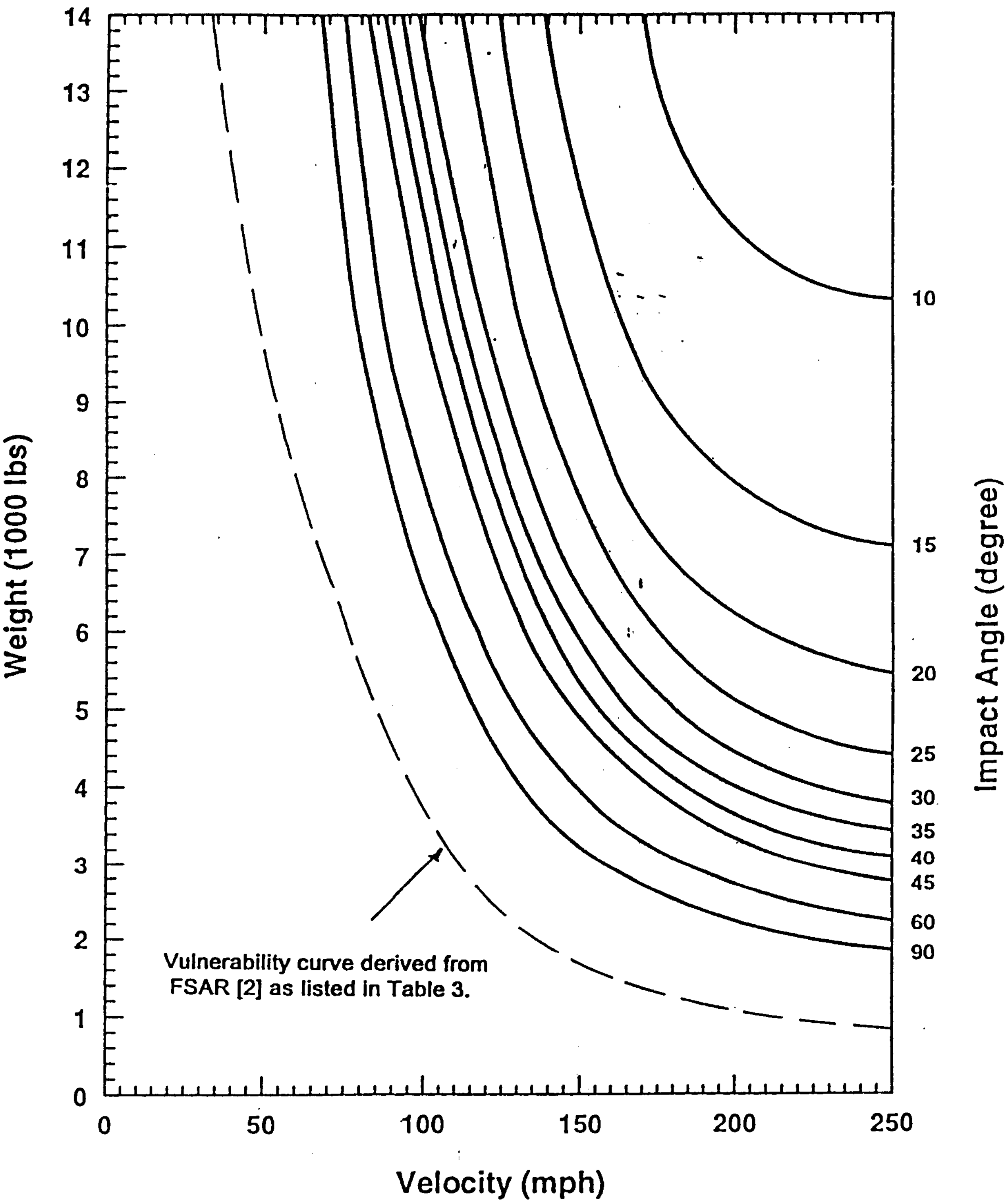


Figure 2 - Vulnerability Curves Generated By USAF Method.

9.1E-08, is the single-engine crash rate per mile. Here the crash rate has been modified to reflect only the higher rate for the single-engine aircraft. This results in the refined estimate of the probability of impact with potential for adverse consequences shown in Table 5.

Table 5 - Annual Probabilities of Aircraft Crashes With Potential For Significant Consequences

Aircraft Class	Crash Probability/Year Verification Analysis	Crash Probability/Year EA Analysis
Air Carrier	2.78E-08	2.78E-08
Military Aviation	2.50E-07	2.50E-07
General Aviation	2.07E-07	3.31E-07
Aerial Application	5.42E-08	5.42E-08
Total	**5.39E-07**	**6.63E-07**

These numbers reflect the probability of the particular categories of aircraft impacting a magazine with the potential to cause damage to the magazine. It should be noted that this is still a conservative estimate because we have not reduced or modified the skid area.

Our estimates consider only the probability of impact, they do not reflect the probability that a release of plutonium will occur. This latter probability is a function of the conditional probability that the containers and contents of the magazine are damaged if the magazine is damaged. These conditional probabilities are not readily quantified because the combined damage of magazine and contents represents a complex scenario that is further complicated by a lack of sound data and thorough analysis. Nevertheless, the product of this sequence of conditional probabilities leading to release will be less than one, and it is likely to be significantly less than one. From this analysis, we conclude that the probability estimate for general aviation aircraft having conditions sufficient to collapse the magazines in Zone 4 as given in the EA is within a reasonable fraction of the more refined analysis given here.

In our opinion, the annual probability of general aviation crashes with the potential for significant consequences presented in EA is a valid and reasonable assessment of the probability.

References

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2. Final Safety Analysis, Appendix C.8,Pantex Plant Site, Amarillo, Texas, US. Dept. of Energy, December, 1992.

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4. Structural Analysis and Design of Nuclear Plant Facilities, Chapter 6, Design Against Impulse and Impact Loads, ASCE - Manuals/Reports on Engineering Practice, No. 58, American Society of Civil Engineers, 1980.

5. The Air Force Manual for Design and Analysis of Hardened Structures, Volume 1, Sections 1 through 8, Air Force Weapons Laboratory Technical Report 87-57 (WI-TR-87-57), June 1987.

Copy to:

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0333 NSIC File P-2A

Attachment 1 - A Brief Listing Of Single-Engine Aircraft Accidents

This attachment lists 2,581 single-engine aircraft accidents retrieved from our current NTSB database. The meaning of the columns are listed in the following table:

Column	Data	Code	
1	NTSB accident/incident number		
2	Aircraft weight in lb.		
3	Distance of crash site from center of nearest airport in miles		
4	Aircraft damage	1 = none 2 = minor 3 = substantial 4 = destroyed	
5	Airspeed at impact in knots	1 = 0-15 2 = 15-30 3 = 30-45 4 = 45-60 5 = 60-75 6 = 75-90	7 = 90-120 8 = 120-150 9 = 150-180 10 = 180-210 11 = 210 plus 0 = other
6	Flight path angle at impact in degrees	0 = other 1 = up 2 = down 3 = 0-5 4 = 5-10 5 = 10-15	6 = 15-20 7 = 20-25 8 = 25-30 9 = 30-45 10 = 45-60 11 = 60-90

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
ANC83FA030	3800	5	3	5	0
ANC83FA032	3200	0	4	4	0
ANC83FA033	1650	0	3	3	0
ANC83FA037	3400	0	3	5	0
ANC83FA042	1800	0	4	0	0
ANC83FA064	1625	0	3	3	0
ANC83FA070	1500	3	3	4	0
ANC83FA071	3400	0	3	6	0
ANC83FA092	2450	0	3	1	0
ANC83FA095	3300	0	3	6	0
ANC83FA113	3800	0	3	4	0
ANC83FA120	2800	0	3	4	0
ANC83FA122	4300	10	4	3	10
ANC83FA126	3000	6	3	3	0
ANC83FA127	1200	0	3	3	0
ANC83FA134	1600	0	3	1	0
ANC83FA139	1650	0	3	4	0
ANC83FA144	4250	0	3	1	0
ANC83FA146	3600	4	4	4	3
ANC83FA152	3320	15	4	6	0
ANC83FA154	2800	0	4	8	0
ANC83FA161	1650	0	3	3	0
ANC83FA167	1750	0	4	4	0
ANC83FAA06	2400	1	4	8	0
ANC83FAA07	900	15	4	6	9
ANC83FAG02	2300	0	3	4	0
ANC83FAG03	3350	1	4	8	8
ANC84FA016	2300	5	3	0	0
ANC84FA036	2300	0	3	3	0
ANC84FA043	3800	0	3	4	0
ANC84FA051	3400	0	4	0	11
ANC84FA052	1650	0	3	0	0
ANC84FA056	1800	0	3	1	0
ANC84FA063	2300	0	3	4	0
ANC84FA067	3200	0	3	1	0
ANC84FA068	2950	0	3	0	0
ANC84FA091	4250	0	3	2	0
ANC84FA116	3400	0	3	4	5

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
ANC84FA140	2950	0	3	3	4
ANC84FA141	2400	0	4	6	0
ANC84FA166	1750	0	3	3	0
ANC84FA169	2100	0	4	7	0
ANC84FA175	2800	1	4	0	0
ANC84FA176	2050	75	3	4	3
ANC84FA189	4000	2	3	4	0
ANC84FA190	1800	0	3	6	0
ANC84FA194	1725	3	3	4	0
ANC85FA012	2500	0	3	4	0
ANC85FA023	2900	0	3	7	0
ANC85FA026	1750	0	4	1	0
ANC85FA027	1450	0	3	3	0
ANC85FA031	1750	0	3	3	8
ANC85FA036	3200	0	4	7	0
ANC85FA040	1750	0	4	7	10
ANC85FA042	1750	0	3	2	0
ANC85FA048	1670	0	3	3	0
ANC85FA052	3200	0	4	3	0
ANC85FA056	1750	0	3	3	10
ANC85FA063	1750	0	3	3	0
ANC85FA065	3200	0	3	2	0
ANC85FA078	2800	0	4	0	0
ANC85FA085	3800	0	3	7	0
ANC85FA090	1313	0	3	3	3
ANC85FA092	1650	0	3	4	0
ANC85FA093	3800	0	3	4	3
ANC85FA095	3800	0	3	7	9
ANC85FA100	2950	0	3	2	3
ANC85FA107	1760	0	3	5	0
ANC85FA111	1750	0	4	4	0
ANC85FA124	3320	0	3	4	10
ANC85FA135	3550	0	4	8	5
ANC85FA136	2800	1	3	3	8
ANC85FA184	5090	0	4	2	0
ANC86FA007	7300	1	4	6	6
ANC86FA009	3400	0	4	5	3
ANC86FA014	3600	0	3	0	0
ANC86FA035	3350	1	3	4	8
ANC86FA055	2350	0	4	5	3
ANC86FA057	12125	0	3	6	8

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
ANC86FA071	1625	0	3	4	3
ANC86FA074	2300	0	3	3	4
ANC86FA080	1650	0	3	0	4
ANC86FA081	1625	0	4	4	3
ANC86FA085	1220	0	3	4	0
ANC86FA114	1650	0	3	3	0
ANC86FA116	2078	0	4	0	0
ANC86FA118B	1670	0	3	9	0
ANC86FA126B	2550	0	3	1	0
ANC86FA130	2800	35	3	7	0
ANC86FA151	1760	0	4	3	9
ANC86FA152	1850	0	3	4	9
ANC86LAG06	1080	0	4	8	8
ANC86MA027	3800	0	4	7	3
ANC87DAG03	850	0	3	2	0
ANC87FA023	3800	0	4	7	3
ANC87FA025	1670	0	3	1	3
ANC87FA028	3800	1	4	6	5
ANC87FA031	1350	0	3	2	0
ANC87FA036	1650	0	3	4	4
ANC87FA043	2450	0	3	1	3
ANC87FA051	3200	0	3	4	0
ANC87FA084	3320	0	3	3	0
ANC87FA097	1750	0	3	3	11
ANC87FA101	3350	0	4	6	11
ANC87FA112	1750	1	3	3	8
ANC87FA117	3600	0	4	0	0
ANC87FA118	5090	0	3	1	3
ANC87FA137	2600	1	3	3	4
ANC87FA138	2450	0	3	3	0
ANC87FA153	1625	0	4	4	9
ANC88DAG06	651	0	3	2	0
ANC88FA011	1750	0	3	0	9
ANC88FA012	3200	0	3	5	3
ANC88FA020	3800	0	3	7	0
ANC88FA021	3200	7	4	8	0
ANC88FA022	7300	0	3	6	3
ANC88FA037	2650	0	4	0	0
ANC88FA045	1625	0	3	3	0
ANC88FA056	3600	0	3	2	0
ANC88FA057	1500	0	3	3	9

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
ANC88FA059	3400	0	4	7	3
ANC88FA062	5100	0	4	5	7
ANC88FA063A	3600	5	4	7	4
ANC88FA063B	4300	5	4	7	3
ANC88FA065	2200	0	4	2	4
ANC88FA067	5100	0	3	5	4
ANC88FA083	3320	0	3	7	0
ANC88LA053	1600	0	4	7	4
ANC89FA009	1750	0	3	0	0
ANC89FA028	2300	0	3	3	0
ATL83AA305	2750	0	4	8	0
ATL83FA083	2450	0	4	0	0
ATL83FA091	2450	1	4	0	0
ATL83FA095	2800	1	4	3	0
ATL83FA099	2400	0	4	7	0
ATL83FA116	2400	0	3	4	0
ATL83FA117	2550	6	4	7	5
ATL83FA121	2740	0	4	0	0
ATL83FA129	2950	6	4	0	3
ATL83FA135	2325	0	3	5	0
ATL83FA140	2150	0	4	6	0
ATL83FA144	1200	1	4	3	0
ATL83FA150	2200	0	3	0	0
ATL83FA155	2550	0	4	1	0
ATL83FA161	2800	15	4	8	2
ATL83FA163	3400	0	4	3	0
ATL83FA174	3600	0	4	7	0
ATL83FA176	3325	20	4	8	3
ATL83FA178	1600	1	3	4	0
ATL83FA179	1600	0	4	7	0
ATL83FA182	2400	0	3	0	0
ATL83FA185	1600	0	4	1	0
ATL83FA198	3600	25	4	0	0
ATL83FA213	1800	0	4	4	0
ATL83FA230	1500	0	3	4	0
ATL83FA232	2230	0	3	5	0
ATL83FA238	2300	0	3	6	0
ATL83FA249	7600	1	4	7	0
ATL83FA262	3125	0	4	7	2
ATL83FA263	1670	0	4	0	0
ATL83FA267	2300	0	3	4	10

ATL83FA270	3400	0	3	5	0
ATL83FA271	1220	0	4	4	11
ATL83FA272	1220	0	3	4	4
ATL83FA313	2800	0	3	4	8
ATL83FA339	1670	0	4	7	0
ATL83FA340	3800	12	3	6	0
ATL83FA365	5300	2	4	7	0
ATL83FA386	1600	0	3	4	0
ATL83FIA04	1670	0	4	5	0
ATL83FID04	3400	0	3	3	0
ATL83FIG03	2200	5	3	5	0
ATL83FIG04	3400	1	3	5	2
ATL83FIG06	1600	0	3	4	0
ATL83FIJ02	2950	1	4	0	0
ATL83FKG08	4000	0	4	4	2
ATL83FKG09	2200	0	3	1	0
ATL83FKG11	4000	12	3	5	0
ATL83FKJ02	1400	1	3	4	0
ATL83FKJ03	1500	0	4	0	9
ATL83FKJ05	1220	0	4	6	0
ATL83FKQ03	7000	0	3	0	0
ATL83FLJ01	2900	5	4	7	9
ATL83FU006	517	6	3	2	0
ATL83LA203	1006	0	3	4	0
ATL83LA204	2900	0	3	6	0
ATL84AA053	3600	7	4	0	3
ATL84FA001	3200	0	4	2	0
ATL84FA005	3300	0	4	4	0
ATL84FA017	1800	1	3	6	0
ATL84FA026	2800	5	3	5	0
ATL84FA028	3600	8	4	8	0
ATL84FA033	2300	1	4	6	0
ATL84FA054	2400	0	4	0	0
ATL84FA057	2600	0	3	2	0
ATL84FA059	3600	1	4	6	0
ATL84FA061	2900	1	4	6	0
ATL84FA068	2300	9	4	7	3
ATL84FA075	2740	17	4	4	0
ATL84FA080	3600	1	4	5	0
ATL84FA082	2500	0	4	4	0
ATL84FA088	4000	7	4	6	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
ATL84FA090	2450	0	4	10	0
ATL84FA092	3600	0	4	7	0
ATL84FA093	3600	5	4	0	0
ATL84FA095	1653	1	4	6	0
ATL84FA100	2450	0	4	1	0
ATL84FA106	3600	6	4	7	4
ATL84FA111	3600	0	4	9	0
ATL84FA116	3100	3	4	8	0
ATL84FA129	3400	0	3	5	0
ATL84FA133	3650	0	3	6	0
ATL84FA141	2950	0	4	7	0
ATL84FA147	2400	0	4	5	0
ATL84FA150	3400	1	4	6	0
ATL84FA151	3400	0	4	6	0
ATL84FA158	3200	0	4	4	10
ATL84FA164	3325	0	4	5	0
ATL84FA168	2658	0	4	11	11
ATL84FA172	2950	1	4	6	4
ATL84FA184	3600	0	4	0	11
ATL84FA190	2750	0	3	3	0
ATL84FA193	1600	1	4	8	0
ATL84FA216	1600	0	3	6	0
ATL84FA218	3000	0	4	2	0
ATL84FA222	3600	0	4	0	0
ATL84FA225	1930	0	4	5	9
ATL84FA250	1600	0	4	4	8
ATL84FA252	2717	0	3	4	0
ATL84FA268	4200	0	4	5	0
ATL84FA275	3100	2	4	4	4
ATL84FA292	2740	5	4	8	0
ATL84FA297	3200	0	4	1	0
ATL84FA298	3400	0	4	0	0
ATL84FIA01	1600	1	3	0	0
ATL84FIG01	2600	0	4	4	0
ATL84FIJ02	1500	0	3	3	0
ATL84FKJ02	3300	3	4	7	5
ATL84FLT07	3500	0	3	2	0
ATL84FLT10	10500	0	4	6	0
ATL84FMG05	3600	0	4	0	0
ATL84FU002	510	0	4	3	0
ATL84FU003	465	0	4	5	0

ATL84FU005	370	0	4	2	0
ATL84LA027	1450	0	3	0	0
ATL84MA101	3400	0	4	8	0
ATL84MA208	3400	0	4	0	0
ATL85FA007B	1670	1	4	6	0
ATL85FA008	1600	1	4	5	4
ATL85FA011	5200	0	4	0	0
ATL85FA013	1600	0	3	6	0
ATL85FA020	1650	1	4	4	8
ATL85FA041	2300	0	3	6	5
ATL85FA043	2950	0	4	5	0
ATL85FA050	3135	0	4	7	0
ATL85FA056	2450	0	4	5	0
ATL85FA060	2200	10	4	6	0
ATL85FA061	2325	1	4	6	0
ATL85FA070	1300	0	4	1	11
ATL85FA071	2300	25	3	4	0
ATL85FA072	2650	2	4	7	3
ATL85FA077	3100	0	4	8	0
ATL85FA081	2800	13	4	4	0
ATL85FA090	1670	0	3	5	0
ATL85FA101	3100	0	4	7	0
ATL85FA106	1670	4	4	8	5
ATL85FA113	2800	0	4	8	6
ATL85FA118	2800	1	4	5	0
ATL85FA140	1450	0	4	7	0
ATL85FA143	2650	12	4	5	0
ATL85FA146	3400	0	4	11	11
ATL85FA147	1670	0	4	0	11
ATL85FA157	2740	0	4	0	0
ATL85FA165	2325	2	3	0	0
ATL85FA170	4000	8	4	1	4
ATL85FA171	2550	1	4	7	0
ATL85FA173	3100	0	4	6	4
ATL85FA179	2150	2	3	5	0
ATL85FA181	3600	5	3	6	0
ATL85FA182	1650	0	4	4	0
ATL85FA189	2300	0	4	5	11
ATL85FA191	1450	1	3	4	0
ATL85FA198	1220	0	3	6	0
ATL85FA216	1570	0	3	2	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
ATL85FA230	3800	2	3	4	0
ATL85FA237	2200	0	3	5	0
ATL85FA242	2400	1	4	6	0
ATL85FA243	1600	1	4	4	0
ATL85FA252	2575	0	4	6	0
ATL85FA266	2900	0	4	0	0
ATL85FA276	1150	0	4	0	11
ATL85FA278	1800	0	3	0	0
ATL85FA280	2300	1	3	5	3
ATL85FA285	3600	1	4	4	9
ATL85FLT02	2800	0	3	5	3
ATL85FLT05	2500	0	3	3	0
ATL85FLT06	1600	0	3	4	9
ATL85FLT09	1600	0	4	1	0
ATL85FLT12	1600	12	3	3	3
ATL85FMG03	1092	0	4	5	5
ATL85FMG05	750	5	4	3	0
ATL85FMG08	2650	5	4	4	3
ATL85LA122	2800	0	4	5	0
ATL85LLT11	3800	1	4	4	0
ATL85MA282B	790	0	4	2	0
ATL85MA286	7300	1	4	4	11
ATL86FA001	2300	0	4	3	0
ATL86FA002	1600	0	4	6	7
ATL86FA003	2300	10	4	6	0
ATL86FA009	2300	0	4	7	0
ATL86FA025	2950	3	3	5	0
ATL86FA028	3400	13	4	7	0
ATL86FA029	3100	1	4	7	11
ATL86FA034	2400	3	4	3	9
ATL86FA040	1800	0	4	7	0
ATL86FA041	2740	0	3	6	3
ATL86FA049	2800	1	4	5	3
ATL86FA064	3400	0	4	7	0
ATL86FA066	1670	1	3	4	0
ATL86FA077	2950	0	4	8	0
ATL86FA079	1675	2	4	8	0
ATL86FA081	1300	0	4	3	0
ATL86FA082	2355	0	3	0	0
ATL86FA084	12499	10	3	1	0
ATL86FA097	1370	0	4	5	0

ATL86FA102	8094	2	4	0	0
ATL86FA116A	1600	0	3	3	0
ATL86FA120	2200	0	4	8	0
ATL86FA126	2450	13	4	7	0
ATL86FA129	2950	0	3	6	0
ATL86FA132	2300	2	4	3	0
ATL86FA133	2075	0	4	5	5
ATL86FA148	1650	0	3	3	0
ATL86FA160	2985	0	4	4	8
ATL86FA176	2450	0	3	4	3
ATL86FA178	1450	0	4	6	7
ATL86FA212	2300	3	4	6	4
ATL86FA217	2150	0	4	4	3
ATL86FA220	3000	0	4	6	9
ATL86FA222	2575	1	4	5	0
ATL86FA223	3000	0	4	9	0
ATL86FA235	1150	0	4	2	9
ATL86FA239	3600	5	4	6	4
ATL86FA240	2150	0	4	7	4
ATL86FA242	1260	0	4	2	0
ATL86FA259	1600	8	4	6	11
ATL86FA266	1100	0	4	4	11
ATL86FEI03	2200	0	3	4	4
ATL86FEI04	1670	0	3	2	3
ATL86FEI05	1100	0	3	0	0
ATL86FEI06	1350	1	4	4	9
ATL86FEI08	2562	0	3	3	4
ATL86FEI09	3223	0	4	4	0
ATL86FEK02	1089	0	3	0	0
ATL86FEK03	3200	0	3	3	0
ATL86FKG01	3400	0	4	4	0
ATL86FKG03	2950	7	4	0	0
ATL86FKG04	2740	5	4	7	3
ATL86FKG07	2400	0	4	7	3
ATL86FKG10	4500	0	3	5	0
ATL86FLQ02	2500	0	3	4	0
ATL86FLQ03	2900	0	3	6	5
ATL86FLQ06	925	0	4	5	0
ATL86FMG05	1600	0	3	6	0
ATL86LA189	2200	5	3	4	3
ATL86LMG06	1600	0	4	5	7

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
ATL86MA087	3400	0	4	5	11
ATL86MA114A	4150	0	4	7	0
ATL86MA114B	2400	0	3	7	0
ATL87DEG03	1880	1	4	3	11
ATL87DEG04	500	0	3	2	3
ATL87DEG05	2150	0	3	1	11
ATL87DEI01	2800	0	3	5	8
ATL87DEI04	1265	5	3	4	3
ATL87DEI05	2450	0	3	1	0
ATL87DEI06	1700	0	4	8	11
ATL87DEI08	4500	0	3	5	0
ATL87DEI09	2200	0	3	0	0
ATL87DEI11	2400	0	3	4	4
ATL87DEI12	1450	0	3	2	0
ATL87DEI13	1500	0	3	4	3
ATL87DEK03	900	0	3	4	0
ATL87DKG05	4500	0	3	4	4
ATL87DKG07	4500	0	4	6	9
ATL87DLQ01	1050	0	4	5	0
ATL87DLQ04	2150	0	4	5	0
ATL87DLT02	2000	0	3	4	0
ATL87DMG02	2900	0	4	6	3
ATL87FA001A	1170	0	4	4	11
ATL87FA001B	3100	0	4	5	11
ATL87FA003	3000	1	4	4	7
ATL87FA004	2550	10	3	4	0
ATL87FA006A	1500	1	3	3	3
ATL87FA006B	1170	1	3	6	4
ATL87FA007	3600	4	4	0	0
ATL87FA009	3200	5	3	1	10
ATL87FA010	1670	0	4	4	0
ATL87FA012	3400	2	4	5	6
ATL87FA016	925	2	4	3	10
ATL87FA017	3800	1	4	0	0
ATL87FA021	3800	17	3	0	0
ATL87FA029	3300	3	4	6	4
ATL37FA038A	3200	0	4	5	5
ATL87FA038B	2575	0	4	5	0
ATL87FA042	2150	0	4	5	5
ATL87FA045	2200	1	4	5	11
ATL87FA051	2900	1	3	8	4

ATL87FA052	1600	0	4	2	0
ATL87FA071	1670	0	4	0	11
ATL87FA074	2950	0	4	8	0
ATL87FA082	2950	1	4	7	0
ATL87FA087	1600	0	4	8	8
ATL87FA088	2450	0	4	4	0
ATL87FA104	2300	0	4	0	0
ATL87FA111	1220	1	4	5	0
ATL87FA130A	3100	0	4	0	0
ATL87FA130B	2300	0	4	0	0
ATL87FA132	1220	2	4	6	11
ATL87FA136	1200	5	4	0	9
ATL87FA147	2750	0	4	3	9
ATL87FA160	1570	0	4	5	4
ATL87FA168	3300	0	4	5	0
ATL87FA174	2600	0	4	7	11
ATL87FA187	3400	0	4	4	3
ATL87FA189	2450	0	4	6	0
ATL87FA194	2070	1	4	3	11
ATL87FA209	1670	0	4	5	4
ATL87FA230	2650	0	4	8	11
ATL87FA234	2150	0	4	0	0
ATL87FA235	2200	0	4	6	3
ATL87FA243	2650	0	4	7	11
ATL87FA244	1600	0	3	6	4
ATL87FA248	2550	0	4	6	0
ATL87FA257	3400	0	4	9	0
ATL87FKG01	900	1	4	5	11
ATL87LA044	2200	0	4	1	0
ATL87LA149	1600	0	3	3	8
ATL87LA267	1950	0	3	1	3
ATL87MA035	4050	5	4	7	3
ATL87MA057	4150	0	4	0	0
ATL88DKG03	1099	0	4	7	0
ATL88DKG08	7200	0	3	1	0
ATL88DKG09	4200	0	4	8	0
ATL88DKG10	4200	0	3	4	3
ATL88DKG11	2900	0	3	5	5
ATL88DKG12	2238	0	4	6	9
ATL88DKG15	6000	0	4	5	3
ATL88DKG17	3186	0	3	1	0

NTSB NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
ATL88DLT01	1500	0	4	0	0
ATL88DMG01	1555	0	4	5	11
ATL88FA010	2325	3	4	0	0
ATL88FA020	2750	5	3	6	10
ATL88FA025	850	0	4	4	0
ATL88FA040	2800	0	3	4	7
ATL88FA043	2300	0	4	5	0
ATL88FA044	3600	0	4	7	0
ATL88FA046	1670	1	4	5	0
ATL88FA055	3400	0	4	5	5
ATL88FA056	2150	0	3	5	0
ATL88FA060	3400	4	4	0	0
ATL88FA066	2800	5	4	0	11
ATL88FA067	2450	0	4	0	4
ATL88FA068	2750	7	4	7	0
ATL88FA070	1670	0	3	7	0
ATL88FA072	11000	0	4	8	9
ATL88FA073	4000	10	4	5	0
ATL88FA078	1600	0	3	5	10
ATL88FA081	2650	0	4	0	9
ATL88FA085	9500	0	4	0	0
ATL88FA088	1600	0	3	0	10
ATL88FA104	3600	0	4	6	0
ATL88FA106B	1675	0	3	5	5
ATL88FA109	1600	6	4	0	0
ATL88FA110	3600	5	4	7	0
ATL88FA118	1220	0	4	5	10
ATL88FA123	2450	0	3	0	0
ATL89FA125	2900	0	4	5	0
ATL88FA136	3600	0	4	0	9
ATL88FA155	1600	1	4	5	9
ATL88FA168	1600	0	3	0	0
ATL88FA174	2740	0	3	5	10
ATL88FA185A	2750	0	4	6	5
ATL88FA185B	2300	0	3	0	0
ATL88FA198	1600	0	4	5	0
ATL88FA199	1200	0	4	4	11
ATL88FA200	1970	0	4	3	10
ATL88FA210	3800	5	3	5	0
ATL88FA211	2350	0	4	4	0
ATL88FA219	2400	0	4	5	10

ATL88FA220	2325	0	3	4	3
ATL88FA231	2400	0	4	7	0
ATL88FA233	3400	12	4	0	0
ATL88FA254	3800	0	4	0	7
ATL88FA256	2700	0	4	9	10
ATL89DKG01	4500	0	3	4	0
ATL89DKG02	4200	0	3	4	3
ATL89FA005	1450	0	4	6	0
ATL89FA006	3800	0	3	5	0
ATL89FA013	2800	0	4	9	3
ATL89FA015	2500	0	4	7	0
ATL89FA019	1220	0	3	5	8
ATL89FA024	2900	0	3	5	3
ATL89FA025	1670	0	3	5	6
ATL89FA035	2050	0	4	4	9
ATL89FA036	1670	0	4	5	3
ATL89FA045	2150	0	4	8	0
ATL89FA047	3125	0	4	7	0
ATL89FA051	3200	0	3	2	11
ATL89FA059	2300	2	4	6	4
ATL89LA030	2150	0	4	7	4
ATL89MA023	3100	2	4	7	0
ATL89MA070	2400	0	4	0	11
BFO84FA001	2900	0	4	9	0
BFO84FA003	1500	1	4	0	0
BFO84FA008	2150	3	4	4	0
BFO85FA002	3600	0	4	7	5
BFO85FA004	1770	0	4	4	9
BFO85FA006	1220	0	4	7	11
BFO85FA007	1100	0	3	4	3
BFO85FA008	2450	0	3	4	0
BFO85FA009	2200	0	4	3	0
BFO85FA013	6615	0	3	3	0
BFO85FA023	2550	4	4	6	3
BFO85FA025	2150	15	3	5	0
BFO85FA026	2950	0	3	5	0
BFO85FA032	3325	3	3	3	0
BFO85FA048	2800	1	4	0	0
BFO85FA051	3325	1	4	5	5
BFO85FA052	2150	0	3	5	9
BFO85FA061	1670	0	3	7	11

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
BFO85FA062	1700	0	4	4	11
BFO85FA068	1800	1	4	4	11
BFO85FA070	1450	7	4	6	0
BFO85FA071	3100	0	4	8	4
BFO85FA077	1600	1	4	4	5
BFO85FID02	2500	1	3	4	0
BFO85FID03	3650	0	3	4	0
BFO86FA002	3600	6	4	0	4
BFO86FA006	720	0	4	4	0
BFO86FA011	2150	4	4	5	4
BFO86FA012	3100	0	3	5	4
BFO86FA015	3400	1	4	7	3
BFO86FA016	3100	1	4	5	4
BFO86FA018	2100	5	3	1	9
BFO86FA020	2300	0	3	4	4
BFO86FA021	2150	0	4	5	6
BFO86FA027	3325	1	4	4	10
BFO86FA029	1000	0	3	4	0
BFO86FA032	2900	0	4	6	4
BFO86FA036	2200	5	3	6	3
BFO86FA037	2150	0	4	11	5
BFO86FA044	2500	0	3	5	3
BFO86FA047	2150	0	4	6	11
BFO86FA050	2740	1	4	5	9
BFO86FIA01	1560	7	4	4	0
BFO86FIA02	2325	0	4	5	0
BFO86FID01	2300	1	4	2	0
BFO86FID03	1013	0	4	0	11
BFO86FID05	2100	1	3	5	3
BFO86FID08	550	0	4	0	0
BFO86FID10	1250	0	4	0	0
BFO86FIG03	1500	0	3	4	3
BFO86LA041	3000	1	3	4	4
BFO87DIG08	2350	0	3	4	0
BFO87FA003	2400	0	3	4	0
BFO87FA004	2750	8	4	7	0
BFO87FA006	2050	0	3	5	4
BFO87FA009	2440	0	4	7	3
BFO87FA020	1670	0	4	6	9
BFO87FA022	1300	0	4	0	3
BFO87FA027	2950	0	4	0	0

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
BFO87FA031	2800	0	4	0	0
BFO87FA037	1600	0	4	0	0
BFO87FA046	2400	0	4	0	0
BFO87FA050	2400	0	3	4	10
BFO87FA057	3200	0	4	1	11
BFO87FA062	2400	0	4	0	0
BFO87FIG04	8100	0	3	0	0
BFO88DIA01	1632	0	4	6	7
BFO88DID04	2300	0	4	6	10
BFO88DIG01	2500	0	3	0	0
BFO88DIG03	4500	0	4	4	4
BFO88FA007	1670	0	4	7	11
BFO88FA008	3400	0	4	0	0
BFO88FA009	2650	0	4	0	9
BFO88FA011	1650	0	4	6	4
BFO88FA014	4000	0	3	6	3
BFO88FA022	1600	0	4	5	0
BFO88FA024	2800	0	4	0	3
BFO88FA025	1600	1	3	4	3
BFO88FA026	3800	0	4	0	0
BFO88FA034	2150	0	4	5	9
BFO88FA046	2450	0	3	5	0
BFO88FA050	1950	0	3	0	0
BFO88FA051	1600	1	4	4	11
BFO88FA054	2800	0	3	4	5
BFO88FA060	3600	0	3	4	0
BFO88FA068	3100	0	4	0	0
BFO88FID02	1200	0	4	1	3
BFO88FID03	1670	1	4	0	0
BFO88FIG01	1670	0	3	3	0
BFO89DID01	1063	0	4	4	0
CHI83FA069	5300	0	4	0	0
CHI83FA076	2300	2	4	6	0
CHI83FA080	1950	9	4	5	0
CHI83FA086	3400	0	4	6	6
CHI83FA089	2300	2	4	5	4
CHI83FA090	2000	3	4	4	0
CHI83FA092	1500	0	3	3	0
CHI83FA125	1050	0	4	1	0
CHI83FA135	2325	0	4	7	0
CHI83FA161	2550	0	4	7	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
CHI83FA160	3100	3	4	7	0
CHI83FA213	2740	0	4	0	0
CHI83FA334	2550	12	4	8	5
CHI83FA336	630	0	4	3	0
CHI83FA346	1220	0	3	4	0
CHI83FA350	560	0	3	3	0
CHI83FA353	2400	0	3	0	0
CHI83FA366	3272	8	4	0	0
CHI83FA407	1670	7	4	3	0
CHI83FA440	900	0	4	6	9
CHI83FU008	525	0	4	3	0
CHI83FU010	550	0	4	0	0
CHI84AA016	925	8	4	7	0
CHI84FA037	1675	0	4	7	0
CHI84FA054	1675	1	4	5	5
CHI84FA058	3800	0	3	8	0
CHI84FA063	1600	0	4	7	11
CHI84FA073	2500	8	4	8	0
CHI84FA110	2800	0	4	6	0
CHI84FA121	3600	1	4	6	0
CHI84FA194	3600	0	3	0	3
CHI84FA250A	6075	0	4	6	4
CHI84FA250B	2500	0	4	6	5
CHI84FA282	3350	20	4	5	0
CHI84FA289	3000	0	4	4	7
CHI84FA292	2650	0	3	6	4
CHI84FA313	3000	0	4	5	0
CHI84FA315	3600	0	4	4	11
CHI84FA343	1750	0	4	4	0
CHI84FA348	2000	0	3	4	0
CHI84FA352	2900	1	4	5	0
CHI84FA364	3320	0	4	0	0
CHI84FA376	1750	0	4	3	0
CHI84FA402	1600	0	4	4	10
CHI84FEI01	2450	0	4	1	0
CHI85FA020	3400	0	4	7	0
CHI85FA034	3550	1	3	1	4
CHI85FA036	3400	0	4	7	6
CHI85FA050	8157	0	4	11	0
CHI85FA054	2150	0	3	4	4
CHI85FA059	1400	0	4	2	6

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	[illegible]	[illegible]	[illegible]
CHI85FA067	1200	2	4	4	0
CHI85FA096	1600	0	3	4	4
CHI85FA104	2575	0	4	5	0
CHI85FA139	3400	0	4	7	0
CHI85FA156	2300	0	4	6	0
CHI85FA158	3800	0	4	8	0
CHI85FA211	2079	0	4	6	5
CHI85FA213	3550	1	4	1	11
CHI85FA229	1200	2	4	2	0
CHI85FA253	2150	0	4	6	0
CHI85FA292	2200	0	3	4	0
CHI85FA301	2850	0	4	0	0
CHI85FA316	2300	1	4	5	0
CHI85FA325	2450	0	3	5	0
CHI85FA356	2200	0	4	5	11
CHI85FA370	1710	1	4	5	5
CHI85FEC01	2800	0	3	3	8
CHI85FEE01	2325	1	4	4	9
CHI85FEE03	1600	0	3	3	9
CHI85FEI02	2300	7	3	0	0
CHI85FEM02	2050	1	4	5	5
CHI85FEP01	2700	0	3	5	0
CHI85FEP02	1100	0	4	3	11
CHI85FEP04	1650	1	3	5	0
CHI85FER01	2706	0	4	4	4
CHI85FER02	4500	3	3	4	4
CHI85FER03	2330	1	3	5	9
CHI85FET01	2300	0	3	3	0
CHI85FET02	2050	1	3	4	0
CHI85FEV03	2200	0	4	0	11
CHI85FEX03	2450	0	3	2	0
CHI85FEX04	2750	0	4	1	11
CHI86FA029	2300	0	4	5	0
CHI86FA031	2325	3	4	5	0
CHI86FA038	3400	0	3	5	0
CHI86FA068	2800	3	4	5	9
CHI86FA077	2575	0	4	5	4
CHI86FA094A	1680	1	4	6	5
CHI86FA094B	2300	1	4	6	5
CHI86FA100A	2300	14	4	7	0
CHI86FA102	3325	1	4	6	9

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
CHI86FA108	4100	3	4	8	0
CHI86FA120	1200	1	4	6	7
CHI86FA146	1650	1	4	6	0
CHI86FA170	2000	0	4	5	10
CHI86FA171	2250	1	4	7	0
CHI86FA174	2300	1	4	5	0
CHI86FA179	2200	1	4	5	6
CHI86FA183	1500	0	4	6	3
CHI86FA194	2800	1	3	6	3
CHI86FA198	1650	0	3	6	11
CHI86FEC01	1200	0	3	3	0
CHI86FEC02	3800	0	3	0	0
CHI86FEC03	3600	0	3	4	5
CHI86FEC07	4400	0	3	4	3
CHI86FEE02	2950	0	3	1	0
CHI86FEE03	520	0	3	5	0
CHI86FEE05	750	0	3	2	6
CHI86FEE06	1425	0	3	5	3
CHI86FEE07	1350	0	3	6	3
CHI86FEI02	1600	0	3	3	0
CHI86FEM05	5400	0	3	4	4
CHI86FEM06	2200	0	3	1	5
CHI86FEM07	3700	0	4	8	11
CHI86FEM08	2650	0	4	4	8
CHI86FEM10	2900	1	3	3	9
CHI86FEM12	1300	0	3	4	4
CHI86FEM13	2150	0	3	1	3
CHI86FEM14	2900	0	3	4	3
CHI86FEP02	1670	0	3	4	6
CHI86FEP06	1150	0	3	2	0
CHI86FEP08	7400	0	3	6	3
CHI86FER01	2300	0	3	6	4
CHI86FER03	1900	0	4	4	3
CHI86FER04	2558	0	3	4	3
CHI86FER06	2020	0	4	7	0
CHI86FER07	2150	0	3	4	5
CHI86FER11	2850	0	4	4	3
CHI86FER12	2900	0	3	3	4
CHI86FER16	3000	0	3	6	5
CHI86FET01	1800	1	3	4	5
CHI86FEV03	1210	0	4	7	6

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CHI86FEX02	1018	0	4	0	0
CHI86FEX03	1300	0	3	1	0
CHI86FEX06	3400	8	4	5	3
CHI86FEX07	5000	0	4	7	0
CHI86FEX09	1600	0	4	4	7
CHI86FEX10	4050	0	4	1	11
CHI86MA071	3200	0	4	6	3
CHI86MA212B	1670	2	4	6	4
CHI87DEC01	1500	0	4	5	0
CHI87DEC03	3150	0	4	6	10
CHI87DEC04	3300	0	4	5	10
CHI87DEE01	2950	5	3	2	4
CHI87DEE03	600	0	3	1	3
CHI87DEE05	732	0	3	1	10
CHI87DEE07	2300	1	3	6	3
CHI87DEE08	890	0	4	0	3
CHI87DEE09	510	0	3	1	3
CHI87DEE10	1550	0	3	3	5
CHI87DEM02	1200	0	3	4	4
CHI87DEM04	925	1	4	3	4
CHI87DEM05	3800	0	3	6	5
CHI87DEM07	2690	0	3	4	11
CHI87DEM08	1670	0	3	4	3
CHI87DEM09	10500	0	4	11	9
CHI87DEM10	2900	0	3	4	5
CHI87DEM11	2400	0	4	4	6
CHI87DEM12	1050	0	3	2	0
CHI87DEP01	1650	0	3	0	0
CHI87DEP06	790	0	4	4	9
CHI87DEP07	4800	0	4	6	6
CHI87DEP08	850	0	3	3	3
CHI87DEP09	6000	0	3	4	3
CHI87DEP10	850	0	4	5	8
CHI87DER03	3100	0	3	3	3
CHI87DER05	2300	0	3	3	4
CHI87DER08	4400	0	3	4	0
CHI87DER09	2000	0	3	4	6
CHI87DER10	5000	0	3	5	8
CHI87DER12	1500	0	3	3	3
CHI87DET03	850	0	3	3	0
CHI87DET05	785	0	3	2	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
CHI87DET07	1500	0	4	7	3
CHI87DET08	2500	0	4	8	6
CHI87DEX06	2300	0	3	4	11
CHI87DEX07	3200	0	4	4	0
CHI87DEX08	1650	1	3	3	4
CHI87FA004A	2325	2	3	6	3
CHI87FA004B	2550	2	4	7	6
CHI87FA012	1625	0	4	5	8
CHI87FA040	2575	2	4	5	0
CHI87FA048	2650	33	3	5	6
CHI87FA054	3000	1	4	5	3
CHI87FA057	3600	0	3	2	3
CHI87FA069	3800	1	4	7	0
CHI87FA083	2300	0	4	7	3
CHI87FA104	3400	0	4	8	7
CHI87FA129	1600	0	4	4	9
CHI87FA140	2200	1	4	6	8
CHI87FA149	2200	0	4	5	0
CHI87FA151	2650	0	4	7	4
CHI87FA198	2950	0	3	0	0
CHI88DCA01	3200	0	3	1	0
CHI88DEE01	900	0	3	4	3
CHI88DEE04	3300	0	4	7	0
CHI88DEE06	2900	0	3	5	4
CHI88DEE07	2050	8	3	1	0
CHI88DEG01	2000	0	3	0	0
CHI88DEI01	2003	0	3	5	6
CHI88DEI03	2150	0	3	4	3
CHI88DEM01	7400	0	3	6	5
CHI88DEM03	3750	0	3	4	3
CHI88DEM07	1500	0	3	3	5
CHI88DEP02	3400	0	4	5	5
CHI88DEP04	2150	0	3	3	3
CHI88DEP05	1000	0	3	4	3
CHI88DEP06	900	0	3	2	3
CHI88DEP08	935	0	3	2	3
CHI88DEP09	1300	0	3	3	3
CHI88DEP10	2900	0	3	3	3
CHI88DEP11	4500	0	3	5	8
CHI88DER02	1650	0	4	0	0
CHI88DER03	2300	0	3	4	0

CHI88DER04	2900	0	3	4	0
CHI88DER07	1300	0	4	0	10
CHI88DER09	1130	0	3	4	3
CHI88DET01	2550	0	3	0	4
CHI88DET03	741	0	3	4	3
CHI88DET04	4000	0	3	4	3
CHI88DEX01	2800	0	4	4	0
CHI88DEX02	1215	0	3	2	6
CHI88DEX03	2150	5	3	3	0
CHI88DEX06	1220	0	3	2	0
CHI88DEX07	2350	0	3	4	0
CHI88DEX08	2450	0	3	1	4
CHI88FA001	1907	0	3	6	3
CHI88FA079	4150	0	4	1	11
CHI88FA090	3400	0	4	7	5
CHI88FA102	1650	0	4	4	10
CHI88FA177	1200	0	3	3	0
CHI88FA178	925	0	3	4	0
CHI89DEP02	2300	0	3	4	5
CHI89DEV01	1670	0	3	4	3
CHI89DEV03	2350	0	3	4	5
CHI89DEV05	2650	0	3	4	5
DCA85AA020	6615	0	3	1	3
DCA86AA028B	3200	0	4	9	0
DEN83FA045	2822	0	3	4	0
DEN83FA049	1300	1	4	0	3
DEN83FA053	3800	0	4	7	0
DEN83FA056	3150	0	4	7	0
DEN83FA070	2200	0	4	6	5
DEN83FA071	2800	1	4	6	0
DEN83FA072	2450	0	3	7	0
DEN83FA077	1450	0	4	0	0
DEN83FA084	2800	0	3	5	0
DEN83FA087	3800	0	4	0	0
DEN83FA089	3400	0	3	7	0
DEN83FA090	1600	0	4	0	0
DEN83FA092	4150	0	4	0	0
DEN83FA108	2400	0	4	7	0
DEN83FA116	2400	0	4	7	0
DEN83FA120	1670	1	4	4	0
DEN83FA122	3200	45	3	1	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
DEN83FA123	2550	0	4	7	0
DEN83FA129	2950	0	3	0	0
DEN83FA150	2690	0	4	4	0
DEN83FA152	3850	0	4	5	0
DEN83FA156	1750	0	4	4	11
DEN83FA180	2900	0	4	5	0
DEN83FA183	3600	0	3	6	1
DEN83FA203	1500	25	4	5	0
DEN83FA214	2550	0	4	7	0
DEN83FA221	2740	1	4	4	9
DEN83FA222	1750	13	4	5	2
DEN83FTC02	900	0	4	7	0
DEN83FTE06	520	1	3	5	4
DEN83FTE12	2900	8	3	5	0
DEN83FTG01	1100	0	4	6	0
DEN83FTI03	1750	0	3	4	0
DEN83FTI04	1675	0	4	4	0
DEN83FTK03	3400	3	4	8	0
DEN83FTK04	2550	5	4	2	0
DEN83FTK05	2400	0	4	4	0
DEN83FTM04	2900	0	3	4	0
DEN83FTM05	550	25	3	3	11
DEN83FTM07	750	0	3	2	0
DEN84FA010	2800	0	4	7	0
DEN84FA011	2550	28	4	0	2
DEN84FA012	3400	0	3	3	0
DEN84FA019	3000	0	4	0	0
DEN84FA039	3325	0	4	5	0
DEN84FA049	3125	0	4	0	0
DEN84FA064	1220	0	3	1	0
DEN84FA076	3650	0	4	6	0
DEN84FA081	2350	0	4	0	0
DEN84FA085	3100	0	4	7	0
DEN84FA086	3800	0	4	8	0
DEN84FA102	3200	0	4	1	0
DEN84FA106	4850	20	3	2	0
DEN84FA107	2740	4	4	7	0
DEN84FA115	2650	5	4	4	0
DEN84FA137	2150	0	4	4	0
DEN84FA142	2100	10	3	0	0
DEN84FA143	3800	0	3	4	3

DEN84FA144	2450	15	4	3	0
DEN84FA155	2800	0	3	2	0
DEN84FA172	2800	0	4	0	0
DEN84FA184	2800	0	3	2	0
DEN84FA188	5550	0	4	0	0
DEN84FA194	2150	0	4	3	3
DEN84FA196	2658	0	4	4	0
DEN84FA199	2740	0	4	4	0
DEN84FA202	2550	0	4	4	0
DEN84FA211	2650	0	4	4	0
DEN84FA219	2900	0	4	0	0
DEN84FA222	10500	0	4	8	0
DEN84FA242	2550	0	4	7	4
DEN84FA259	2300	0	4	8	0
DEN84FA274	2717	0	3	5	0
DEN84FA275	2800	0	4	3	0
DEN84FA278	1500	0	4	3	0
DEN84FA290	4150	0	4	0	0
DEN84FA293	2300	0	3	0	0
DEN84FA295	3300	0	4	8	0
DEN84FA298	2950	0	4	8	0
DEN84FTK01	1450	0	3	4	0
DEN84FTM02	1500	0	3	4	0
DEN84FTM03	1285	0	3	0	0
DEN84FU001	450	5	4	2	0
DEN84LA101	2300	0	3	1	0
DEN85FA007	3200	0	3	2	3
DEN85FA008	3350	0	4	7	0
DEN85FA009	3000	0	4	8	11
DEN85FA010	3400	0	4	7	0
DEN85FA014	2575	0	4	6	4
DEN85FA019	3100	0	4	7	5
DEN85FA027	3200	0	4	5	0
DEN85FA028	1650	0	4	4	9
DEN85FA034	3300	0	4	0	0
DEN85FA035	2800	15	4	6	0
DEN85FA037	3400	0	4	0	0
DEN85FA048	3400	2	4	0	0
DEN85FA067	4150	15	4	7	0
DEN85FA069	1600	0	3	4	0
DEN85FA074	2550	0	4	0	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
DEN85FA084	1150	0	4	4	11
DEN85FA088	1650	0	4	7	0
DEN85FA096	2900	0	4	6	0
DEN85FA097	2740	26	4	8	9
DEN85FA099	2800	0	4	5	3
DEN85FA102	2550	0	4	7	3
DEN85FA118	2400	0	4	0	0
DEN85FA153	3400	0	3	3	8
DEN85FA179	1220	1	3	2	0
DEN85FA180	2550	1	4	3	0
DEN85FA186	2325	0	4	4	0
DEN85FA202	2200	10	4	6	5
DEN85FA203	2550	27	4	7	3
DEN85FA222	2400	0	4	6	11
DEN85FA225	2800	0	3	5	3
DEN85FA229	1750	0	4	4	0
DEN85FA236	2900	0	4	7	4
DEN85FA241	5040	0	4	6	6
DEN85FA246	2550	1	4	4	0
DEN85FTE08	2950	0	3	4	0
DEN85FTI02	1150	5	3	4	0
DEN85FTK01	2950	0	3	5	9
DEN85FTK03	1670	1	3	4	3
DEN85FTM06	2500	1.	3	6	0
DEN85LTG02	3600	0	4	7	0
DEN85LTG06	2950	5	3	1	11
DEN86FA002	1625	0	4	6	11
DEN86FA008	2350	0	4	6	5
DEN86FA009	2550	0	4	5	9
DEN86FA022	2900	0	4	7	11
DEN86FA023	2950	1	3	4	8
DEN86FA028	2900	45	4	7	8
DEN86FA039	3150	0	4	7	9
DEN86FA054	4150	0	4	2	3
DEN86FA056	3800	4	4	9	0
DEN86FA060	1670	2	3	3	4
DEN86FA070	1670	0	3	6	3
DEN86FA071	2800	15	4	5	0
DEN86FA076	3800	0	4	5	0
DEN86FA077	4016	0	3	6	7
DEN86FA092	2500	0	4	4	3

DEN86FA101	3400	0	4	3	0
DEN86FA115	4000	15	3	4	0
DEN86FA131	2150	0	4	6	3
DEN86FA141	1600	0	3	4	0
DEN86FA142	4000	0	4	11	0
DEN86FA146	615	3	4	4	10
DEN86FA147	1800	0	3	4	11
DEN86FA149	1500	1	3	5	4
DEN86FA150	3650	0	4	9	10
DEN86FA160	2450	0	4	4	9
DEN86FA165	3600	0	4	7	10
DEN86FA170	1600	0	4	5	11
DEN86FA181	3000	0	4	9	6
DEN86FA207	1450	1	3	3	3
DEN86FA208A	4100	0	4	8	8
DEN86FA211	1250	0	4	4	3
DEN86FA213	1563	2	4	7	0
DEN86FA216	3400	0	4	5	3
DEN86FA223	2200	0	4	4	0
DEN86FA231	5300	0	4	7	0
DEN86FA232	3800	0	4	8	10
DEN86FA249	2800	0	4	9	0
DEN86FA252	2300	0	4	8	0
DEN86FA254	2950	0	4	8	3
DEN86FTE01	1000	0	3	4	9
DEN86FTE02	1825	0	4	0	11
DEN86FTG02	1507	1	3	4	8
DEN86FTK01	1650	0	3	3	9
DEN86FTK02	3000	0	3	4	0
DEN86FTK03	2300	0	3	7	4
DEN86FTK04	2900	0	4	5	3
DEN86FTM02	820	0	3	3	0
DEN87DTI01	4000	0	3	5	3
DEN87DTK01	1500	0	4	8	3
DEN87DTM01	600	0	4	5	7
DEN87FA002	1220	0	4	3	0
DEN87FA007	2900	0	4	6	3
DEN87FA008	2450	0	4	4	3
DEN87FA011	2400	0	4	4	0
DEN87FA014	2075	0	4	4	11
DEN87FA017	3600	5	3	6	3

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
DEN87FA018	4150	0	4	1	3
DEN87FA023	3650	0	4	6	3
DEN87FA024	2550	0	4	0	3
DEN87FA035	1750	0	4	4	11
DEN87FA036	2150	0	4	5	3
DEN87FA037	1625	0	3	3	0
DEN87FA038	2300	0	3	4	3
DEN87FA041	3800	0	4	7	0
DEN87FA046	2900	0	3	9	0
DEN87FA050	3100	0	4	10	0
DEN87FA057	3800	0	3	5	3
DEN87FA061	3800	0	4	8	3
DEN87FA064	4000	11	4	8	3
DEN87FA081	2000	0	4	4	9
DEN87FA090	1650	0	4	5	9
DEN87FA091A	4500	0	4	7	0
DEN87FA091B	2900	0	4	7	0
DEN87FA103	2300	0	4	6	3
DEN87FA111	1500	0	3	4	0
DEN87FA134	2900	4	4	6	4
DEN87FA147	4150	0	4	1	0
DEN87FA148	2900	0	4	6	11
DEN87FA159	2450	0	4	6	10
DEN87FA167	2740	0	4	4	11
DEN87FA177	1670	0	3	4	4
DEN87FA178	2800	0	4	8	3
DEN87FA186	2575	0	4	7	11
DEN87FA188	2900	0	3	8	0
DEN87FA203	4000	0	4	5	0
DEN87FA216	1618	0	4	7	6
DEN87FA218	2250	0	4	7	0
DEN87FA219	2950	0	4	6	3
DEN87FA220	2670	0	4	6	4
DEN87FA224	1650	0	4	0	10
DEN87FA226	2650	0	4	8	3
DEN87FA230	2200	0	4	5	5
DEN87FA234	1750	0	4	6	3
DEN87FA237	2750	0	4	6	3
DEN87LA170	1237	0	4	7	0
DEN88DQA01	1600	0	4	0	11
DEN88DTE02	4000	4	4	6	0

DEN88DTE06	1100	0	3	5	3
DEN88DTK01	4000	0	4	7	7
DEN88DTM01	3300	0	4	7	10
DEN88DTM03	1950	0	4	11	11
DEN88FA001	1500	0	3	4	0
DEN88FA016	3600	12	4	9	3
DEN88FA021	2558	0	4	4	7
DEN88FA023	2650	0	4	8	3
DEN88FA030	2900	0	4	9	4
DEN88FA033	2900	1	4	6	3
DEN88FA036	1670	0	4	6	3
DEN88FA037	2325	0	4	1	11
DEN88FA054	2200	0	4	7	0
DEN88FA062	1500	0	4	7	11
DEN88FA071	2300	0	4	7	0
DEN88FA084	2000	0	4	4	3
DEN88FA090	3600	2	4	5	3
DEN88FA096	2325	0	4	6	0
DEN88FA097	1500	0	4	5	0
DEN88FA098	2650	0	3	8	3
DEN88FA099	2200	0	4	5	3
DEN88FA100	2800	3	4	5	11
DEN88FA106	2860	0	4	1	4
DEN88FA107	2230	0	4	5	5
DEN88FA109	3800	0	4	5	11
DEN88FA110	1670	0	4	4	11
DEN88FA111	4000	0	4	5	5
DEN88FA112	1200	0	4	5	10
DEN88FA114	4250	1	4	6	4
DEN88FA119	2200	0	4	5	11
DEN88FA120	1400	0	4	4	6
DEN88FA121	2400	0	4	4	3
DEN88FA128	2800	0	4	6	3
DEN88FA141	2900	0	4	8	0
DEN88FA186	1200	0	4	4	9
DEN88FA193	2740	0	4	0	11
DEN88FA212	2000	0	4	5	7
DEN88GA185	2800	0	3	7	0
DEN89FA001	1670	0	4	4	0
DEN89FA007	2575	0	4	7	4
DEN89FA009	3800	0	4	0	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
DEN89FA010	2550	0	4	4	3
DEN89FA017	2150	0	4	5	4
DEN89FA019	4250	0	4	7	0
DEN89FA036	3300	0	4	7	4
DEN89FA038	1600	0	4	4	11
DEN89FA041	2900	0	4	8	10
DEN89FA045	2900	0	4	7	3
DEN89FA056	8750	3	4	7	3
DEN89FA101	3200	0	3	1	3
FTW83FA078	1600	1	4	4	11
FTW83FA079	2575	0	4	0	0
FTW83FA092	1600	0	3	3	3
FTW83FA097	4150	0	4	7	0
FTW83FA101	2575	3	3	4	0
FTW83FA126	2300	2	4	5	2
FTW83FA134	2550	10	4	4	3
FTW83FA142	3300	0	4	8	0
FTW83FA143	2350	0	3	1	0
FTW83FA144	2150	8	4	7	3
FTW83FA150	2550	1	4	6	0
FTW83FA170	3600	4	4	9	0
FTW83FA176	2300	0	4	5	0
FTW83FA222	2200	11	4	6	8
FTW83FA226	2800	10	4	4	0
FTW83FA251	2150	0	3	0	0
FTW83FA254	2175	0	4	8	0
FTW83FA259	3190	0	4	4	0
FTW83FA261	2900	0	4	7	0
FTW83FA270	1500	1	4	5	11
FTW83FA276	1500	0	4	5	0
FTW83FA280	3200	0	4	0	0
FTW83FA302	1600	0	3	6	0
FTW83FA310	3600	0	4	5	6
FTW83FA311	2450	10	4	2	0
FTW83FA323	1500	0	4	3	0
FTW83FA343	1670	7	4	3	0
FTW83FA361	2900	19	4	9	3
FTW83FA362	2300	2	4	5	0
FTW83FA373	2500	10	4	8	0
FTW83FA387	3400	1	4	5	0
FTW83FA441	2300	0	4	5	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
FTW83LA296	2650	0	3	0	0
FTW84FA014	3350	0	4	8	0
FTW84FA020	7000	1	4	6	0
FTW84FA023	2300	0	4	0	0
FTW84FA032	2950	0	4	8	0
FTW84FA034	1260	0	4	4	0
FTW84FA050	2325	0	4	8	0
FTW84FA057	3800	1	3	6	0
FTW84FA060	1670	9	4	6	0
FTW84FA068	2740	0	4	0	0
FTW84FA083	3325	5	4	8	0
FTW84FA102	2850	10	4	0	0
FTW84FA115	1800	0	4	0	0
FTW84FA121	3600	9	3	6	0
FTW84FA125	1670	3	4	7	0
FTW84FA170	2400	5	4	3	0
FTW84FA171	1800	0	4	5	0
FTW84FA180	3350	0	4	7	0
FTW84FA206	5300	0	4	7	10
FTW84FA209	2000	1	4	5	6
FTW84FA218	1770	0	4	4	0
FTW84FA220	1000	0	4	7	0
FTW84FA224	1250	0	4	4	0
FTW84FA237	2775	0	4	0	9
FTW84FA242	2775	0	4	11	0
FTW84FA243	2500	0	3	0	0
FTW84FA244	3350	0	4	2	0
FTW84FA264	3350	0	4	7	3
FTW84FA272	1650	0	4	6	0
FTW84FA288	1950	0	4	4	0
FTW84FA291	1670	0	4	7	0
FTW84FA297	1615	0	4	8	0
FTW84FA300	1670	0	3	4	0
FTW84FA321	3200	0	4	0	0
FTW84FA331	3350	0	4	8	0
FTW84FA342	3400	1	3	6	0
FTW84FA343	1600	0	4	4	5
FTW84FA347	1066	0	4	0	0
FTW84FA354	2950	0	4	4	11
FTW84FA382	2150	0	4	6	0
FTW84FA393	3200	1	3	0	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
FTW84FA404	3400	0	4	7	0
FTW84FA408	2220	0	4	6	9
FTW84FPJ01	1800	0	4	7	0
FTW84LA416	3800	0	4	8	3
FTW84MA069	4000	8	4	8	0
FTW85FA006	1670	0	4	7	0
FTW85FA032	3200	0	4	1	0
FTW85FA034	1800	0	4	7	0
FTW85FA041	5300	0	4	7	0
FTW85FA045	2100	0	4	5	8
FTW85FA050	1670	0	4	1	0
FTW85FA054	3325	0	3	9	0
FTW85FA055	3650	0	4	10	0
FTW85FA060	2075	2	4	4	0
FTW85FA065	2650	0	4	7	0
FTW85FA079	1670	0	4	5	0
FTW85FA084	3600	35	4	6	0
FTW85FA087	3800	0	4	7	3
FTW85FA088	2740	0	4	9	0
FTW85FA090	2300	0	4	5	10
FTW85FA100	4150	3	3	1	9
FTW85FA130	2050	0	3	2	9
FTW85FA140	2400	0	4	4	3
FTW85FA152	2000	0	3	7	0
FTW85FA158	2750	1	3	5	0
FTW85FA159	1670	0	4	4	0
FTW85FA171	3800	0	4	4	0
FTW85FA176	1670	0	4	3	0
FTW85FA180	1670	8	4	5	0
FTW85FA188	8500	0	4	1	10
FTW85FA204	1095	1	4	6	9
FTW85FA220	3100	8	4	6	11
FTW85FA245	1500	3	4	4	5
FTW85FA247	2900	1	4	4	6
FTW85FA254	2350	0	4	2	3
FTW85FA257	3800	1	4	4	0
FTW85FA261A	1600	0	3	5	10
FTW85FA261B	1670	0	4	5	11
FTW85FA265	4190	0	4	0	0
FTW85FA287	2000	0	4	0	0
FTW85FA300	4190	0	4	1	5

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
FTW85FA306	1600	0	3	7	0
FTW85FA310	8500	0	4	1	0
FTW85FA331	1804	6	4	5	0
FTW85FA335	5300	0	4	8	0
FTW85FA346	900	0	4	8	11
FTW85FA358	2800	0	3	4	0
FTW85FPA01	5000	0	3	0	0
FTW85FPA02	2900	4	3	7	0
FTW85FQG03	2900	0	4	0	10
FTW85FRD01	1450	0	4	4	3
FTW85FRD02	735	0	4	3	11
FTW85FRD03	7100	0	4	4	0
FTW85FRG01	1450	0	3	4	11
FTW85MA297	2900	0	4	0	0
FTW86FA008	2400	2	4	8	0
FTW86FA019	2400	4	4	8	0
FTW86FA023	1670	0	4	6	0
FTW86FA024	3300	1	4	6	3
FTW86FA026	1600	0	4	4	11
FTW86FA027A	2200	1	4	4	11
FTW86FA027B	1150	1	3	0	0
FTW86FA028	3000	2	4	10	6
FTW86FA033	3200	0	4	1	0
FTW86FA035	2950	0	4	9	0
FTW86FA046	1450	12	4	4	8
FTW86FA049A	1150	0	3	5	10
FTW86FA050	3532	0	4	5	11
FTW86FA054	1600	0	4	5	3
FTW86FA063	2800	2	4	0	0
FTW86FA076	5300	0	4	6	8
FTW86FA086B	1220	5	3	6	3
FTW86FA092	3800	31	4	9	11
FTW86FA098	3800	5	4	0	11
FTW86FA142	3200	0	3	3	0
FTW86FA154	1750	0	4	3	0
FTW86FA171	1670	0	3	4	0
FTW86FPA05	2740	0	3	5	0
FTW86FPA07	1500	1	4	7	0
FTW86FPA18	5400	0	3	4	9
FTW86FPA21	1600	0	3	3	3
FTW86FPA22	1425	0	3	5	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
FTW86FPA23	4000	0	4	5	0
FTW86FPA26	1150	0	3	4	0
FTW86FPA27	2910	1	4	4	5
FTW86FQG02	2050	0	3	1	11
FTW86FQG04	1560	9	4	0	0
FTW86FQG09	5000	0	3	6	0
FTW86FRA09	2400	5	4	4	8
FTW86FRD10	2150	8	3	4	3
FTW86FRD11	4500	0	3	0	9
FTW86FRD24	2350	15	3	0	0
FTW86FRD25	9260	2	4	6	11
FTW86FRG02	2900	25	3	5	0
FTW86FRG10	2575	0	4	4	0
FTW86FRG19	1600	1	4	6	0
FTW86LPJ10	3725	0	3	3	0
FTW86LQG17	1500	0	4	3	3
FTW86LRD18	4500	0	4	4	3
FTW86MA001B	1670	0	4	4	0
FTW86MA010	3400	20	4	5	9
FTW87DPA04	1129	0	3	3	6
FTW87DPJ03	4200	0	3	6	9
FTW87DPJ04	5000	0	3	4	3
FTW87DPJ05	1930	2	4	7	8
FTW87DPJ07	2740	0	3	0	0
FTW87DPJ08	5000	0	4	5	4
FTW87DPJ09	2500	0	3	2	0
FTW87DRA02	1285	0	4	1	3
FTW87DRA04	4450	0	4	6	0
FTW87DRA05	3300	0	3	3	4
FTW87DRA07	5000	0	3	6	0
FTW87DRA08	840	0	3	3	5
FTW87DRD03	7200	0	3	2	3
FTW87DRD04	3700	1	3	4	5
FTW87DRD12	2000	2	4	3	3
FTW87DRG01	1112	0	4	6	8
FTW87DRG04	1500	0	4	6	3
FTW87DRG05	6000	0	3	4	3
FTW87FA007	3200	1	3	1	4
FTW87FA017	1670	61	4	4	6
FTW87FA022A	2150	0	4	4	10
FTW87FA022B	1650	0	3	4	10

FTW87FA029	2650	15	4	8	0
FTW87FA031	1700	3	4	6	5
FTW87FA043	2740	2	4	9	0
FTW87FA047	1600	4	4	3	0
FTW87FA054	1950	4	4	4	3
FTW87FA064	3800	0	4	10	0
FTW87FA087	2050	0	3	4	9
FTW87FA088	2550	0	4	6	10
FTW87FA090	3600	0	3	4	9
FTW87FA093	1600	0	3	6	5
FTW87FA111	3200	0	3	3	0
FTW87FA116	3400	0	4	0	0
FTW87FA123	3600	8	4	4	11
FTW87FA134	2550	0	3	6	6
FTW87FA137	1560	0	3	3	0
FTW87FA139	3400	2	4	4	5
FTW87FA151	4200	0	3	4	3
FTW87FA161	2800	0	4	4	5
FTW87FA168	2450	4	3	0	5
FTW87FA170	3325	2	3	4	5
FTW87FA183	2900	0	4	6	11
FTW87FA190	3600	0	3	5	0
FTW87FA196	3400	1	4	5	3
FTW87FA197	6500	0	3	6	6
FTW87FA198	3200	0	3	1	11
FTW87FA206A	3600	0	4	4	11
FTW87FA208	8000	0	3	0	9
FTW87FA209	2575	0	4	6	8
FTW87FA210	1220	0	3	5	9
FTW87FA223	1220	0	3	4	3
FTW87MA133	4100	0	4	5	11
FTW88DPA03	6500	0	3	5	9
FTW88DPA04	1350	0	3	6	8
FTW88DPA05	1200	0	3	3	6
FTW88DPA06	1600	0	3	2	0
FTW88DPA09	1250	0	3	4	4
FTW88DPJ01	935	0	4	7	7
FTW88DPJ02	2900	0	4	3	0
FTW88DPJ03	2350	1	4	5	6
FTW88DPJ05	2400	0	4	4	5
FTW88DPJ08	1670	13	3	2	7

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
FTW88DPJ09	1670	0	3	1	3
FTW88DPJ10	4200	0	4	5	0
FTW88DPJ11	1600	1	3	3	5
FTW88DPJ13	6000	0	3	4	4
FTW88DQG02	5000	0	3	0	10
FTW88DQG03	2775	0	3	5	3
FTW88DQG04	3000	0	3	6	3
FTW88DRA04	785	0	3	2	0
FTW88DRA06	1700	5	4	4	0
FTW88DRA07	4500	0	4	4	3
FTW88DRA10	1425	0	3	6	6
FTW88DRA11	2430	0	4	0	11
FTW88DRA12	4500	0	3	6	3
FTW88DRA14	3750	0	3	4	4
FTW88DRA15	850	0	4	4	11
FTW88DRD02	3800	0	3	3	3
FTW88DRD04	4500	1	3	5	0
FTW88DRD06	4500	0	3	3	0
FTW88DRD07	10370	0	3	3	3
FTW88DRD08	4000	0	4	4	0
FTW88DRD11	6500	0	4	3	0
FTW88DRD12	2750	0	4	2	6
FTW88DRD14	4500	0	4	4	9
FTW88DRD15	4200	0	3	6	0
FTW88DRD16	9260	0	3	2	0
FTW88DRD17	4500	0	3	4	5
FTW88DRD18	4500	0	3	5	4
FTW88DRD19	5200	0	4	6	0
FTW88DRD20	1450	10	4	8	11
FTW88DRG02	4500	1	3	4	0
FTW88DRG04	1350	2	4	6	3
FTW88DRG06	200	0	3	1	8
FTW88DRG07	4500	0	4	4	3
FTW88DRG10	2750	2	4	6	0
FTW88FA005	2350	2	4	4	10
FTW88FA007	3400	0	4	4	10
FTW88FA011	2300	16	4	4	0
FTW88FA023	3400	0	4	7	3
FTW88FA024	1450	0	4	4	9
FTW88FA032	2900	0	4	11	0
FTW88FA046	3850	1	3	6	6

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FTW88FA057	1450	0	4	4	6
FTW88FA060	3600	0	3	6	3
FTW88FA063	3300	0	4	8	11
FTW88FA069	1200	0	4	6	10
FTW88FA074A	1600	0	3	5	4
FTW88FA074B	1200	0	4	4	11
FTW88FA084	2300	0	4	5	0
FTW88FA085	3200	0	4	0	8
FTW88FA100	2150	0	4	4	9
FTW88FA103	1710	1	4	5	6
FTW88FA104	2400	0	4	5	0
FTW88FA114A	2400	0	4	5	3
FTW88FA114B	2900	0	3	5	3
FTW88FA119	3300	0	4	7	3
FTW88FA162	2400	0	4	6	4
FTW89DPA01	600	0	3	3	9
FTW89DPJ01	1235	0	4	1	3
FTW89DPJ02	1260	0	4	6	9
FTW89DQA01	3000	0	3	4	0
FTW89DRA02	1100	0	3	6	10
FTW89DRD01	1200	0	4	4	4
FTW89DRD02	2900	4	3	3	8
FTW89FA006	2575	0	4	8	0
FTW89FA015	1600	0	4	4	11
FTW89FA023	3600	0	4	7	3
FTW89FA025	1400	0	4	6	10
FTW89FA028	1670	0	4	5	11
LAX83FA067	2400	0	4	0	0
LAX83FA091	2800	0	4	7	3
LAX83FA095	4000	0	4	8	0
LAX83FA120	6000	0	4	6	0
LAX83FA121	2050	0	4	1	0
LAX83FA124	1500	0	4	9	0
LAX83FA141	3233	0	4	0	0
LAX83FA144	3600	0	4	0	0
LAX83FA153	2200	0	4	7	0
LAX83FA160	2575	0	4	8	0
LAX83FA185	3400	0	4	0	0
LAX83FA192	2800	0	4	7	0
LAX83FA205	2650	1	3	6	3
LAX83FA211	2550	5	4	5	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
LAX83FA240	1860	5	4	0	0
LAX83FA246	1050	0	4	0	0
LAX83FA260	3400	1	4	6	0
LAX83FA266	2350	0	4	2	0
LAX83FA276	2550	5	4	0	0
LAX83FA295	2650	1	4	4	0
LAX83FA314	2200	0	4	5	0
LAX83FA341	2350	1	4	0	0
LAX83FA346	1110	0	4	0	0
LAX83FA348	3800	0	4	7	0
LAX83FA377	2400	0	4	6	0
LAX83FA388	3600	0	4	6	0
LAX83FA397	1400	0	4	4	0
LAX83FA424	6500	0	4	6	4
LAX83FA434	2150	5	3	5	0
LAX83FA435	750	0	4	7	0
LAX83FA439	1670	2	4	3	0
LAX83FA442	1680	0	3	4	8
LAX83FA455	2150	12	4	5	0
LAX83FA456	2900	0	4	8	0
LAX83FJA05	6250	0	4	7	0
LAX83FUA02	2325	1	4	4	0
LAX83FUG13	3400	0	4	0	0
LAX83FUG20	2200	1	3	6	0
LAX83FUJ12	2650	10	3	5	0
LAX83FUJ13	2500	2	3	0	0
LAX83FUM06	2650	0	4	7	0
LAX83FUM08	1350	0	4	7	0
LAX83FVA02	1600	0	3	5	0
LAX83FVG09	3400	0	4	7	0
LAX83FVG10	1650	8	4	0	0
LAX83FVG13	1650	0	4	5	0
LAX83FVG17	3100	1	4	3	0
LAX83LUQ01	1670	45	4	6	0
LAX84FA002	2800	0	4	9	0
LAX84FA012	3300	0	4	8	0
LAX84FA025	1200	0	3	4	0
LAX84FA028	1260	0	4	5	0
LAX84FA032	1450	12	3	1	0
LAX84FA034	2300	0	3	4	0
LAX84FA046	1128	0	3	4	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
LAX84FA047	2300	35	4	7	8
LAX84FA055	1700	11	4	6	0
LAX84FA057	1670	0	4	4	0
LAX84FA065	2450	0	4	7	0
LAX84FA068	3000	0	4	0	0
LAX84FA071	2800	0	4	7	0
LAX84FA073	2900	3	4	6	0
LAX84FA087	3400	0	4	0	6
LAX84FA107	2900	1	4	5	2
LAX84FA113	2900	0	4	8	0
LAX84FA114	2800	0	4	7	0
LAX84FA116	3125	0	4	0	0
LAX84FA129	1150	1	4	0	0
LAX84FA138	2650	1	4	5	3
LAX84FA142	2950	0	4	10	0
LAX84FA144	3400	0	4	4	0
LAX84FA152	2220	0	4	0	0
LAX84FA193	1300	0	4	0	0
LAX84FA221	1280	0	4	5	0
LAX84FA227	3600	0	4	4	0
LAX84FA251	2200	0	4	8	0
LAX84FA253	890	0	4	7	0
LAX84FA256	2430	0	4	4	0
LAX84FA258	1220	0	4	6	0
LAX84FA259	2550	0	4	4	0
LAX84FA280	2400	0	4	7	0
LAX84FA299	3100	0	4	6	0
LAX84FA300	2150	0	3	5	0
LAX84FA304	1000	0	4	7	0
LAX84FA319A	1670	0	4	4	0
LAX84FA319B	2500	0	4	6	0
LAX84FA330	1150	0	4	3	0
LAX84FA367	2550	3	4	2	11
LAX84FA371	1670	4	4	8	11
LAX84FA378A	2950	0	3	7	0
LAX84FA378B	2300	0	4	7	0
LAX84FA390	2500	1	4	7	0
LAX84FA395	3100	0	3	1	0
LAX84FA396	2450	0	4	4	0
LAX84FA405	3000	0	4	0	0
LAX84FA407	3400	0	4	0	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
LAX84FA421	2750	0	4	2	0
LAX84FA429	1650	0	4	3	11
LAX84FA439	3100	0	4	8	0
LAX84FA444	3800	63	3	4	0
LAX84FA452	2150	0	4	6	0
LAX84FA459	2050	0	4	0	0
LAX84FA460	2150	0	4	7	0
LAX84FA463	2400	1	3	4	0
LAX84FA466	2450	0	3	0	0
LAX84FA469	3400	0	4	8	0
LAX84FA473	2650	0	4	4	0
LAX84FA481	3000	3	4	5	7
LAX84FA484	2050	1	4	5	0
LAX84FA498	2200	0	4	7	0
LAX84FJA02	2150	0	4	4	0
LAX84FUJ04	4000	0	4	0	0
LAX84FVM01	1100	0	3	1	3
LAX84FVM02	2400	0	3	6	0
LAX84LA305	1650	0	3	0	0
LAX85FA015	1650	0	4	3	0
LAX85FA019	2900	3	3	4	0
LAX85FA024	3800	1	4	4	0
LAX85FA030	1600	0	4	5	3
LAX85FA036	3200	0	4	1	0
LAX85FA038	2150	0	4	6	0
LAX85FA048	2300	7	4	6	7
LAX85FA066	500	0	4	2	11
LAX85FA067	2775	0	3	0	0
LAX85FA068	1519	3	4	6	11
LAX85FA069	1670	0	4	7	0
LAX85FA071	2200	0	4	6	0
LAX85FA074	1675	5	4	7	5
LAX85FA078	2400	2	4	5	7
LAX85FA086	2300	9	4	7	0
LAX85FA088	2950	0	4	7	3
LAX85FA093	2950	8	4	9	0
LAX85FA097	2950	0	3	4	3
LAX85FA100	2650	0	4	7	7
LAX85FA102	3400	25	4	4	0
LAX85FA106	2500	2	4	0	6
LAX85FA115	9500	25	4	5	4

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LAX85FA122	3600	0	3	5	3
LAX85FA123A	1450	5	4	8	0
LAX85FA123B	1670	5	3	5	7
LAX85FA128	2650	0	3	4	5
LAX85FA136	3000	0	3	0	0
LAX85FA137	2800	0	4	5	0
LAX85FA142	3400	0	3	2	0
LAX85FA159	2725	1	4	5	11
LAX85FA163	1670	0	4	6	9
LAX85FA178	1600	10	4	6	8
LAX85FA192	1600	0	4	3	0
LAX85FA193	1600	0	3	4	3
LAX85FA199	3100	0	4	0	0
LAX85FA202A	2300	0	4	4	11
LAX85FA202B	2150	0	3	4	4
LAX85FA213	3300	0	4	7	0
LAX85FA216	2900	1	4	7	0
LAX85FA217	4150	0	4	2	0
LAX85FA218	1670	0	4	6	5
LAX85FA228	5300	0	4	5	0
LAX85FA232	3000	1	4	5	5
LAX85FA241	5250	0	4	1	0
LAX85FA251	3600	0	4	5	9
LAX85FA253	2500	0	4	4	0
LAX85FA259	1710	0	4	6	0
LAX85FA262	3600	0	4	4	0
LAX85FA280	1300	0	3	1	11
LAX85FA283	2550	0	4	4	0
LAX85FA286	11200	0	4	5	7
LAX85FA311	1670	0	4	4	9
LAX85FA355A	1600	0	4	1	0
LAX85FA355B	1600	0	4	6	0
LAX85FA384	3650	0	3	5	3
LAX85FA385	1100	0	3	6	4
LAX85FA402	4300	0	3	1	0
LAX85FJA06	6250	0	4	0	0
LAX85FUG01	3350	0	3	2	0
LAX85FUM01	1500	0	4	7	0
LAX85FVA02	2200	0	4	0	0
LAX85FVW01	1600	12	3	2	0
LAX85LA273	1600	0	3	4	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
LAX85LVA04	8500	0	3	0	0
LAX86DVA04	2400	0	4	0	0
LAX86DVA06	8500	0	4	2	0
LAX86DVA07	941	5	4	0	9
LAX86DVA09	3100	2	3	0	0
LAX86DVA17	2850	4	4	5	7
LAX86FA003	2400	0	4	4	0
LAX86FA007	2150	0	4	8	0
LAX86FA014	3200	0	4	5	10
LAX86FA024	1650	0	3	4	0
LAX86FA038	2000	28	4	0	0
LAX86FA039	2950	0	4	4	9
LAX86FA048	2800	0	4	8	0
LAX86FA063	3100	0	4	9	3
LAX86FA069	3100	4	4	6	7
LAX86FA077	3800	0	4	5	0
LAX86FA089	2300	1	4	8	0
LAX86FA092	3800	0	4	9	6
LAX86FA106	3200	0	4	1	0
LAX86FA107	2550	0	4	7	3
LAX86FA114	3200	0	4	5	0
LAX86FA130	2350	1	4	7	5
LAX86FA178	2550	0	4	5	9
LAX86FA183	1500	0	4	0	0
LAX86FA220	2200	0	4	5	9
LAX86FA240	2500	1	4	4	0
LAX86FA243	3200	1	4	0	0
LAX86FA247	3150	0	4	6	3
LAX86FA249	1570	0	4	4	8
LAX86FA282	1600	0	4	4	3
LAX86FA297	1750	0	4	3	8
LAX86FA326	2800	0	4	5	4
LAX86FA328	2300	1	4	6	5
LAX86FJA03	2950	0	3	2	9
LAX86FJA06	3200	0	4	7	10
LAX86FUM02	496	0	4	7	0
LAX86FUM04	1650	0	4	1	5
LAX86FVA08	1050	0	4	6	3
LAX86FVA10	8500	0	3	1	3
LAX86FVA11	2850	0	3	1	0
LAX86FVA12	6000	1	4	6	8

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
LAX86FVA14	3100	5	3	4	7
LAX86FVD01	1500	0	4	0	11
LAX86FVD02	550	0	3	6	11
LAX86FVD04	1150	0	4	6	11
LAX86FVD07	2850	0	4	1	0
LAX86MA050A	4150	0	4	2	9
LAX86MA050B	4150	0	4	2	11
LAX86MA311	3200	0	4	4	11
LAX87DJA02	2300	2	4	5	3
LAX87DJA03	6250	0	4	0	0
LAX87DJA07	6250	0	3	4	0
LAX87DUG04	1250	0	3	4	0
LAX87DUG06	1650	0	3	2	3
LAX87DUG07	1100	1	4	7	0
LAX87DUG08	1800	0	3	3	5
LAX87DUJ06	1250	0	4	7	3
LAX87DUJ09	2900	0	3	5	3
LAX87DUJ11	2750	0	4	0	9
LAX87DUM01	8238	0	3	1	3
LAX87DUM05	1050	0	4	5	6
LAX87DVA02	4500	0	3	7	3
LAX87DVA03	4000	0	3	5	5
LAX87DVA04	2750	0	3	1	0
LAX87DVA05	3100	0	3	1	3
LAX87DVA11	8500	0	3	6	3
LAX87DVD02	1305	5	4	0	0
LAX87DVD03	4400	1	4	6	0
LAX87DVG06	6000	0	3	4	4
LAX87DVG07	6000	0	3	6	0
LAX87FA017	3200	0	4	1	3
LAX87FA065	2300	1	3	5	0
LAX87FA066	2740	26	3	0	0
LAX87FA084	3400	0	4	6	9
LAX87FA087	7000	46	4	10	3
LAX87FA102	2400	0	4	7	0
LAX87FA112	3550	0	4	1	0
LAX87FA117	2800	0	4	8	10
LAX87FA136	1650	0	4	6	3
LAX87FA149	2800	0	4	7	0
LAX87FA151	3800	0	4	6	5
LAX87FA196	2550	0	3	7	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
LAX87FA198	2740	1	3	5	3
LAX87FA207	2800	1	4	5	5
LAX87FA212	3140	0	4	8	4
LAX87FA264	1885	3	4	4	4
LAX87FA267	3800	0	4	7	9
LAX87FA291	2550	1	3	3	0
LAX87FA296B	2740	0	3	8	0
LAX87FA298	1600	0	3	5	3
LAX87MA018	2250	9	4	0	0
LAX87MA052	3600	0	4	4	10
LAX87MA068A	2325	16	3	0	0
LAX87MA068B	2900	16	3	0	3
LAX88DUG01	1000	0	3	4	3
LAX88DUM01	560	0	4	3	10
LAX88DUM03	3650	0	4	2	11
LAX88DUM04	2750	0	4	4	4
LAX88DUM06	2750	0	3	4	3
LAX88DVA01	3860	0	4	6	5
LAX88DVA03	3300	0	3	3	5
LAX88DVA04	1100	0	4	4	8
LAX88DVA06	590	0	4	3	5
LAX88DVA09	500	0	4	2	3
LAX88DVA15	6075	0	3	6	4
LAX88DVA16	2750	0	3	1	0
LAX88DVD03	1300	0	4	7	8
LAX88DVD05	850	0	3	2	3
LAX88DVG02	4500	0	3	6	3
LAX88DVG03	5200	0	3	5	5
LAX88DVG05	4500	2	4	4	0
LAX88DVG07	5000	0	3	3	3
LAX88DVG10	4000	0	4	7	8
LAX88DVM01	2600	0	3	4	0
LAX88DVM02	2850	0	3	2	3
LAX88DVM04	4800	0	4	3	0
LAX88DXQ02	800	0	4	4	11
LAX88FA001	2650	0	4	4	8
LAX88FA016	2750	0	4	6	6
LAX88FA033	4150	0	3	1	0
LAX88FA052	3800	0	4	9	0
LAX88FA061	1550	0	4	6	0
LAX88FA114	2350	5	4	7	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
LAX88FA144	2175	0	4	3	0
LAX88FA149	1670	0	3	2	6
LAX88FA196	2900	3	4	7	0
LAX88FA258	2150	0	4	5	11
LAX88FA278	3800	6	4	5	0
LAX89DUJ02	2900	0	3	7	3
LAX89DUM02	4400	0	4	3	4
LAX89DVA01	8653	0	3	3	0
LAX89DVA05	6075	0	3	6	4
LAX89DVD02	2000	0	4	0	0
LAX89DVD03	1237	0	4	9	3
LAX89DVG01	1500	0	4	0	0
LAX89DVM01	2450	0	3	1	3
LAX89DVM02	3100	0	3	1	0
LAX89FA032	2900	0	3	5	4
LAX89FA076	2175	0	3	2	5
MIA83FA057	1670	0	4	8	5
MIA83FA058	1675	0	4	0	0
MIA83FA065	1235	4	3	2	0
MIA83FA073	1450	0	4	6	0
MIA83FA081	2800	1	4	5	0
MIA83FA082	3600	0	4	0	0
MIA83FA096	1220	0	4	6	0
MIA83FA113	2650	0	4	4	0
MIA83FA123	3400	0	4	5	6
MIA83FA140	1800	0	4	6	0
MIA83FA143	2150	0	4	7	0
MIA83FA145	1850	1	4	6	0
MIA83FA146	4016	0	4	0	4
MIA83FA148	3400	0	4	6	0
MIA83FA152	3400	0	4	0	0
MIA83FA168	3400	1	4	5	0
MIA83FA173	1500	0	4	4	10
MIA83FA174	1600	0	4	4	0
MIA83FA175	1650	0	4	9	0
MIA83FA177	3200	0	3	1	0
MIA83FA178	560	1	4	4	0
MIA83FA197	2150	0	4	5	0
MIA83FA202	3250	0	4	0	0
MIA83FA203	1400	0	4	0	0
MIA83FA208	685	0	3	0	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
MIA83FA216	2325	0	4	5	1
MIA83FA223	3300	0	3	5	0
MIA83FA225	1670	0	4	6	0
MIA83FA231	1500	0	3	0	0
MIA83FA233	3600	0	4	5	0
MIA83FKA01	500	0	4	4	0
MIA84FA005	1710	0	4	6	0
MIA84FA036	3100	0	4	0	0
MIA84FA038	2650	0	4	0	0
MIA84FA042	1850	0	4	4	0
MIA84FA048	3400	1	4	5	0
MIA84FA049	1750	0	4	5	0
MIA84FA051	4500	0	4	0	0
MIA84FA072	2000	0	4	3	0
MIA84FA075	2150	0	4	5	4
MIA84FA078	2750	0	4	5	0
MIA84FA081	2450	0	3	1	11
MIA84FA082	1670	0	4	7	6
MIA84FA091	3350	0	4	5	0
MIA84FA099	2800	0	4	4	0
MIA84FA101	1670	0	4	5	5
MIA84FA116	1929	0	4	8	9
MIA84FA139	3260	0	4	0	0
MIA84FA149	2150	0	4	0	0
MIA84FA161	2550	1	4	4	0
MIA84FA164	850	0	4	0	0
MIA84FA170	1670	0	4	7	0
MIA84FA188	3300	0	4	4	4
MIA84FA190	2950	0	4	5	0
MIA84FA196	3400	3	4	5	0
MIA84FA200	1650	0	3	5	0
MIA84FA203	2600	0	4	5	0
MIA84FA204	2900	1	3	6	9
MIA84FA206	3600	0	4	0	0
MIA84FA225	1800	0	4	4	11
MIA84FA234	4100	0	4	5	0
MIA84FA240	1670	0	4	5	0
MIA84FA241A	1670	1	4	6	0
MIA84FA241B	1600	1	4	5	0
MIA85FA002	1670	5	3	3	3
MIA85FA009	1425	1	4	5	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
MIA89FA004	1670	0	4	1	3
MIA89FA027	2000	0	4	7	5
MIA89FA033	2550	1	4	0	0
MIA89FA044	2325	0	4	7	11
MIA89FA048	1600	0	4	1	0
MIA89FA078	2550	0	4	4	0
MIA89GA082	3800	0	3	5	5
MKC83FA060	2900	0	4	7	0
MKC83FA065	3100	0	4	9	0
MKC83FA066	2600	0	4	7	0
MKC83FA069	1600	0	4	4	0
MKC83FA081	3600	0	4	6	0
MKC83FA090	1360	0	4	3	4
MKC83FA114	2750	0	4	4	0
MKC83FA136	1670	0	4	9	0
MKC83FA165	1450	0	4	3	0
MKC83FA171	1350	0	3	4	0
MKC83FA177	2900	0	4	5	0
MKC83FA189	2900	0	4	4	0
MKC83FA190	2900	2	3	0	0
MKC83FA209	4800	0	4	4	11
MKC83FA214	2700	0	3	4	0
MKC83FA216	1700	0	3	4	0
MKC83FA225	6725	0	4	0	0
MKC83FU001	510	0	3	2	0
MKC84FA002	3100	0	4	4	0
MKC84FA005	1800	0	4	4	3
MKC84FA014	3400	1	4	7	3
MKC84FA029	4190	0	3	2	0
MKC84FA034	3800	4	3	4	0
MKC84FA106	3850	0	4	4	0
MKC84FA115	2650	0	4	8	0
MKC84FA119	2150	0	4	4	0
MKC84FA147	2100	0	3	4	0
MKC84FA157	1220	0	3	3	0
MKC84FA164	2900	0	4	0	0
MKC84FA174	2700	0	4	5	8
MKC84FA195	2550	0	4	6	0
MKC84FA197	1625	0	4	5	0
MKC84FA218	1500	0	4	6	0
MKC84FA221	1600	0	4	7	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
MIA85FA012	3000	0	4	4	11
MIA85FA016	2850	0	3	1	0
MIA85FA023	2450	2	4	4	5
MIA85FA028	1600	0	4	4	0
MIA85FA037	1750	1	4	4	0
MIA85FA038	3900	16	4	4	0
MIA85FA041	2550	0	4	4	7
MIA85FA065	2530	0	4	4	11
MIA85FA067	1500	0	4	4	0
MIA85FA071	3250	0	3	4	5
MIA85FA098	2650	1	4	3	0
MIA85FA101	2500	1	4	5	0
MIA85FA105	3800	0	4	7	6
MIA85FA106	2200	0	4	7	0
MIA85FA123	1880	0	4	8	0
MIA85FA146	2450	0	3	3	11
MIA85FA150	1800	5	4	7	5
MIA85FA159	2700	0	4	6	7
MIA85FA170	1200	0	4	4	10
MIA85FA187	1260	0	4	6	3
MIA85FA202	3400	0	4	6	3
MIA85FA215	3400	0	3	1	0
MIA85FA227	2650	1	4	5	0
MIA85FA233B	1670	1	3	5	3
MIA85FA234	2300	0	4	4	0
MIA85FA235	2300	0	4	5	11
MIA85FA239	1400	0	4	4	11
MIA85FA241	1560	0	3	6	0
MIA85FA248	2250	0	4	4	6
MIA85FA251	813	0	4	4	0
MIA85FA254	2740	0	4	7	0
MIA85FA261	2400	0	3	4	0
MIA85FLD01	2075	5	3	4	3
MIA86FA015	2650	0	3	4	3
MIA86FA028	3400	0	4	0	0
MIA86FA033	6871	0	4	5	0
MIA86FA034	2740	0	4	4	0
MIA86FA044	2450	0	4	6	0
MIA86FA053	2300	0	4	7	0
MIA86FA055	3800	0	4	0	0
MIA86FA059	1600	0	4	4	0

MIA86FA081	2690	0	4	0	0
MIA86FA085	3400	0	4	0	0
MIA86FA091	550	0	4	5	0
MIA86FA093	2150	0	3	3	0
MIA86FA097	1100	0	4	6	0
MIA86FA101	1700	0	3	5	0
MIA86FA110	2750	0	4	4	0
MIA86FA115	900	0	4	7	0
MIA86FA135	2300	0	3	3	7
MIA86FA142	2300	0	4	4	9
MIA86FA146	1600	0	4	0	0
MIA86FA148	1600	0	4	4	6
MIA86FA181	1300	0	4	5	0
MIA86FA184	1300	0	4	5	11
MIA86FA185	10000	0	4	6	9
MIA86FA202	7020	1	4	6	0
MIA86FA218	2450	0	4	8	11
MIA86MA182	2550	0	4	1	11
MIA87FA009	1670	0	3	4	0
MIA87FA015	8000	0	4	5	8
MIA87FA020	1500	0	4	8	8
MIA87FA022	3160	0	4	3	4
MIA87FA025	1670	0	4	7	10
MIA87FA031	3600	0	4	8	4
MIA87FA035	3300	1	4	7	4
MIA87FA046	2400	0	4	6	0
MIA87FA048	2950	0	3	4	4
MIA87FA056	2150	0	4	7	11
MIA87FA067	3400	0	4	7	4
MIA87FA084	1670	0	4	6	0
MIA87FA091	3650	1	3	5	10
MIA87FA114	2150	0	4	6	4
MIA87FA118	1140	0	4	7	6
MIA87FA135	2450	0	4	9	11
MIA87FA150	1220	0	4	4	9
MIA87FA153B	1670	0	3	4	4
MIA87FA157	1600	0	4	4	5
MIA87FA160	6075	0	4	7	3
MIA87FA186	1800	0	4	5	0
MIA87FA187	2740	0	4	5	0
MIA87FA188	2150	0	3	4	0

11SU_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
MIA87FA189	2300	0	4	5	6
MIA87FA203	2650	0	4	4	3
MIA87FA205	3000	0	4	7	0
MIA87FA217	3350	0	3	4	9
MIA87FA220	600	0	4	4	0
MIA87FA231	2650	0	4	4	8
MIA87FA234	3600	2	4	4	7
MIA87FA257	3400	0	4	6	3
MIA87FA260	2650	0	4	6	10
MIA88DL001	1200	0	3	7	4
MIA88FA006	1300	0	4	1	11
MIA88FA012	3800	0	4	5	3
MIA88FA025	1250	0	3	3	0
MIA88FA044	2150	0	4	7	3
MIA88FA049	2950	0	4	5	0
MIA88FA063	1850	0	4	4	0
MIA88FA071	1600	0	4	6	0
MIA88FA081	1670	0	4	6	11
MIA88FA083	3400	0	4	5	0
MIA88FA088	1800	0	4	3	9
MIA88FA114	2150	0	4	4	5
MIA88FA127	2740	5	4	6	4
MIA88FA134	3000	10	4	5	3
MIA88FA142	2300	0	4	4	3
MIA88FA144	2350	0	3	5	0
MIA88FA178	3600	0	3	0	0
MIA88FA179	2550	0	4	7	0
MIA88FA184	1220	0	4	4	11
MIA88FA187	2300	0	3	4	4
MIA88FA191	1670	0	3	4	0
MIA88FA206	2450	0	4	0	3
MIA88FA213	1000	0	4	4	0
MIA88FA214	3325	0	4	5	5
MIA88FA232	7000	0	4	4	0
MIA88FA234	3000	0	4	0	9
MIA88FA244	1600	0	4	3	0
MIA88FA254	2300	0	4	1	10
MIA88FA257	2700	0	3	5	5
MIA88FA262	1038	0	4	8	10
MIA88FA269	2300	0	3	5	6
MIA88LA215	1670	0	4	4	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
MKC84FA225	736	1	4	3	0
MKC84FA240A	3300	0	3	6	0
MKC84FA245	3300	0	4	0	0
MKC84FA254	3300	0	4	7	0
MKC84FA256	2200	0	4	6	10
MKC84FA262	790	10	3	0	0
MKC84FA271	3100	1	3	6	4
MKC84FA272A	3150	0	4	0	0
MKC84FA272B	2550	0	4	0	0
MKC84FA285	1650	0	4	3	0
MKC84FCA02	2575	0	4	7	3
MKC84FU002	500	0	3	2	0
MKC85FA007	2450	0	4	8	3
MKC85FA017	1750	0	3	5	0
MKC85FA030	1600	0	4	5	6
MKC85FA039	2950	0	4	7	3
MKC85FA042	1600	0	3	4	9
MKC85FA069	1600	0	4	6	5
MKC85FA070	4100	0	4	0	0
MKC85FA078	2650	0	4	8	0
MKC85FA080	4500	0	4	6	11
MKC85FA084	3600	0	4	0	0
MKC85FA087	6000	0	4	6	7
MKC85FA089	3200	15	4	7	0
MKC85FA111	1500	0	3	7	0
MKC85FA114	2350	0	3	2	3
MKC85FA120	1500	0	4	4	9
MKC85FA124	1578	0	4	6	0
MKC85FA134	3233	0	4	7	10
MKC85FA137	1670	0	3	4	0
MKC85FA169	1500	0	4	3	11
MKC85FA177	4000	0	4	6	0
MKC85FA179	3200	0	4	6	0
MKC85FA180	1600	0	4	8	0
MKC85FA181	1750	0	4	0	0
MKC85FA182	630	1	4	2	0
MKC85FA189	2850	10	3	1	0
MKC85FA191	1500	0	4	0	0
MKC85FA199	1220	0	4	4	0
MKC85FA217	2450	0	3	7	0

MKC85FCA01	2150	0	4	4	0
MKC85FCA02	2600	0	4	7	0
MKC85FCD02	2300	1	3	5	0
MKC85FCJ01	1300	0	4	1	0
MKC85FCQ02	3000	0	3	6	3
MKC85FCQ04	2750	0	3	0	0
MKC85FPG01	2150	0	3	4	0
MKC85FPG02	3800	0	4	6	0
MKC85FPG03	3400	0	3	6	4
MKC86FA002	2650	1	3	6	0
MKC86FA008	2450	0	4	8	11
MKC86FA011	3400	0	4	7	0
MKC86FA017	750	0	3	5	0
MKC86FA020	4050	0	4	5	0
MKC86FA023	3600	0	4	4	0
MKC86FA027	3400	0	4	8	10
MKC86FA030	4000	0	4	10	0
MKC86FA033	3400	0	3	3	0
MKC86FA048	2650	1	4	9	5
MKC86FA053	3400	2	4	0	0
MKC86FA077	895	1	4	5	0
MKC86FA080	1600	0	3	0	0
MKC86FA082	2500	0	4	3	0
MKC86FA098	1650	0	3	5	10
MKC86FA103	1150	2	4	1	8
MKC86FA123A	1450	0	4	5	0
MKC86FA139	2800	0	4	9	8
MKC86FA151	2200	0	4	7	0
MKC86FA166	1050	0	4	3	0
MKC86FA181	2150	1	4	4	11
MKC86FA189	2300	0	4	7	11
MKC86FA195	2450	0	4	8	7
MKC86FCA01	934	5	4	7	11
MKC86FCA02	1670	0	4	4	10
MKC86FCA03	1800	0	4	0	0
MKC86FCD01	2900	0	4	3	0
MKC86FCD02	1474	0	3	3	0
MKC86FCJ01	1065	0	4	0	0
MKC86FCJ02	4200	0	4	0	4
MKC86FCJ03	3000	0	4	6	11
MKC86FCJ04	1100	0	4	5	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
MKC86FCQ01	950	0	3	4	0
MKC86FPG03	5200	0	4	5	9
MKC87DCA01	1675	0	4	2	10
MKC87DCA02	1285	0	3	1	11
MKC87DCA03	1100	1	3	6	4
MKC87DCQ01	485	1	4	4	11
MKC87DCQ02	3800	9	4	0	0
MKC87DCQ03	4800	0	4	0	0
MKC87DPG01	4200	0	4	5	9
MKC87DPG02	2900	0	4	3	0
MKC87DPG03	5000	1	3	6	0
MKC87FA002	1600	0	4	4	11
MKC87FA012	2550	1	4	8	6
MKC87FA020	2650	0	4	0	4
MKC87FA022	2550	0	4	7	5
MKC87FA027	2800	0	4	7	0
MKC87FA030	2325	0	4	5	5
MKC87FA033	1650	0	3	4	9
MKC87FA036	1670	0	4	7	0
MKC87FA037	4000	0	3	6	4
MKC87FA044	1600	0	4	4	4
MKC87FA048	1600	3	4	6	0
MKC87FA051	1500	0	4	6	11
MKC87FA077	1600	0	4	4	11
MKC87FA078	2690	0	4	6	3
MKC87FA083	1250	0	3	4	0
MKC87FA087	3400	0	4	8	6
MKC87FA092	2550	0	4	6	7
MKC87FA094	2050	0	4	2	0
MKC87FA103	1450	0	4	1	0
MKC87FA106	2500	3	4	8	11
MKC87FA121	1150	0	3	4	0
MKC87FA131	1800	0	4	8	11
MKC87FA148	728	0	3	0	11
MKC87FA159	2150	0	4	7	6
MKC87FA161	1840	0	4	5	7
MKC87FA163	2550	0	4	4	4
MKC87FA165	1840	0	4	5	10
MKC87FA169	3200	0	4	8	0
MKC87FA172	4500	0	3	5	3
MKC88DCA02	3400	0	3	0	3

[illegible]	AIRCRAFT_WGT	DIST_AIRPORT	[illegible]	AIRSPEED_[illegible]	FLT_PATH_ANGLE
MKC88DCA03	1200	0	4	4	7
MKC88DCD01	900	0	3	3	3
MKC88DCD02	900	0	4	2	11
MKC88DCG01	3520	0	3	7	4
MKC88DCJ01	4200	0	4	7	5
MKC88DCQ02	2300	0	3	5	9
MKC88DCQ03	1250	0	3	2	0
MKC88DCQ04	900	0	3	2	4
MKC88DPG01	1400	0	4	0	10
MKC88DPG02A	4400	0	4	7	3
MKC88DPG02B	4550	0	4	7	3
MKC88FA003	2078	0	3	3	3
MKC88FA005	3400	0	4	6	6
MKC88FA007	1650	1	4	5	10
MKC88FA012	1100	4	3	6	4
MKC88FA019	3600	1	4	7	3
MKC88FA021	2175	0	4	7	0
MKC88FA023	2550	0	4	4	9
MKC88FA026	1817	1	4	6	5
MKC88FA039	2800	1	4	5	6
MKC88FA040	2050	0	4	5	10
MKC88FA043	4300	0	4	1	9
MKC88FA058	2150	0	4	1	0
MKC88FA070	4150	0	3	3	6
MKC88FA086	1600	0	3	4	8
MKC88FA147	2575	0	3	0	0
MKC88FA166	1600	0	3	7	4
MKC89DCJ01	1150	0	3	6	11
MKC89FA004	2550	0	3	2	7
MKC89FA011	1220	0	3	4	8
MKC89FA014	1500	0	3	3	11
MKC89FA017	3800	0	3	5	6
NYC83AA208	2550	0	4	0	0
NYC83AA209	4300	0	4	5	0
NYC83FA052	1300	0	3	1	0
NYC83FA061	1200	1	4	3	0
NYC83FA062	2325	0	3	5	0
NYC83FA071	2300	0	3	5	0
NYC83FA072	1600	2	3	4	0
NYC83FA085	2750	10	4	7	0
NYC83FA086	3800	6	3	3	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
NYC83FA087	3600	8	4	8	0
NYC83FA088	2550	4	3	5	0
NYC83FA091	2300	16	4	7	0
NYC83FA098	2550	1	4	6	0
NYC83FA102	2750	0	4	4	0
NYC83FA105	1670	0	4	3	0
NYC83FA106	2450	0	4	0	0
NYC83FA107	2800	7	4	7	2
NYC83FA110	2400	3	3	5	0
NYC83FA121	2900	0	4	0	0
NYC83FA122	2200	0	4	5	0
NYC83FA125	1950	7	4	7	0
NYC83FA126	3866	1	4	0	0
NYC83FA130	5300	0	4	0	0
NYC83FA141	2950	0	4	5	0
NYC83FA142	1750	0	4	0	0
NYC83FA168	2400	0	3	5	0
NYC83FA172	1220	0	4	3	0
NYC83FA187	2400	10	4	7	0
NYC83FA188A	3500	1	4	7	3
NYC83FA188B	3000	0	4	1	0
NYC83FA192	3300	0	4	0	3
NYC83FA198	3400	1	4	6	0
NYC83FA204	3300	1	4	9	0
NYC83FA242	3600	6	4	0	0
NYC83FA244	4850	0	4	2	0
NYC83FA256	2740	0	4	5	0
NYC83FA260	2200	0	4	0	0
NYC83FFA02	1600	0	3	6	3
NYC83FFA03	3400	1	3	6	0
NYC83FFJ02	4500	0	3	5	3
NYC83FGM02	2350	0	3	0	5
NYC83FGM03	1100	0	4	2	3
NYC83FGM04	720	1	4	0	0
NYC83FGM05	1675	1	4	0	0
NYC83FHA03	2000	13	3	0	0
NYC83FHD02	3400	4	4	5	2
NYC83FHM02	1500	0	4	9	0
NYC83FNC08	2350	0	4	3	0
NYC83FNC09	2300	0	4	4	3
NYC83FNC11	1800	0	3	3	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
NYC83FNE02	2200	1	3	5	0
NYC83FNE03	1800	1	4	6	0
NYC83FNE04	959	0	3	6	2
NYC83FU002	550	0	4	4	0
NYC83FU004	445	0	4	5	0
NYC83FU005A	440	0	4	3	0
NYC83FU005B	440	0	3	3	0
NYC83LA066	3600	0	3	0	0
NYC84FA009	3200	0	4	3	0
NYC84FA016	3325	0	4	7	0
NYC84FA022	3400	1	4	0	0
NYC84FA032A	2950	0	4	0	0
NYC84FA039	1500	2	4	5	0
NYC84FA046	1670	0	3	6	5
NYC84FA053	3200	2	4	0	0
NYC84FA057	1220	0	4	0	0
NYC84FA058	2950	0	4	9	0
NYC84FA059	3600	1	4	5	0
NYC84FA072	1675	0	4	0	0
NYC84FA074	4000	2	4	9	9
NYC84FA085	2650	1	4	0	0
NYC84FA096	3350	1	4	5	0
NYC84FA104	2550	0	4	0	0
NYC84FA107	1500	0	4	1	0
NYC84FA108	2500	0	4	5	0
NYC84FA117	2450	0	4	0	0
NYC84FA118	1650	0	4	0	0
NYC84FA129	2750	0	4	3	8
NYC84FA137	1600	1	4	5	0
NYC84FA138	3050	5	4	7	3
NYC84FA143	2650	3	4	8	0
NYC84FA148	3600	0	4	7	0
NYC84FA149	2200	0	4	4	0
NYC84FA157	1670	0	4	0	0
NYC84FA158	1750	0	4	3	0
NYC84FA159	2150	1	4	5	3
NYC84FA165	2150	0	4	5	0
NYC84FA178	3100	3	4	0	0
NYC84FA180	2985	1	4	0	0
NYC84FA189	1100	0	4	0	0
NYC84FA201	2400	0	4	3	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
NYC84FA214	4300	0	4	0	0
NYC84FA218	1600	1	4	0	0
NYC84FA224	2400	1	4	0	0
NYC84FA233	2200	0	4	6	0
NYC84FA269	4118	10	4	0	0
NYC84FA274	3100	1	4	0	0
NYC84FA275	2300	1	4	6	3
NYC84FA293B	2650	0	3	5	3
NYC84FA306	2150	0	4	0	11
NYC84FA307	3200	0	4	0	0
NYC84FA310	1250	0	4	3	0
NYC84FA314	3600	0	4	6	0
NYC84FFA01	1600	0	3	4	0
NYC84FFA02	2400	0	3	2	8
NYC84FFA03	1250	0	4	4	0
NYC84FFA05	1500	0	3	4	0
NYC84FFJ01	2750	0	4	6	0
NYC84FGM01	2325	10	4	0	7
NYC84FGM03	950	0	3	4	0
NYC84FGM04	3100	0	3	2	0
NYC84FGT01	2575	0	4	6	11
NYC84FGT02	2850	0	3	0	0
NYC84FHJ02	1830	0	3	0	0
NYC84FHM01	2550	0	4	0	11
NYC84FHM02	2740	0	3	1	0
NYC84FHM03	1000	1	3	6	0
NYC84FHM05	2950	4	4	0	0
NYC84FIA03	2550	0	3	4	0
NYC84FIG01	2325	2	3	4	0
NYC84FIG02	2075	0	3	5	0
NYC84FIG03	1670	0	3	5	0
NYC84FNA01	2500	0	3	2	0
NYC84FNC03	2150	0	3	4	0
NYC84FNC07	3400	0	3	0	0
NYC84FNC08	1250	1	4	4	0
NYC84FNC09	2200	0	4	0	0
NYC84FNC10	2950	0	3	1	10
NYC84FNE01	2325	0	3	2	0
NYC84FNE04	1600	0	3	6	10
NYC84FNE05	2575	1	4	4	0
NYC84FNE06	4150	0	3	1	3

[illegible]	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
NYC84FU005	530	1	4	3	0
NYC85FA001	4000	0	3	0	0
NYC85FA003	2550	0	4	5	11
NYC85FA014	1600	0	4	7	4
NYC85FA015	2200	0	4	5	0
NYC85FA019	2150	1	4	7	0
NYC85FA029	2900	0	4	7	11
NYC85FA092	7200	0	3	6	0
NYC85FA103	2740	2	4	0	0
NYC85FA104	2450	0	4	6	3
NYC85FA109	2150	0	4	5	6
NYC85FA110	3100	0	4	7	0
NYC85FA131	3100	0	4	0	0
NYC85FA166	2900	1	4	4	3
NYC85FA201	2500	0	4	0	0
NYC85FA213	2300	0	4	4	0
NYC85FA219	1600	0	4	4	0
NYC85FA222	1400	0	4	3	0
NYC85FA227	1600	15	4	0	0
NYC85FA241	2150	0	4	8	0
NYC85FA244	3400	2	4	4	6
NYC85FA245	3350	0	4	1	0
NYC85FFA01	2300	0	3	4	0
NYC85FFA03	2300	0	3	0	0
NYC85FFJ01	274	0	3	0	0
NYC85FGM04	3200	0	3	4	0
NYC85FGM05	1500	0	4	0	0
NYC85FGT02	1800	0	4	4	0
NYC85FHA02	2950	0	3	0	0
NYC85FHA03	2300	0	3	3	8
NYC85FHD01	2150	0	3	4	0
NYC85FHD02	3300	0	4	7	0
NYC85FHD03	2300	0	3	3	0
NYC85FHJ01	2150	0	4	0	0
NYC85FHJ02	1670	0	3	4	0
NYC85FHJ04	2300	0	3	4	5
NYC85FNA02	793	0	3	3	11
NYC85FNC06	1350	0	4	4	10
NYC85FNE01	1050	0	3	5	6
NYC86FA001	2740	1	4	7	9
NYC86FA023	2300	1	4	4	0

NTSB NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
NYC86FA030	2950	0	4	7	3
NYC86FA037	2900	0	4	5	0
NYC86FA048	2150	0	4	0	0
NYC86FA057	2800	6	4	0	9
NYC86FA077	2150	1	4	5	11
NYC86FA084	2550	1	4	7	0
NYC86FA096	2500	2	4	7	0
NYC86FA111	2150	1	4	6	0
NYC86FA114A	1014	0	4	6	0
NYC86FA127	1370	0	4	3	0
NYC86FA135	2600	1	4	6	8
NYC86FA138	2300	0	4	4	0
NYC86FA158	3400	2	4	7	6
NYC86FA176	2400	0	4	5	3
NYC86FA213	4100	0	4	5	5
NYC86FA214	2900	0	4	0	0
NYC86FA216	3000	0	4	7	10
NYC86FA218	2150	2	4	5	0
NYC86FA219	1600	0	4	7	0
NYC86FA234	3600	2	3	4	3
NYC86FGM05	1500	0	4	5	8
NYC86FGM06	1339	1	4	6	9
NYC86FGM07	550	0	4	3	0
NYC86FHA01	2150	0	3	4	0
NYC86FHA02	1500	1	3	6	0
NYC86FHD03	2000	0	4	0	10
NYC86FHM01	2300	0	3	0	0
NYC86FNC02	1220	1	3	3	9
NYC86FNC03	1100	0	4	4	7
NYC86FNC07	1600	0	4	2	11
NYC86FNC08	1650	0	4	5	11
NYC87DGM01	2740	0	3	5	0
NYC87DGM02	1100	0	3	5	0
NYC87DHD04	803	0	4	7	5
NYC87DHJ01	1600	5	4	0	0
NYC87DHM02	1254	0	3	4	8
NYC87DNC04	1200	0	3	3	11
NYC87DNC05	1500	0	4	5	0
NYC87DNC07	450	0	4	4	10
NYC87DNC12	1600	0	4	5	0
NYC87FA002	1670	0	4	3	11

[illegible]	AIRCRAFT_WGT	DIST_AIRPORT	[illegible]	[illegible]	[illegible]
NYC87FA006	2050	2	4	7	0
NYC87FA015	3350	0	3	5	6
NYC87FA020A	2800	0	4	3	0
NYC87FA021	3000	2	4	6	5
NYC87FA023	2550	7	4	7	3
NYC87FA025	3200	0	4	7	5
NYC87FA038	2325	0	4	7	3
NYC87FA045	1670	0	4	9	0
NYC87FA063	2450	5	4	7	4
NYC87FA095	1670	0	4	5	11
NYC87FA119	2300	0	4	4	0
NYC87FA127	2400	0	4	10	9
NYC87FA160	2500	0	4	4	0
NYC87FA262	3400	0	4	6	0
NYC87MA024	2600	0	4	2	0
NYC88DFJ04	3000	0	3	6	0
NYC88DGM03	2325	0	4	7	0
NYC88DGT01	7000	0	4	0	0
NYC88FA062	3600	0	4	6	5
NYC88FA133	3200	0	4	4	9
NYC88FA143	3200	0	3	4	5
NYC88FA202	2400	0	4	5	3
NYC88FA216	3600	0	3	4	10
NYC89FA003	1250	0	4	4	6
NYC89FA007	1500	0	4	1	11
NYC89FA013	4050	0	4	1	10
SEA83AA176	2750	0	4	0	0
SEA83FA037	4000	7	4	8	3
SEA83FA042	1800	0	4	6	0
SEA83FA044	4000	3	4	0	0
SEA83FA045	1150	1	4	1	0
SEA83FA052	2300	0	4	3	0
SEA83FA058	1450	0	4	4	0
SEA83FA060	1700	1	4	0	0
SEA83FA062	1600	0	4	0	0
SEA83FA065	2750	0	4	0	0
SEA83FA072	1500	0	4	2	0
SEA83FA087	2400	0	4	8	0
SEA83FA089	2150	0	4	7	9
SEA83FA093	1675	0	4	3	0
SEA83FA094	2200	1	4	4	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
SEA83FA095	2450	0	4	8	4
SEA83FA103	3600	1	4	5	0
SEA83FA113	2800	0	4	8	0
SEA83FA115	2800	0	4	0	0
SEA83FA118	2900	0	4	7	0
SEA83FA127	2900	0	4	4	0
SEA83FA131	3400	0	4	8	0
SEA83FA135	2350	0	3	2	0
SEA83FA139	2800	0	4	4	0
SEA83FA141	560	3	4	4	0
SEA83FA142	1500	0	4	5	0
SEA83FA162	4800	0	4	5	0
SEA83FA168	1150	2	4	3	0
SEA83FA178	1500	1	4	3	0
SEA83FA186	1834	0	4	2	0
SEA83FA187	2650	0	4	5	1
SEA83FA197	3600	0	4	7	0
SEA83FA198	9500	0	4	2	2
SEA83FA204	2600	4	4	0	0
SEA83FYA02	1650	10	3	6	0
SEA83FYK04	1600	0	4	0	0
SEA83FYM05	1600	0	3	1	0
SEA83FYM06	3800	5	3	0	0
SEA84FA005	1500	0	4	4	11
SEA84FA007	3100	0	4	3	0
SEA84FA011	2950	0	4	4	3
SEA84FA015	1600	14	4	4	0
SEA84FA017	3350	0	4	4	0
SEA84FA020	1300	20	4	2	0
SEA84FA055	1300	0	4	0	0
SEA84FA058	3000	11	4	7	0
SEA84FA063	2350	0	4	0	0
SEA84FA068	2750	0	4	7	0
SEA84FA071	2900	0	4	7	0
SEA84FA078	3125	7	4	4	0
SEA84FA088	1600	0	4	0	0
SEA84FA090	1650	0	4	6	0
SEA84FA101	3800	0	4	9	0
SEA84FA102	1450	0	4	3	0
SEA84FA110	6000	0	3	4	0
SEA84FA111	2400	0	4	5	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
SEA84FA113	1600	0	4	0	0
SEA84FA135	2200	0	4	0	0
SEA84FA158	1600	1	4	5	0
SEA84FA164	1650	0	4	4	0
SEA84FA171	3350	4	4	5	3
SEA84FA173	2800	0	4	0	0
SEA84FA175	2800	2	4	7	0
SEA84FA178	1800	0	4	0	0
SEA84FA185	5100	0	4	5	0
SEA84FA196	2000	1	4	4	0
SEA84FA198	1400	1	4	4	0
SEA84FA201	2800	0	4	4	0
SEA84FA204	1616	0	4	0	0
SEA84FA209	600	0	4	3	0
SEA84FA215A	2175	0	4	0	0
SEA84FA215B	2100	0	4	0	0
SEA84FA217	3800	0	4	3	11
SEA84FA223	3800	0	4	0	0
SEA84FA228	3600	2	4	5	0
SEA84FYK01	2300	0	4	6	6
SEA84MA016	5100	0	4	4	0
SEA85FA001	3100	0	4	4	8
SEA85FA012	2800	0	4	8	0
SEA85FA016	2300	0	4	0	0
SEA85FA030	1670	1	4	5	0
SEA85FA034	8000	5	3	6	0
SEA85FA036	1750	0	4	0	0
SEA85FA040	3200	0	3	2	0
SEA85FA043	2050	0	4	4	0
SEA85FA048	2447	0	4	7	3
SEA85FA050	2350	0	4	4	0
SEA85FA051	3125	0	4	7	3
SEA85FA065	2500	0	4	8	0
SEA85FA067	2350	0	4	5	4
SEA85FA082	2200	0	4	0	0
SEA85FA084	3325	2	4	5	11
SEA85FA086	1750	0	4	2	0
SEA85FA100	1850	0	4	0	0
SEA85FA103	3600	0	4	5	11
SEA85FA104	3000	0	4	1	3
SEA85FA113	2800	0	4	0	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
SEA85FA120	3300	0	4	0	0
SEA85FA122	3400	0	4	7	9
SEA85FA124	2350	0	4	5	11
SEA85FA134	8500	0	4	0	0
SEA85FA137	2400	0	3	2	4
SEA85FA147	2800	0	4	4	0
SEA85FA156	850	0	4	4	0
SEA85FA162	3600	0	4	0	0
SEA85FA171	1220	0	4	1	11
SEA85FA181	2000	0	4	4	4
SEA85FA190	1350	0	4	3	5
SEA85FA203	3400	0	4	0	0
SEA85FA208	2900	0	4	3	0
SEA85FA211	3200	0	4	4	0
SEA85FA212	1200	0	4	0	0
SEA85FA217	1260	0	4	0	0
SEA85FA225	2500	0	4	4	0
SEA85FYM01	6600	0	4	0	0
SEA85FYM03	2200	0	3	5	0
SEA85LA054	2800	0	4	0	0
SEA85LA095	3600	1	4	0	0
SEA86FA004	1650	0	4	1	0
SEA86FA007	2300	0	4	5	5
SEA86FA020	1650	0	4	7	0
SEA86FA034	2100	0	4	4	3
SEA86FA035	2325	0	4	4	10
SEA86FA039	3100	0	4	0	11
SEA86FA041	2950	1	4	6	8
SEA86FA047	3300	2	4	0	0
SEA86FA052	3500	0	4	5	0
SEA86FA053	2550	2	4	7	4
SEA86FA054	2300	0	4	8	3
SEA86FA056	3000	0	4	7	3
SEA86FA071	2950	0	4	0	0
SEA86FA073	3650	0	4	3	11
SEA86FA075	2400	0	4	5	4
SEA86FA092A	2400	0	4	0	0
SEA86FA092B	2400	0	4	0	0
SEA86FA096	2450	4	4	6	0
SEA86FA098	3600	0	4	2	11
SEA86FA100	2500	0	4	0	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
SEA86FA121A	1670	0	4	0	0
SEA86FA121B	3600	0	4	8	0
SEA86FA126	3050	0	4	5	11
SEA86FA137	9500	0	4	0	0
SEA86FA139	2750	0	4	3	0
SEA86FA144	1704	0	4	4	0
SEA86FA145	2200	0	4	0	11
SEA86FA155	1300	1	4	3	11
SEA86FA165	1500	1	4	5	0
SEA86FA174	1125	0	4	0	10
SEA86FA188	2200	0	4	5	3
SEA86FA207	2350	1	4	4	0
SEA86FA213	1400	0	4	3	11
SEA86FA215	3800	0	4	0	0
SEA86FA216	1500	0	4	5	0
SEA86FA217	1650	0	4	3	9
SEA86FA231	1400	0	4	4	10
SEA86FA232	2175	0	4	0	0
SEA86FA233	2550	0	4	7	0
SEA86FA245	1600	0	4	0	0
SEA86FA248	2300	0	4	6	4
SEA86LA043	1260	0	4	7	0
SEA86LA122	2950	0	4	7	4
SEA87FA014	1670	0	4	7	0
SEA87FA019	2950	0	4	7	4
SEA87FA027	3600	0	4	5	0
SEA87FA031	2800	1	4	6	4
SEA87FA051	1600	0	4	0	11
SEA87FA060	2800	4	4	7	0
SEA87FA062	1600	0	4	0	0
SEA87FA100A	2200	0	4	7	11
SEA87FA102	2535	0	4	0	0
SEA87FA112	1600	0	3	4	5
SEA87FA129	1600	0	4	0	0
SEA87FA145	4000	0	4	0	0
SEA87FA152	2150	0	4	5	0
SEA87FA158	1600	2	4	5	11
SEA87FA162B	3100	1	3	6	0
SEA87FA165	2050	0	4	0	0
SEA87FA166	2650	0	4	5	3
SEA87FA178	1800	0	4	4	0

NTSB_NBR	AIRCRAFT_WGT	DIST_AIRPORT	ACFT_DAMAGE	AIRSPEED_IMPACT	FLT_PATH_ANGLE
SEA87FA185	3300	7	4	0	0
SEA87FA190	3800	0	4	0	0
SEA87FA194	3000	0	3	1	0
SEA87LA048	1100	0	4	0	11
SEA87LA142	2150	0	4	8	0
SEA87LA174	825	1	4	0	0
SEA87MA034	4150	5	4	4	4
SEA87MA035	3500	0	4	6	3
SEA88FA011	2650	0	4	5	3
SEA88FA012	2450	0	4	0	0
SEA88FA021	3100	0	4	9	0
SEA88FA023	2300	0	4	6	3
SEA88FA024	2800	0	4	7	3
SEA88FA031	3600	0	4	0	0
SEA88FA032	1950	0	4	0	0
SEA88FA034	2800	0	4	5	4
SEA88FA039	2450	0	4	0	0
SEA88FA054	4000	0	4	6	4
SEA88FA060A	1450	0	4	5	3
SEA88FA060B	1397	0	4	5	3
SEA88FA078	3600	0	4	7	0
SEA88FA095	2300	1	4	0	0
SEA88FA120	1600	0	4	0	0
SEA88FA122	3600	0	4	5	0
SEA88FA140	3320	0	4	5	9
SEA88FA154	3100	0	4	7	3
SEA88FA156	5090	0	4	0	0
SEA88FA160	2450	0	4	4	9
SEA88FA166	1600	0	3	4	0
SEA88FA176	9500	0	4	1	11
SEA88LA072	1950	1	4	6	4
SEA88LA094	1750	0	4	4	6
SEA88LA177	2300	0	4	3	10
SEA88LA182	2900	0	4	0	0
SEA88LA188	1000	0	4	0	11
SEA89FA002	3800	0	4	6	3
SEA89FA010	2400	0	4	7	9
SEA89FA027	5000	0	4	4	9
SEA89FA036	7967	0	4	0	0
SEA89FA041	1260	0	4	3	0
SEA89GA064	2400	0	4	4	0

SEA89LA011	1325	0	4	0	0
SEA89LA013	3100	0	4	6	9

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POTENTIAL OGALLALA AQUIFER IMPACTS OF A HYPOTHETICAL PLUTONIUM DISPERSAL ACCIDENT IN ZONE 4 OF THE PANTEX PLANT

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1 – EXECUTIVE SUMMARY

Pantex Plant and DOE Albuquerque Field Office staffs are currently preparing a Safety Analysis Report and Environmental Assessment describing current weapon staging and proposed component interim storage operations in Zone 4 of the Pantex Plant, near Amarillo, Texas. The State of Texas has expressed concern over the potential consequences to the Ogallala Aquifer of an accidental plutonium release. Members of the Los Alamos National Laboratory Earth and Environmental Sciences Division have prepared this report describing the potential for aquifer contamination should plutonium be released to the environment within an 80-km radius of the Pantex Plant.

The following assumptions were used in preparing the groundwater impact analysis:

- Surface soils would be decontaminated to a maximum radiation level of 0.2 $\mu Ci/m^2$ following the hypothetical accident.
- Surface transport processes may increase soil concentrations ten-fold, to 2.0 $\mu Ci/m^2$, before infiltration takes place.
- Recharge to the Ogallala Aquifer is focused at playa lake beds. Playa lake recharge rates are approximately 3 cm/year, ten times the High Plains average.
- The Ogallala Aquifer water table may be encountered as shallow as 50 feet beneath the land surface within the study area.
- The entire unsaturated zone exhibits a plutonium sorption coefficient of 100 mL/g, approximating the sorption of clean Ogallala sand.

With these conservative assumptions in place, two analyses were performed. A non-dispersive piston-flow model indicated that significant plutonium levels might be encountered in a 50-foot deep aquifer after approximately 76,000 years. A second, more realistic analysis incorporating dispersion showed that even with unrealistically low dispersivity values, peak plutonium concentrations in the 50-foot aquifer would never exceed the most restrictive drinking water dose limits. With more realistic dispersivity values, or deeper water tables more typical of the study area, peak plutonium concentrations in the aquifer would be orders of magnitude below dose limits. Neither analysis showed significant impacts to deeper aquifers.

Additional complicating factors have also been analyzed. These include colloidal plutonium transport, preferential flow, the effects of perched aquifers, opportunities for "short-circuit" flow through abandoned wells or other conduits, and the fate of daughter products. Although it is difficult to quantify these factors accurately, most are expected to have little if any negative impact on the Ogallala Aquifer. Colloidal transport is perhaps the most uncertain process in this category, but a field experiment at a nearby location suggests that colloidal transport will not enhance radionuclide transport enough to significantly affect groundwater quality in the Ogallala Aquifer.

The final conclusion of these analyses is that the hypothetical plutonium dispersal accident does not pose a significant threat to the Ogallala Aquifer.

2 – STATEMENT OF PROBLEM

The hypothetical accident leading to dispersal of plutonium to the environment around Pantex is a high-temperature fire caused by a jet plane impact into a Zone 4 storage igloo containing nuclear weapons components, and subsequent ignition of jet fuel. These conditions may cause surface deposition of air-borne particulate plutonium across a large area downwind of the plant. The exact dimensions and location of this plume will depend on local meteorological conditions at the time of the fire, but much of the plutonium will likely fall on the Southern High Plains and Central High Plains of Texas. These are the recharge areas for the Ogallala (or High Plains) Aquifer, the primary water source for much of the Texas Panhandle. This aquifer is of immense economic significance, and potential threats to the resource should be carefully analyzed and, if necessary, minimized.

This report describes the potential impacts of the hypothetical accident on water quality in the Ogallala Aquifer. The results presented here are based on a thorough review of existing information on local and regional hydrogeology, new laboratory sorption studies on local geologic materials, and transport and dosimetry modeling. Although this is not a formal "worst-case" analysis, we have consistently made conservative assumptions to maximize the probability of identifying any real threats to the Ogallala Aquifer.

3 – PLUTONIUM TRANSPORT TO THE OGALLALA AQUIFER

Any potential impacts to the Ogallala Aquifer would entail transport of contaminants from their deposition site at the ground surface down to the water table. This section of the report briefly outlines the processes that control this transport and describes the conceptual model that underlies the quantitative calculations discussed in the following sections.

Regional Setting

In the Panhandle section of Texas, the Ogallala Aquifer underlies the Southern and Central High Plains (Figure 3-1). These provinces are topographically-isolated plateaus bordered by the Pecos and Canadian River valleys to the west and the Caprock Escarpment to the east. The Southern High Plains are separated from the Central High Plains by the Canadian Breaks, an eroded landscape along the Canadian River.

The Ogallala Formation, primary host of the Ogallala Aquifer, is Tertiary in age and consists of eolian and alluvial material derived from the Southern Rocky Mountains to the west. Aquifer materials range from gravel to clay in grain size, and include some post-depositional caliche layers. The Ogallala Formation has been eroded and is no longer present along the Canadian and Pecos Rivers, or on the Rolling Plains, east of the Caprock Escarpment.

The Ogallala Formation is overlain by up to 27 m of Quaternary-age eolian silt and sand that comprise the Blackwater Draw Formation (Holliday, 1990). The major soil on the uplands in the study area is Pullman clay loam, derived from the underlying fine-textured eolian sediments (Unger and Pringle, 1981). The lower horizons of the Pullman soils are characterized by manganese-iron films on the surfaces (Allen et al., 1972). The High Plains surface is characterized by numerous playa lakes, small surface depressions found throughout the study area. The soil underlying the playa lakes is primarily Randall clay, sometimes associated with soils of the Estacado, Mansker, Lofton, and Lipan series (Unger and Pringle, 1981). Based on X-ray diffractometry, Allen et al. (1972) report that the clay mineralogy of the Randall soil consists mainly of poorly organized montmorillonite (associated with fine clay) with considerable quantities of illite, and smaller quantities of kaolinite (associated with coarse clay). Silt mineralogy is dominated by quartz and feldspars.

Groundwater in the Ogallala Aquifer occurs under unconfined or water-table conditions. Regional groundwater flow is from west to east, reflecting the regional topography. Recharge to the aquifer occurs through infiltration of rainfall and surface water through the Blackwater Draw Formation (Nativ and Smith, 1987). Recharge is probably focused at playa lakes, small surface depressions ubiquitous throughout the study area. The question of focused recharge will be discussed further below.

Natural discharge from the Ogallala Aquifer historically occurred through seeps and springs along the boundaries of the High Plains, particularly along the Eastern Caprock Escarpment and

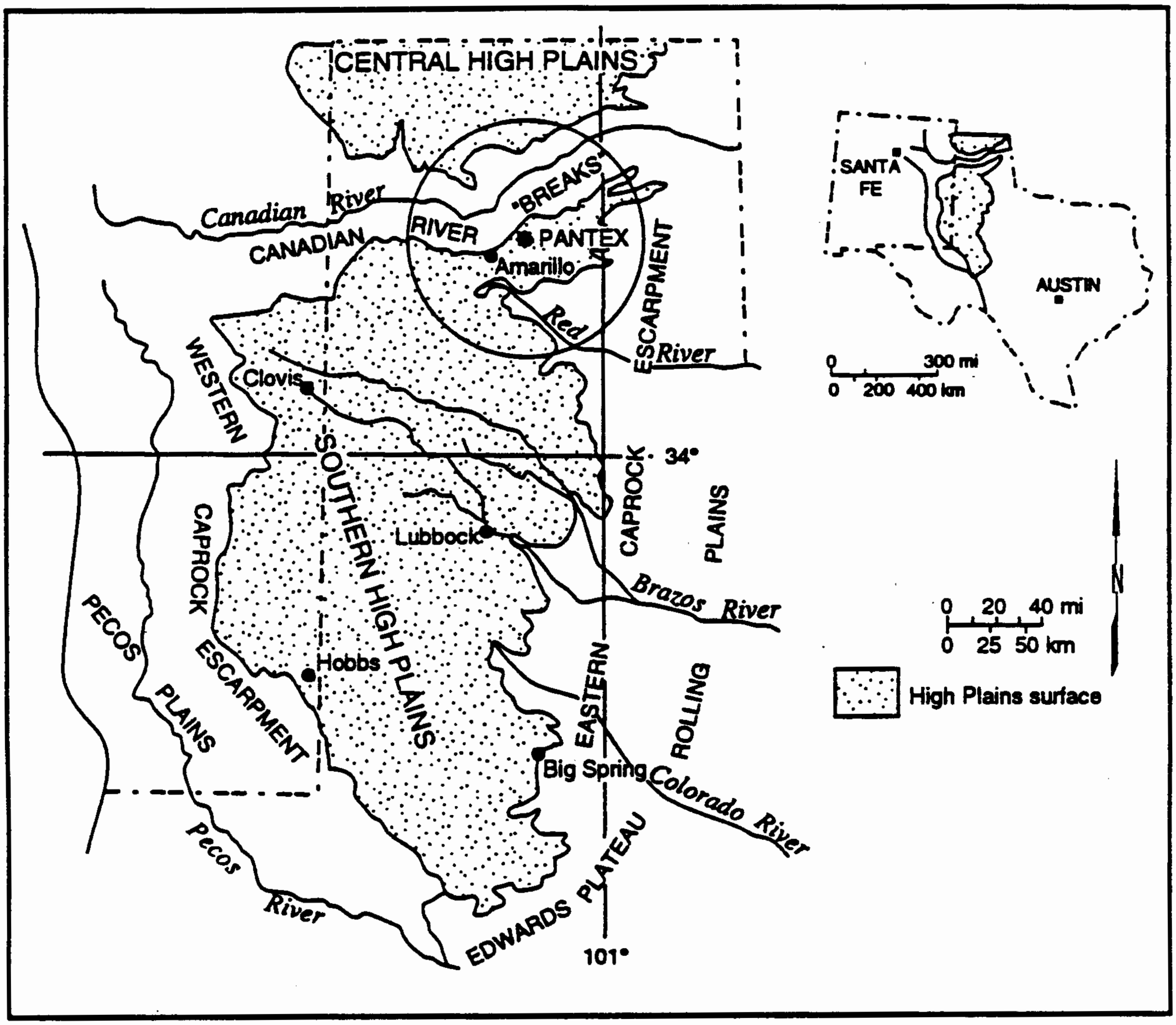

Figure 3-1. Central and Southern High Plains of Texas, showing the 80-km radius study area (adapted from Gustavson et al., 1990).

the Canadian Breaks. Some leakage into underlying formations is also possible. Since massive groundwater pumpage for agriculture began after World War II, many of these natural discharge points have stopped flowing, and today, groundwater pumpage is by far the most significant discharge route from the Ogallala Aquifer (Nativ and Smith, 1987). Current pumpage rates far exceed recharge, and the resulting groundwater mining is leading to declining water tables in most of the study area (Ashworth, 1991).

Water chemistry in the Ogallala aquifer and in the unsaturated zone beneath playas is generally quite good, typically a mixed-cation / bicarbonate water with 200-500 mg/L total dissolved solids and a pH of about 7.5 (Purtymun and Becker, 1982; Wood and Ostercamp, 1984).

Recharge to the Ogallala Aquifer

Because of the economic importance of the Ogallala Aquifer and concern over water level declines, numerous researchers have studied the aquifer's recharge rate (Table 3-1). As Stone and McGurk (1985) pointed out, recharge can be considered on various spatial scales, ranging from local through areal to regional. At the local scale, recharge is likely to vary widely from spot to spot over a distance of meters, due to variations in local rainfall, surface slope, and soil properties. Over a larger area, these local variations will tend to average out, and a representative recharge rate may be applied over the entire extent of a particular landscape setting, such as playa lakes or uplands. Finally, a weighted average of different areal recharge rates may represent an overall regional recharge rate for a region the size of the Southern High Plains.

Table 3-1. Recharge rate estimates for the Southern High Plains.

Recharge Estimate	(cm/year)	Location	Source
< 0.5 in/yr	< 1.3	Regional, SHP	C.V. Theis, cited by Aronovici and Schneider, 1972
0.25 cm/yr	0.25	Regional, SHP	Wood and Petraitis, 1984
4 - 5 cm/yr	4 - 5	Playa annuli, SHP	Wood and Petraitis, 1984
0.11 in/yr	0.28	Regional, northern SHP	Luckey, 1984
< 3/16 in/yr	< 0.48	Regional, TX High Plains	Knowles, 1984
0.75 mm/yr	0.075	Blackwater Draw Fm., NM	Stone and McGurk, 1985
4.36 mm/yr	0.436	Sand Dunes, NM	Stone and McGurk, 1985
12.22 mm/yr	1.222	Playas, NM	Stone and McGurk, 1985
1.5 mm/yr	0.15	Regional, NM	Stone and McGurk, 1985
0.3 cm/yr	0.3	Regional, SHP	Ostercamp and Wood, 1987
1.3 - 8 cm/yr	1.3 - 8	Maximum, SHP	Nativ and Riggio, 1990

SHP: Southern High Plains

Numerical model calibrations have yielded regional recharge estimates for the High Plains ranging from 0.25 - 0.3 cm/year (Luckey, 1984; Wood and Petraitis, 1984; Ostercamp and Wood, 1987). This relatively narrow range suggests that this number is fairly accurate.

Local recharge is more variable. After years of controversy, there appears to be a consensus building that the playa lakes of the High Plains focus recharge in a relatively small area, and that recharge in the uplands between playas is relatively insignificant or even nonexistent (Wood and Ostercamp, 1984; Wood and Petraitis, 1984; Stone and McGurk, 1985; Nativ and Smith, 1987). Local recharge rates in the playa basins must therefore significantly exceed the regional averages cited above. Local recharge estimates range from 1.2 cm/year for playas in eastern New Mexico (Stone and McGurk, 1985) to 4-5 cm/year for playa annuli (Wood and Petraitis, 1984). By analyzing groundwater tritium concentrations, Nativ and Riggio (1990) calculated a maximum estimated recharge rate at 1.3 - 8 cm/year, but pointed out that the higher rates are found in the southern part of the Southern High Plains, south of the present study area. For the purposes of this project, we shall assume that recharge rates beneath playas in the study area consisting of the northern part of the Southern High Plains and the southernmost part of the Central High Plains is approximately 3 cm/year.

Thickness of the Unsaturated Zone

Water movement through the unsaturated zone between the ground surface and the water table in arid regions is often quite slow. The thickness of the unsaturated zone is therefore an important parameter controlling an aquifer's susceptibility to contamination. Although no recent contour maps showing depth-to-water for the study area were available, a comparison of a recent water-table elevation map (Ashworth, 1991) and USGS topographic maps suggest that typical depths to the water table in the 80-km radius study area are on the order of 200 feet. In the immediate vicinity of the Pantex Plant, the Ogallala water table is much deeper, 400 feet down, primarily due to a zone of depression caused by the City of Amarillo well field. In parts of Randall and Swisher counties, south of Pantex, water tables are shallower, in some cases as shallow as 50 feet.

Hydrogeologic studies in the immediate vicinity of the Pantex Plant have revealed a local perched aquifer above the main Ogallala Aquifer (Purtymun and Becker, 1982; Texas Bureau of Economic Geology, 1992). The lateral extent and continuity of this secondary aquifer is not yet known. Possible effects of the perched aquifer on the potential for contamination of the Ogallala Aquifer will be discussed in Section 5.

Definition of the Contaminant Source Term

An important step in this impact analysis is a determination of the quantity and location of plutonium dispersed by the hypothetical accident that could impact the Ogallala Aquifer. Only materials that fall on the recharge area of the aquifer have that potential. The recharge area for the Ogallala Aquifer is the relatively flat High Plains surface shown in Figure 3-1. The Ogallala Formation has been completely eroded away along the Canadian River Valley and on the Rolling Plains east of the Caprock Escarpment, and the Ogallala outcrop areas along the margins of the High Plains are groundwater discharge areas.

In the event of the hypothetical accident, the overall size and specific location of the affected area will depend on local meteorological conditions. Predominant wind directions in the Amarillo area are to the north-northeast (Dewart et al., 1982), but for this project, we have conservatively assumed that the contamination plume may extend in all directions for a distance of up to 80 km from the Pantex Plant. Contamination that may pose a risk to the Ogallala Aquifer will therefore be assumed to be limited to material falling onto the High Plains surface within a 80-km radius of Pantex.

If the hypothetical accident occurs, the affected area will be decontaminated to a maximum radioactivity level of 0.2 $\mu Ci/m^2$. As mentioned earlier, recharge to the Ogallala Aquifer is focused at playa lakes scattered across the High Plains Surface. Precipitation runoff collects in these playa lakes, and may be expected to carry particulate and sorbed plutonium as well. Wind transport may also redistribute and locally concentrate plutonium at the playa lakes. To account for these surface processes, we have assumed that a ten-fold concentration of plutonium may occur between decontamination and infiltration, resulting in a soil contamination level of 2.0 $\mu Ci/m^2$ at the Ogallala recharge areas in the playa lakes. This is a very conservative assumption -- a study of ^{137}Cs levels in soil affected by fallout from the Trinity Test showed that after 32 years, surface processes had locally concentrated contaminants by only a factor of 1.5 - 2 (Hansen and Rodgers, 1985).

Radionuclide Geochemistry and Sorption Properties

The material dispersed to the environment by the hypothetical accident would be weapons-grade plutonium, a mixture of plutonium isotopes with a trace of americium (Table 3-2). ^{239}Pu dominates the mixture on a mass basis, but because of its greater specific activity, ^{241}Pu is the primary activity source. The decay chains and daughter product half-lives for the various nuclides are shown in Figure 3-2. The potential elements of concern are plutonium, americium, neptunium, and uranium.

Plutonium Solution Chemistry and Sorption

The plutonium solubility reported by Nitsche (1990) in an oxidizing groundwater with a high bicarbonate content at 25° C and pH 7 - 8.5 is approximately 10^{-7} M; the plutonium oxidation states are: Pu(V) (~70%), Pu(VI) (~20%) and small amounts of Pu(IV) and Pu polymer. The main species at pH 8.5 are Pu(V) and Pu(VI) carbonate complexes and Pu(IV) hydrolysis products; at pH 7 the main species are PuO_2CO_3 and uncomplexed PuO_2^+. A review of the sorption literature presented by Meijer (1992) indicates that plutonium has a high affinity for quartz and feldspar. Triay et al. (1992) reported plutonium distribution sorption coefficients

Table 3-2. Isotopic composition of weapons grade plutonium (Wenzel and Gallegos, 1982).

Nuclide	Weight % in Weapons Grade Plutonium Mixture	Activity in Mixture (Ci/g mixture)
^{238}Pu	0.05	0.0087
^{239}Pu	93.6	0.0575
^{240}Pu	6.0	0.0136
^{241}Pu	0.4	0.448
^{242}Pu	0.5	1.95×10^{-6}
^{241}Am	~0.02	6.48×10^{-4}

(K_D) for clays in an oxidizing groundwater at a pH of approximately 8.5: the K_D values for smectites, illite, and kaolinite are in the range of 6×10^2 - 1×10^4 mL/g. High affinities of actinides for oxide minerals are reported by Meijer (1992) and Triay et al. (1991c). The sorption mechanism for actinides onto oxide minerals seems to be correlated with hydrolysis constants for these actinides in solution (Meijer, 1992).

Plutonium transport through the unsaturated zone is the major risk under evaluation in this report, and is primarily controlled by the degree of plutonium sorption onto local soils and aquifer materials. Because of the importance of this sorption process, a series of laboratory

^{238}Pu (88 y)	-->	^{234}U (2.5×10^5 y)						
^{239}Pu (2.4×10^4 y)	-->	^{235}U (7.0×10^8 y)						
^{240}Pu (6.6×10^3 y)	-->	^{236}U (2.3×10^7 y)						
^{241}Pu (14.35 y)	-->	^{241}Am (432 y)	-->	^{237}Np (2.1×10^6 y)	-->	^{233}Pa (27 d)	-->	^{233}U (1.6×10^5 y)
^{242}Pu (3.8×10^5 y)	-->	^{238}U (4.5×10^9 y)						

Figure 3-2. Decay chains of weapons grade plutonium components.

batch sorption studies were performed at Los Alamos National Laboratory, using actual plutonium solutions and geologic samples from the vicinity of the Pantex Plant. Studies were conducted using plutonium in various oxidation states, in both deionized and Ogallala Aquifer water, and samples of the Pullman Clay Loam and Ogallala Sand. A full description of the sorption experiments can be found in Appendix A. The plutonium sorption distribution coefficient (K_D) measured for the Pullman soil was on the order of 10^3 mL/g; the sorption coefficient for the Ogallala sand was on the order of 10^2 mL/g. These experimental results are in good agreement with published results which indicate that plutonium sorption distribution coefficients for similar soils and water are on the order of 10^2 to 10^4 mL/g (Ames and Rai, 1978; Thomas, 1987; Meijer, 1992, Triay et. al, 1992). Unfortunately, no samples of the Randall playa soils were available for experimentation, but based on their soil properties (Allen et al., 1972), it is likely that the Randall soils would sorb plutonium more strongly than the Pullman soils tested. Using the Pullman results is therefore a conservative assumption.

Americium Solution Chemistry and Sorption

The americium solubility reported by Nitsche (1990) in an oxidizing groundwater with a high bicarbonate content at 25° C and pH 7 - 8.5 is approximately 10^{-9} M; americium exists in the III oxidation state. The main species at pH 8.5 are Am(III) carbonate complexes; at pH 7 the main species are $AmCO_3^+$, $AmOH^{+2}$, and Am^{+3}. The sorption distribution coefficients for americium are extremely high (>10^3 mL/g) in groundwaters regardless of the sorbing mineral phase (Thomas, 1987; Triay et al., 1991b; Meijer, 1992). In fact, americium has been shown to sorb even to non-geologic materials, such as the walls of the containers used for sorption experiments (Triay et al., 1991b).

^{241}Am is a daughter product of ^{241}Pu, which is a minor constituent of the weapons mix (Table 3-2). Although ^{241}Am has a relatively high specific activity, its high sorption suggests that it poses only a minimal risk to the aquifer.

Uranium Solution Chemistry and Sorption

Uranium has a high solubility under oxidizing conditions, near neutral pH, in a bicarbonate environment. Uranium exists in the VI oxidation state. The main species in the pH range from 7 - 8 are probably uranyl and U(VI) carbonate complexes. Meijer's review on sorption (1992) indicates that uranium will have a sorption distribution coefficient larger than 10^2 mL/g on oxide minerals, clays, and quartz. Uranium seems to sorb to clays by ion exchange. Uranium sorption decreases at higher pH values (>8) due to the formation of U(VI) carbonate complexes (Meijer, 1992).

The long half-lives of most uranium isotopes and uranium's low toxicity relative to plutonium suggest that it is unlikely to pose a significant risk compared to plutonium.

Neptunium Solution Chemistry and Sorption

The neptunium solubility reported by Nitsche (1990) in an oxidizing groundwater with a high bicarbonate content at 25° C and pH 7 - 8.5 is approximately 10^{-5} M; neptunium exists in the V oxidation state. The main species in the pH range from 7 to 8.5 are NpO_2^+, $NpO_2CO_3^-$, and NpO_2OH. The sorption distribution coefficients for neptunium are small (on the order of 0 - 50 mL/g) for quartz, feldspar, montmorillonite, and calcite (Thomas, 1987; Triay et al., 1991c; Meijer, 1992). However, neptunium sorbs strongly to metal oxides in the pH range from 7 - 8.5 with a distribution coefficient larger than 10^3 mL/g (Triay et al., 1991c). Consequently the oxide mineral coatings in the Pantex soils are expected to retard neptunium transport by sorption.

^{237}Np is the only neptunium isotope on the decay chains shown in Figure 3-2. It is in the decay chain of ^{241}Pu, which is a very minor mass constituent of the weapons material (Table 3-2). This low concentration, coupled with its long half-life, limit the risk posed by ^{237}Np.

It is apparent that of these four elements, plutonium poses by far the greatest risk. The groundwater impact analysis will therefore be confined to plutonium. However, potential effects of the daughter products will be discussed briefly in Section 5, and analyzed in Section 6.

Conceptual Transport Model

At this point, we have developed a conceptual model that describes our vision of the environmental fate and transport of plutonium dispersed by the hypothetical accident. The jet-fuel fire may disperse fine particulate plutonium downwind of the Pantex Plant. A prompt decontamination effort will reduce radiation levels to 0.2 μCi/m^2, but surface runoff and wind transport may concentrate contamination at playa lakes, where surface soil radiation levels may be as high as 2.0 μCi/m^2. Surface water infiltrating through this contaminated soil will tend to carry contamination down towards the Ogallala Aquifer, with an average recharge rate of 3 cm/year. Recharge water will reach the Ogallala water table at a depth of 50 - 400 feet, possibly after interacting with one or more perched aquifers on the way down. Sorption interactions with both surficial materials and the unsaturated portion of the Ogallala Formation will retard the movement of plutonium relative to the infiltrating water. During the transport time, radioactive decay will constantly reduce plutonium concentrations. The purpose of the quantitative analyses described in the next section is to estimate if and when plutonium will reach the Ogallala water table, and if so, at what concentration.

4 – ANALYSIS OF GROUNDWATER IMPACTS

Starting with the conceptual transport model just described, we can estimate plutonium arrival times and concentrations at the Ogallala water table. Two alternative calculation methods have been used: a simple non-dispersive piston-flow model, and a more complex model based on the one-dimensional advection-dispersion equation.

Piston Flow Results

Under the assumptions of piston flow, a "packet" of infiltrating water moves downward towards the water table without interacting with water packets above or below. If we conservatively assume that the entire plutonium surface loading infiltrates with a single year's recharge, we can then envision a contaminated layer of 3 cm of water moving downward through the unsaturated zone completely intact. This contaminated layer will reach the water table as a single unit during a single year at some time in the future, while the preceding and following year's infiltration will be completely uncontaminated. Although this model is clearly unrealistic, it is very simple conceptually and computationally, and provides a useful bounding case of transport behavior.

With the piston-flow model, infiltrating water moves downward with a velocity v_w:

$$v_w = \frac{I}{\theta}$$

where:

v_w	=	Downward water velocity (cm/year)
I	=	Infiltration or recharge rate (cm/year)
Θ	=	Soil volumetric water content (cm^3 water / cm^3 soil)

Due to sorption effects, plutonium moves slower than water by a factor known as the retardation factor, R_{Pu}:

$$v_{Pu} = \frac{v_w}{R_{Pu}}$$

where:

v_{Pu}	=	Downward plutonium velocity (cm/year)
R_{Pu}	=	Plutonium retardation factor

Assuming linear sorption and local equilibrium conditions, the retardation factor can be related to the sorption distribution coefficient for plutonium on the materials in question:

$$R_{Pu} = 1 + \frac{\rho_B K_D}{\theta}$$

where:

ρ_B = Soil bulk density (g/mL)
K_D = Sorption distribution coefficient (mL/g)

To calculate travel times and concentrations for plutonium, all of these quantities must be measured or estimated. As described previously, K_D has been measured directly using laboratory batch studies on Pantex-area geologic materials. Soil bulk density has not been measured directly, but does not vary much under natural conditions, and has been estimated at 1.5 g/mL. Volumetric moisture content, on the other hand, can vary quite widely. Some preliminary geophysical logs near Pantex suggest a mean subsurface moisture content of about 0.15, but also show high variability (Texas Bureau of Economic Geology, 1992).

Fortunately, it can be shown that for highly-sorbed species such as plutonium, the moisture content does not significantly affect solute velocities. For a highly-sorbed species,

$$R_{Pu} \approx \frac{\rho_B K_D}{\theta} \quad , \; when \quad K_D > 1$$

in which case

$$v_{Pu} = \frac{v_w}{R_{Pu}} = \frac{I/\theta}{\rho_B K_D/\theta} = \frac{I}{\rho_B K_D}$$

Using this last equation, we can calculate plutonium velocities directly, without estimating moisture contents.

Using a recharge rate of 3 cm/year, a soil bulk density of 1.5 g/mL, and a conservative (low-end) K_D of 100 mL/g, we obtain a downward plutonium velocity of 0.02 cm/year. For water table depths of 50, 200, and 400 feet (15.2, 61.0, 121.9 meters), plutonium travel times are 76,000, 305,000, and 610,000 years, respectively. Based on the 24,400 year half-life of ^{239}Pu, the longest-lived component of the contaminant mix, during this period concentrations will decrease to 11.5%, 0.02%, and 3.0×10^{-8} of the initial concentration. Again, using our conservative assumption that the entire 2.0 μCi/L plutonium loading is incorporated into one year's 3-cm recharge, we can calculate that the initial plutonium concentration will be 6.7×10^4 pCi/L. By the time this material reaches the water table at depths of 50, 200, and 400 feet, the concentration will have decreased to 7700 pCi/L, 13 pCi/L, and 2.0×10^{-3} pCi/L, respectively.

Under the piston flow scenario, these concentrations are assumed to occur within a narrow layer of the aquifer, sandwiched between uncontaminated water. The only significant route from the aquifer to a receptor is via a water-supply well, which will likely be screened over a large vertical interval. The contaminated groundwater will therefore be diluted within the well, before it reaches any receptors. The degree of dilution can be estimated by comparing the thickness of the contaminated layer to a typical screen length in a water supply well. Assuming a typical aquifer porosity of 0.3, the 3 cm of contaminated water will form a layer 10 cm thick in the aquifer. A high-capacity water-supply well will typically have at least 50 feet (15 m) of screen. Mixing within the well will therefore dilute the recharge water by a factor of 150, decreasing plutonium concentrations at the well head to 51 pCi/L, 0.09 pCi/L, and 1.0×10^{-5} pCi/L for the three different depth-to-water scenarios. Only the 50-foot scenario result exceeds any recognized drinking water dose limits (Appendix B).

We have shown that even using the physically unrealistic and extremely conservative piston-flow model for plutonium transport, plutonium concentrations in water delivered to potential receptors will be well below dose limits over most of the study area. The only area at risk is shallow groundwater regions south of Pantex, directly opposite predominant wind directions. In order to further determine the extent of risk, we have conducted a more complex analysis, using the advection-dispersion equation.

Advection-Dispersion Results

In the real world, packets of water do not travel intact through porous media for thousands of years. Rather, mixing processes on various scales tend to mix and homogenize the water as it travels. This effect is known as dispersion, and includes molecular diffusion, mixing within single soil pores (hydrodynamic dispersion), and mixing processes induced by large-scale aquifer property variations (macrodispersion). Transport with a dispersion component can be described using a partial differential equation known as the advection-dispersion equation, and the magnitude of dispersion is measured using an aquifer property known as dispersivity, with units of length.

The advection-dispersion formulation is mathematically more complicated than the piston-flow model, and computer codes are often used for solutions. One such code is CXTFIT (Parker and van Genuchten, 1984). CXTFIT solves the one-dimensional advection-dispersion equation for solutes that display linear sorption and first-order decay. CXTFIT simulations were performed for the same plutonium transport scenarios described for the piston-flow model, using two different dispersivities. A small dispersivity of 1 cm is typical of hydrodynamic dispersion effects, such as might be observed in a column experiment using clean uniform sand. The larger dispersivity of 1 m might result from macrodispersion effects observable during a field experiment in actual aquifer materials.

The results of these simulations for a 50-foot and a 200-foot deep water table are shown in Figure 4-1. These results show that even with the lower dispersivity and a shallow water table, peak plutonium concentrations after 76,000 years are approximately 1.1 pCi/L, lower than the strictest plutonium dose limits for drinking water. With the higher, more realistic dispersivity value, peak concentrations arrive sooner, but are lower, roughly 0.2 pCi/L. Peak concentrations at the deeper 200-foot water table are about three orders of magnitude lower. 400-foot water table simulations were not conducted, but peak plutonium concentrations would clearly be several orders of magnitude lower still.

The advection-dispersion analysis shows that dispersion effects will reduce peak plutonium concentrations below any drinking water dose limits, even for the low dispersivity / shallow water table scenario. With a more realistic dispersivity value and a more typical deeper water table, peak concentrations are decreased several orders of magnitude further.

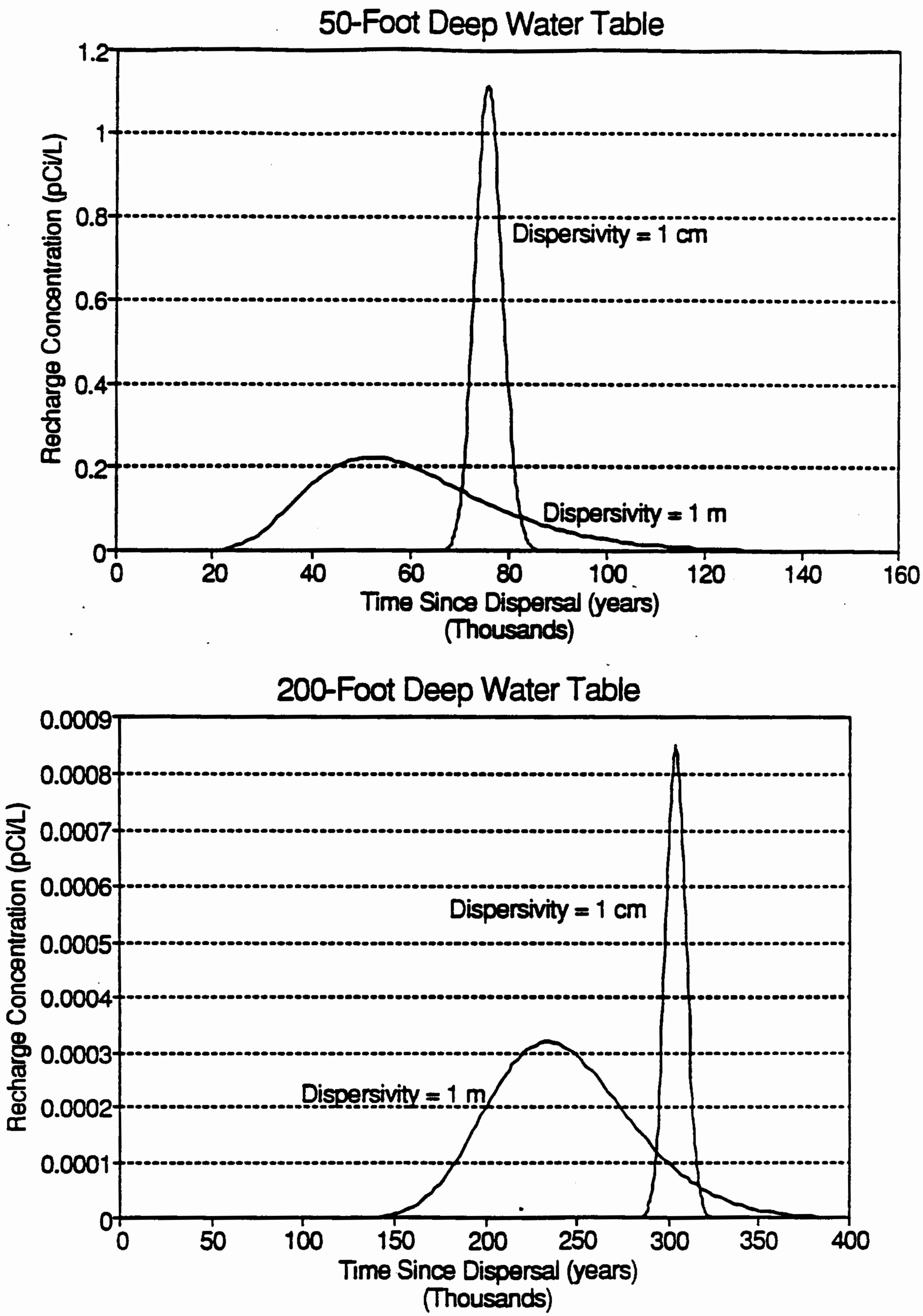

Figure 4-1. CXTFIT simulation results for plutonium transport to a 50-foot and 200-foot deep aquifer.

5 – POTENTIAL COMPLICATIONS

The preceding sections focused on "well-behaved" solute transport processes. There are a number of potential complicating factors that may affect plutonium transport to the Ogallala Aquifer. These factors unfortunately tend to be difficult to quantify accurately, but in the following paragraphs, some of these factors will be described, and their effects approximated.

Colloidal Transport

Colloids are extremely small ($< 2\mu m$) solid particles that may be able to sorb contaminants and carry them in moving water. Actinides can form several types of colloids in natural groundwaters (Choppin, 1988; Kim, 1991). "Real colloids" can be formed as a result of the aggregation of hydrolyzed actinide ions. "Pseudocolloids" can be formed by the sorption of actinides onto natural colloids that exist in the groundwater. Triay et al. (1991a) have provided evidence for the formation of real plutonium colloids at pH values of 1 and greater. Pseudocolloids can be formed by the attachment of plutonium or americium onto the colloids in the Ogallala aquifer. Likely natural colloids have been identified by Wood and Petraitis (1984) and Wood and Ostercamp (1987), who invoke clay colloids coated with organic material infiltrating through the unsaturated zone in their hydrologic model of the playa lake basins.

The effects of colloids on the subsurface transport of contaminants has been reviewed by McCarthy and Zachara (1989). Many researchers have invoked colloidal transport to explain the observed movement of contaminants when it exceeds transport predictions. Penrose et al. (1990) observed plutonium and americium mobility through a shallow aquifer in Los Alamos (a semiarid region); they postulate that the observed transport (which exceeds predictions based on laboratory data) is due to the irreversible sorption of plutonium and americium to colloidal material.

The effect of colloidal filtration by a porous medium (McDowell-Boyer et al., 1986) is a likely mechanism for retardation of colloids traveling through the Ogallala formation. However, this filtration effect is difficult to quantify in the absence of a detailed characterization of the colloids in the groundwater and a detailed hydrologic description of the transport pathway.

The most relevant paper relative to likely conditions in the study area after an accidental dispersal of plutonium is the work of Goss et al. (1973). In this study Goss and co-workers performed recharge experiments in Bushland, Texas, on the Southern High Plains just 50 km west of the Pantex Plant. These investigators eluted radioactively-tagged clay colloids through a recharge basin. The basin was constructed to maximize the potential for colloidal transport by removing the slowly permeable surface of the Pullman clay loam and exposing the calcareous underlying sediments, observed to have large pores (ranging from .1 to 1 mm). After infiltration of the radioactively tagged clay colloids in 72.5 ft of water (equivalent to 730 years of natural recharge, assuming 3 cm/year), 35% of the colloids were captured in the top six inches, 50% in the top 18 inches, 75% in the top 4 feet, and there was no evidence of any colloid transport below the top nine feet. In a second experiment, in which the large pores were destroyed by cultivation, they found that after 52.2 ft of water infiltrated (530 years of natural recharge), over 90% of the radioactively tagged colloids were retained in the upper 1 inch and there was no evidence of colloid transport below the top 30 inches. Based on these results it is not likely that colloid transport is a dominant transport mechanism for the migration of contaminants to the Ogallala Aquifer.

Perched Aquifers

As mentioned previously, there is a known perched aquifer above the Ogallala Aquifer in the immediate vicinity of the Pantex Plant (Purtymun and Becker, 1982; Texas Bureau of Economic Geology, 1992). The lateral extent and continuity of this layer are not known, and it was completely neglected during the travel time and concentration analyses described previously. This was a conservative decision, because it is clear that a perched water zone, if present, would act as an impediment to downward transport for two reasons. First, the existence of perched water indicates that there is a relatively impermeable perching layer present that is impeding downward flow. Second, the perched water constitutes an additional reservoir of water within the unsaturated zone, which implies increased travel times for a given recharge rate. Therefore, a perched aquifer, if present beneath the hypothetical dispersal area, would actually decrease the risk to Ogallala groundwater relative to that calculated here.

The shallow perched aquifer itself would be more vulnerable to contamination than the deeper Ogallala aquifer, and in the event of a plutonium-dispersal accident, monitoring of perched-aquifer water quality would be prudent.

"Short-Circuit" Recharge Paths

Under the conceptual model described earlier, primary protection of the aquifer is provided by slow flow and transport through the unsaturated zone. It is possible that artificial recharge conduits could bypass much of the unsaturated zone, thereby "short-circuiting" this protective layer. Two major types of short-circuit paths are unintentional flow down along improperly-constructed or abandoned water wells; and intentional flow to the Ogallala Aquifer as part of an artificial recharge project.

Unintentional downward flow through water wells is unlikely to constitute a major problem, because the high silt content of surface water in the area tends to quickly clog aquifer materials encountered. In fact, this clogging effect stymied almost all early attempts at intentionally recharging the Ogallala Aquifer with playa lake water (Urban et al., 1988). The risk of short-circuiting along improperly-constructed or abandoned wells could be further minimized by identification and grouting of these wells, possibly in conjunction with the post-dispersal decontamination effort.

Recent advances in recharge techniques using geotextile filters have made artificial recharge of the Ogallala Aquifer a real possibility, which will become ever more attractive as the water table continues to fall (Urban et al., 1988). A successful artificial recharge project may conceivably provide a means of moving plutonium down to the Ogallala Aquifer rapidly and in potentially hazardous concentrations, although the same geotextile filter that traps silts may trap most colloidal or polymeric plutonium. It is therefore imperative that in the event of an accident that disperses plutonium into the environment, active groundwater recharge projects be monitored and shut down if necessary.

The potential risks posed by these "short-circuit" recharge paths are purely local in scale, and may be minimized by implementing the described measures in the event of the accident.

Preferential Flow

The term "preferential flow" encompasses different phenomena that all cause accelerated transport -- solute velocities greater than that predicted using the simple infiltration rate / moisture content relationship described earlier. Macropore flow is one obvious example, in which water rapidly infiltrates via burrows, root casts, mud cracks, or other visible soil features. Immobile water trapped in dead-end pores can also cause accelerated transport, as can microporosity within individual soil grains. Gish and Shirmohammadi (1991) have edited a large collection of papers describing recent research in this field.

The magnitude of accelerated transport observed in actual field studies varies widely, from none (Biggar and Nielsen, 1976; Van De Pol et al., 1977; Jury et al., 1982) to factors on the order of 2 (Bowman and Rice, 1986a; 1986b; Turin, 1992). In one experiment, solutes moved roughly 5 times the predicted rate (Rice et al., 1986). The degree of preferential flow seems to depend primarily on soil type and infiltration patterns.

It is very difficult, if not impossible, to accurately determine the importance of preferential effects on plutonium transport in the study area without conducting detailed field studies. To get some idea of the sensitivity of the results of the advection-dispersion analysis to accelerated transport, two additional CXTFIT simulations were performed for the 50-foot water table case, using twice the calculated water velocity. Results are shown in Figure 5-1. As might be expected, higher transport velocities result in faster plutonium arrival at the water table. Shorter elapsed time before arrival means less radioactive decay, so peak concentrations are higher. Even so, under these strongly conservative assumptions and a dispersivity of 1 cm, predicted peak plutonium concentrations exceed only one of the three applicable drinking water dose limits (Appendix B), and with a dispersivity of 1 m, no dose limits are exceeded. These results indicate that even if preferential flow effects double predicted velocities, adverse impacts on the Ogallala Aquifer are likely to be minimal.

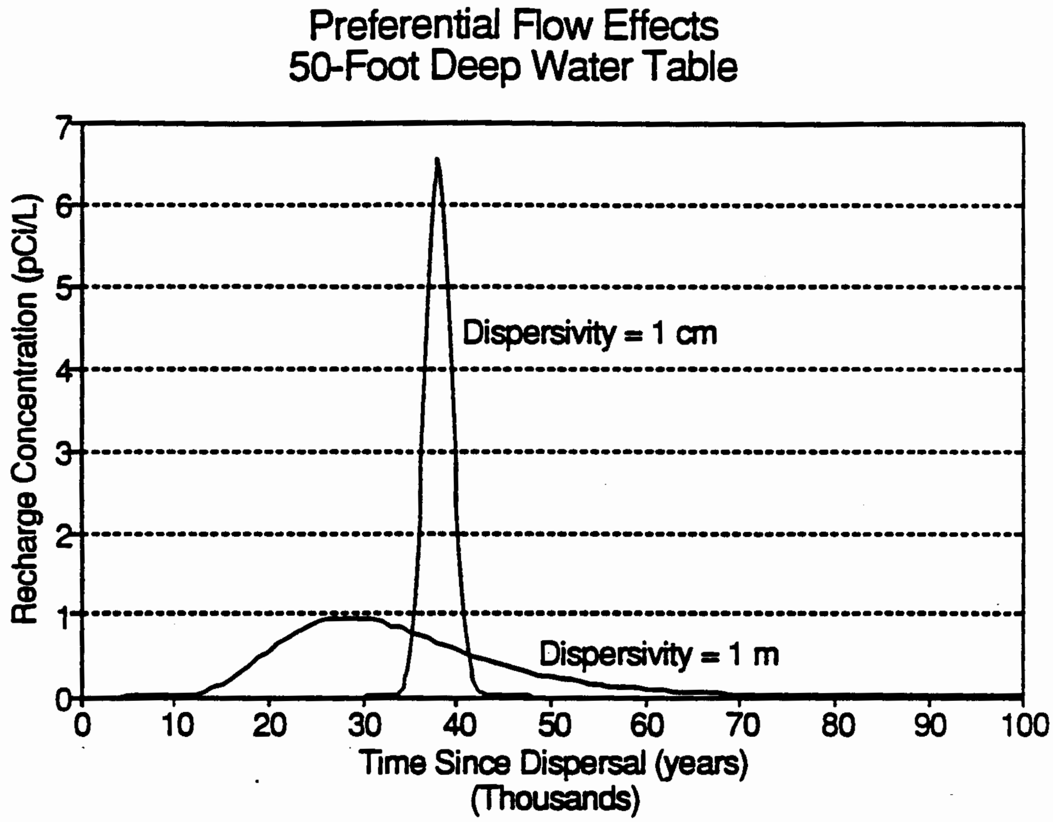

Figure 5-1. CXTFIT simulation results for plutonium transport to a 50-foot deep aquifer, with accelerated transport due to preferential flow.

Multidimensional Flow

Both the piston-flow and advection-dispersion models assume one-dimensional downward flow through the unsaturated zone. Approximately one-dimensional flow and transport would occur if recharge was uniform across the surface of the High Plains, but as pointed out earlier, recharge is focused at the playa lakes, and relatively unimportant elsewhere. Therefore, the assumption of one-dimensional flow is not strictly valid. In this case, however, one-dimensionality is a conservative assumption, and the true multidimensional nature of the flow system will decrease the impact on the aquifer below that predicted here, for two major reasons. Transverse (horizontal) dispersion in the unsaturated zone will cause increased dilution of the contaminated recharge water, and horizontal spreading of the plume will increase travel time to the water table, in turn allowing more radioactive decay en route.

Dropping Groundwater Levels

The groundwater impact analyses were performed assuming that 1990 water levels would persist into the future. The present rate of water-table decline indicates that this is clearly not likely. In fact, in much of the study area, the water table is dropping faster than the calculated plutonium velocity, implying that the plutonium will never catch up and reach the water table. Obviously, the present rate of water-table decline cannot persist for even a hundred years, and certainly not for the tens of thousands of years discussed in this analysis, because the Ogallala Aquifer would be pumped dry long before. Predicting actual future water levels in the Ogallala is beyond the scope of this report, but it seems likely that as long as the Ogallala Aquifer remains the primary water supply for agriculture, residential, and industrial uses in the Texas Panhandle, water levels are likely to continue to fall. In this case, using present-day water levels is a conservative assumption, because at the hypothetical future date of the plutonium-dispersal accident, and certainly by the time plutonium would have infiltrated down to the water table, depths to water will have increased, affording additional protection to the aquifer.

Decay Products

As mentioned in Section 3, plutonium poses the primary risk in this hypothetical situation, and was therefore the only element considered in the preceding analyses. The conclusion that minimal risk is posed by plutonium contamination suggests that none of the other potential contaminants pose a significant risk. However, as a check of this assumption, the RESRAD model, which incorporates decay-product transport, was used to calculate total doses caused by the hypothetical accident. Results are presented and discussed in the following Section.

6 – DOSIMETRY AND RESRAD MODELING OF PLUTONIUM MIGRATION

A check of the results of the previous groundwater impact analyses was carried out using a model developed for estimation of dose from residual radioactivity. The model, RESRAD, was developed for determination of dose to man from all pathways of migration of radionuclides (Gilbert et al., 1989). The model is recommended by DOE Order 5400.5 for determination of doses and cleanup levels for residual radioactivity in the environment. RESRAD is a complex model that allows the user to select site-specific parameters for estimation of dose. The result is a more realistic estimation of the radiation dose, estimated as Committed Effective Dose Equivalents (CEDE) that takes into consideration the specific climate and land use parameters of the contaminated area.

For this project, several scenarios were developed to check on the potential for plutonium migration to the water tables in the area of Pantex. These scenarios included three different aquifer depths: 400 feet, 200 feet, and 50 feet.

The first RESRAD simulation determined the CEDE resulting from a soil contamination level of 0.2 $\mu Ci/m^2$, using the default values of the model and standard conditions described for the EPA's proposed standard for transuranic elements in soil. The output indicated a committed dose equivalent of 10 mrem/year for the heavy dust loadings in air used by EPA, confirming the behavior of the model. The doses in this scenario were dominated by resuspension of plutonium attached to soil particles – water pathways contributed an insignificant amount of radiation dose from plutonium in the environment. Additional calculations using RESRAD for conditions of a plume of plutonium contamination at the EPA screening limit dispersed over a wide area results in the same conclusion, that the migration of plutonium to an aquifer is not a significant source of radiation risk.

Tables 6-1 and 6-2 list the site-specific distribution coefficients (K_D) and initial contaminant isotopic composition used in the calculations. The isotopic mix used was weapons grade plutonium (Table 3-2). ^{241}Pu is the most abundant isotope, but emits beta particles. The radioactive decay product ^{241}Am is an alpha-emitter that appears wherever and whenever ^{241}Pu decays.

Table 6-3 lists the resulting breakthrough times for first arrival of contaminants at different depth aquifers, and Table 6-4 lists estimated maximum dosages for the groundwater pathways. Each scenario simulated has individual doses calculated for inhalation of air and dusts, consumption of foods grown on the contaminated soils, meat and milk produced in the contaminated area, and drinking water from an aquifer below the contaminated zone. Radioactive decay products are included in the calculations. Estimation of the time of maximum dose rate is made by carrying out dose calculations over 10,000 years. In all cases, the dose was dominated by inhalation of resuspended plutonium followed by ingestion of plutonium attached to soil particles on foodstuffs.

Table 6-1. Distribution coefficients used for RESRAD simulations.

Medium	Element	K_D (mL/g)
Contaminated Soil	Pu	3000
	Am	1000
Top meter of soil	Pu	3000
	Am	1000
Unsaturated zone	Pu	100
	Am	1000
Aquifer sands	Pu	100
	Am	1000

Table 6-2. Initial contaminant mixture used for RESRAD simulations.

Nuclide	Activity (pCi/g)
^{238}Pu	1.62
^{239}Pu	10.7
^{240}Pu	2.53
^{241}Pu	83.6
^{242}Pu	0.0004
^{241}Am	0.121

The water dependent pathways did show one case of 0.001 mrem/year from migration of ^{237}Np, a decay product of ^{241}Am, after 30 years for an aquifer 50 feet below the surface. ^{237}Np is conservatively assigned a K_D of 0, indicating that the material moves with water with no adsorption on the soils. The calculated dose for all other scenarios and times was zero. The amount of transuranic elements was not sufficient to contaminate the water enough to produce a radiation dose greater than 0.001 mrem/year for the large area of contamination at low levels. RESRAD calculations resulted in zero dose for water pathways for all other depths to the water table over a 10,000-year period.

The final case set up for calculations by RESRAD was that of a playa that received runoff containing suspended sediments over time. In this case, the playa acts as an accumulation point for radioactively contaminated sediments. This type of concentration was demonstrated within

Table 6-3. Contaminant breakthrough times predicted by RESRAD for various aquifer depths.

Depth to Aquifer	Breakthrough Time
400 feet	190,000 years
200 feet	110,000 years
50 feet	56,000 years

Table 6-4. Maximum water pathway doses predicted by RESRAD for various aquifer depths.

Depth to Aquifer	Maximum Dose (mrem/yr)
400 feet	0.0
200 feet	0.0
50 feet	0.001

the Trinity Test fallout zone by Hansen and Rogers (1985), who measured accumulations of radioactive fallout ^{137}Cs in New Mexico playas that were 1.5 to 2 times the concentrations in surrounding slopes after 32 years. For this calculation, the playa size and watershed area were based on Playas 1 and 2 at the Pantex Plant. The aquifer was conservatively assumed to be located at 50 feet below the surface. The inventory of plutonium and americium isotopes was multiplied by 10 to reflect a conservative concentration of the residual radionuclides in playa sediments. For this scenario, the maximum dose calculated was 0.01 mrem/year after 30 years, from ^{241}Am formation of ^{237}Np. After 100 years the dose was zero. This conservative case indicates that an insignificant radiation dose would be produced by the residuals resulting from the hypothetical accident.

To summarize, in every RESRAD simulation, the doses estimated were zero or well below any applicable standard for radioactive contamination of aquifers or drinking water.

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APPENDIX A

Laboratory Plutonium Sorption Study

^{239}Pu-Solutions Preparation:

Three ^{239}Pu oxidation states were studied: IV, V, and VI. Two waters were used for preparing solutions: deionized water and water typical of the Ogallala aquifer (filtered through a 0.05 mm polycarbonate filter). Solutions were prepared by adding an aliquot of a well-characterized Pu(IV), Pu(V) or Pu(VI) acidic stock to deionized or Ogallala water. The concentration of all plutonium solutions was 10^{-7} M with the exception of the Pu(IV) solution in the Ogallala water which was 10^{-8} M. The reason for this difference is that Pu(IV) acidic stock was added to the Ogallala water and most of the plutonium precipitated out (probably due to Pu(IV) polymer formation). The resulting 10^{-8} M plutonium solution was stable with no further loss of plutonium after centrifugation for 4 hours at 12,000 rpm (28,000 g). Aliquots of all the plutonium solutions prepared were centrifuged for 4 hours at 12,000 rpm and the initial plutonium concentrations never differed from the plutonium concentrations after centrifugation by more than 6%.

Soil Samples:

Soils samples from the Ogallala Formation along Highway 136 (sample numbers 3A and 3B) and the A Horizon of the Pullman soil (sample numbers 1A and 1B) were air-dried and sieved to obtain particles in the size range from 75 - 500 μm. For experiments involving the Ogallala water, soil samples were preconditioned with the water by equilibrating the soil with the Ogallala water (in the ratio of 1 g to 20 mL) for 24 hours. The phases were separated by centrifugation for 1 hour at 12,000 rpm (28,000 g). The pre-conditioned soil was used for the sorption experiments. The pH and Eh of the water after equilibration with the soil was measured.

Sorption Procedure:

The sorption procedure utilized in these studies consists of:

1) equilibrating a soil sample with an aliquot of a plutonium solution (in the ratio of 1 g to 20 mL) for 48 hours,

2) separating the phases by serial centrifugations totaling 4 hours at 12,000 rpm (28,000 g).

3) measuring the pH and Eh of the water after sorption,

4) determining the amount of plutonium sorbed to the soil by liquid scintillation counting, and

5) calculating K_D, defined as:

$$\frac{\text{moles of plutonium sorbed to solid phase per g of soil}}{\text{moles of plutonium in groundwater per mL of solution}}$$

Analytical Procedure for ^{239}Pu Determination:

Liquid scintillation counting consists of counting the ^{239}Pu solution three times for fifteen minutes in a Packard Liquid Scintillation Counter with a window setting from 25 to 800 KeV. The liquid scintillation samples consist of an aliquot of the plutonium solution and an aliquot of make-up water totaling 6 mL, and 14 mL of Ultima Gold Liquid Scintillation Fluor. The efficiency of the counter was determined by counting an aliquot of the ^{239}Pu standard SRM-949F. The counter was found to be 100% efficient.

Results

The results of the sorption experiments are given in Tables A-1 and A-2. The equilibration among different oxidation states of plutonium in solution is slow; however only one optimal plutonium speciation in each of the waters is expected once the plutonium solution attains equilibrium. The water chemistry in these experiments is expected to be controlled by the type of soil used. Consequently, sorption is fairly independent of initial plutonium oxidation state and water used. The reason for the higher plutonium sorption distribution coefficients for the Pullman soil is its high clay content. The Ogallala sand consist of quartz and feldspars which have a lower affinity for plutonium than clay. The results for Pu(VI) in the Ogallala water are different from all the other results due the change of pH during the experiment (from 8.2 to 7.4). Actinides are well known for having a sorption edge in the pH region from 7-8. The reason for the change in pH in the case of Pu(VI) in the Ogallala water was probably an experimental artifact; the pH of the Pu(VI) solution in the Ogallala water was not adjusted correctly after the aliquot of the Pu(VI) acidic stock was added to the water. The most representative sorption results are those obtained with Pu(V) solutions since Pu(V) is the expected plutonium oxidation state in this type of water. Consequently, even if the plutonium solution did not attain equilibrium prior to use in the plutonium experiments, most of the plutonium in the solutions should have been in the V oxidation state.

Table A-1. Plutonium sorption onto Pullman soil. Initial Ogallala water: pH 8.2, Eh 240 mV. After pre-conditioning: pH 7.7, Eh 220 mV.

Initial Plutonium Oxidation State	K_D (mL/g) Sample 1A	K_D (mL/g) Sample 1B	^{239}Pu Solution after Sorption pH	^{239}Pu Solution after Sorption Eh (mV)
	Deionized Water			
IV	4×10^3	3×10^3	8.1	190
V	3×10^3	4×10^3	8.3	200
VI	3×10^3	5×10^3	8.1	200
	Ogallala Aquifer Water			
IV	2×10^3	2×10^3	7.9	240
V	3×10^3	4×10^3	8.0	230
VI	8×10^2	9×10^2	7.4	230

Table A-2. Plutonium sorption onto Ogallala sand. Initial Ogallala water: pH 8.2, Eh 240 mV. After pre-conditioning: pH 8.1, Eh 220 mV.

Initial Plutonium Oxidation State	K_D (mL/g) Sample 3A	K_D (mL/g) Sample 3B	^{239}Pu Solution after Sorption pH	^{239}Pu Solution after Sorption Eh (mV)
	Deionized Water			
IV	3×10^2	5×10^2	8.3	220
V	6×10^1	1×10^2	8.3	220
VI	7×10^2	8×10^2	8.3	220
	Ogallala Aquifer Water			
IV	4×10^2	5×10^2	8.2	220
V	1×10^2	2×10^2	8.3	230
VI	3×10^2	4×10^2	7.6	240

APPENDIX B

Recommended Drinking Water Dose Limits for Plutonium Ingestion

A. DOE and EPA Drinking Water Dose Limits

The Committed Effective Dose Equivalent (CEDE) is the sum of the dose equivalents from ^{239}Pu alpha radiation deposited internally to various tissues in the body, each multiplied by the appropriate ICRP 26 weighting factor. The CEDE is expressed in units of mrem.

In DOE Order 5400.5-II.1a the public dose limit is defined as "the exposure of members of the public to radiation sources as a consequence of all routine DOE activities shall not cause, in a year, an effective dose equivalent greater than 100 mrem." Derived Concentration Guides (DCGs) are given in 5400.5 for ingestion of two liters of water a day based on a CEDE of 100 mrem for plutonium taken into the body for one year. Plutonium is poorly absorbed from the gut and chemical forms influence the absorption. DOE gives an f_1, the fraction absorbed from the gut into the body, of .00001 for plutonium oxides and hydroxides, .0001 for plutonium nitrates, and .001 for all other chemical forms of plutonium in the environment. The DOE DCGs are 2000 pCi/L for oxides and hydroxides and 30 pCi/L for "other" chemical forms of plutonium. To be conservative we will choose f_1 of .001 since we do not know the long term chemical form of plutonium in this ecosystem even though the initial form is probably an oxide. Once we assume f_1 then the ^{239}Pu Dose Conversion Factor (DCF), in mrem CEDE/pCi ingested, can be derived based on the ICRP 26 weighting factors, metabolism, and deposition patterns in the body after absorption from the gut. DOE/CH-8901 gives a DCF of .0043 mrem/pCi for an f_1 of .001. This gives the DOE DCG:

x pci/L = (y/365d)(d/2L)(1/DCF)(100mrem/yr Public Limit)
= (1/365)(1/2)(1/.0043)(100)
= 30 pci/L in drinking water

DOE 5400.5-I3 also states " a higher dose limit, not to exceed the 500 mrem effective dose equivalent recommended by ICRP as an occasional annual limit, may be authorized for a limited period if it is justified by unusual operating conditions." Therefore, under "unusual" conditions a ^{239}Pu drinking water limit of 150 pCi/L could be acceptable and approved by DOE.

The Safe Drinking Water Act regulated by EPA under 40CFR141, National Interim Primary Drinking Water Regulations, prescribes radionuclide concentration limits for public drinking water systems. The limits in public water systems (PWS) for ^{226}Ra and ^{228}Ra are explicitly given in 40CFR141.15 as "(a) Combined radium-226 and radium-228: 5pCi/L." Back calculation of this limit to mrem CEDE/y gives:

mrem CEDE/y = (2L/d)(365d/y)[(2.5pCi ^{226}Ra/L)(.0011mrem/pCi)+
(2.5pCi ^{228}Ra/L)(.0012mrem/pCi)]
= 4.2 mrem CEDE/y

The EPA regulations further state in 40CFR141.26-a1i that "a gross alpha particle activity measurement may be substituted for the required radium-226 and radium-228 analysis provided that the measured gross alpha particle activity does not exceed 5 pCi/L at a confidence level of 95 percent." The regulations also develop other limits for beta and gamma emitting nuclides based on the 4mrem CEDE/y.

DOE Order 5400.5-II.1d adopts the SDWA regulations by stating "It is the policy of DOE to provide a level of protection for persons consuming water from a public drinking water supply operated by the DOE, either directly or through a DOE contractor, that is equivalent to that provided to the public by the public community drinking water standards of 40 CFR Part 141. These systems shall not cause persons consuming the water to receive an effective dose equivalent greater than 4 mrem in a year. The dose limit is the effective dose equivalent to individuals whose exclusive source of drinking water contains a radionuclide, or a mixture of radionuclides, at a monthly average level of four percent of the appropriate DCG value." This ^{239}Pu limit for PWS can be derived as follows:

$$\begin{aligned} x \text{ pCi } {}^{239}\text{Pu/L} &= (y/365)(d/2L)(1/.0043)(4\text{mrem/y}) \\ &= 1.3 \text{ pCi } {}^{239}\text{Pu/L of drinking water} \end{aligned}$$

B. Recommendations for Limiting Doses

Three dose limits are recommended for plutonium ingested exclusively from the drinking water pathway, one at 1.3 pCi/L for PWS using 4 mrem CEDE/yr, the second at 30 pCi/L for the "worst case plausible scenario" for the family farm scenario addressed in DOE/CH-8901 based on 100 mrem CEDE/yr, and a third at 150 pCi/L based on 500 mrem CEDE/yr "unusual circumstances" explained in 5400.5 IV.3b. We recommend usage of all three limits for this exercise because the remediation and subsequent residual contamination of areas in the square kilometer range will have public water systems, private farms with their own wells, and hot spot unusual circumstances requiring application of the three limits based on risk, cost/benefit optimization, and the site specific scenario.

C. References

DOE Order 5400.5. "Radiation Protection of the Public and the Environment", Effective May 1990.

EPA Title 40 CFR 141. "National Interim Primary Drinking Water Regulations", (Safe Drinking Water Act, Amended 1988).

Gilbert et al., June 1989. "A Manual for Implementing Residual Radioactive Material Guidelines", DOE/CH-8901, Argonne National Laboratory.

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Assessment are due to one or more of the following reasons: 1) not applicable to the timeframe of the data base; 2) not an in flight accident; or 3) not an aircraft crash. The Department identified and included all of the aircraft crashes that Kimura had identified over the timeframe used for the Aircraft Crash Analysis data.

Mr. Kimura also suggests that F-16 and F-18 aircraft operations should have been considered in the Aircraft Crash Analysis. These aircraft were not observed in the Pantex area during the timeframe when actual aircraft counts were made. The goal of this aircraft accident analysis was to obtain a realistic overall average estimate of accident rates for military aircraft which would then be used with the overall estimate of actual flights.

In summary, the Department concludes that the accidents identified by Kimura and consideration of Class A do not cause the military aircraft crash rate determined in the Aircraft Crash Analysis to change. Therefore, the analysis performed for the Environmental Assessment (Appendix E, Reference 9) remains applicable.

Comment: ***Provide a definition of interim storage and indicate how long and to what capacity the Environmental Assessment covers.***

Response: Interim storage is defined as storage until a long-term storage facility is identified and operational. The Department will complete an Environmental Impact Statement covering dismantlement and storage of the resulting nuclear materials and classified weapons components and will issue a record of decision within three years of issuance of this Finding of No Significant Impact. This is in addition to the Nuclear Weapons Complex Reconfiguration Programmatic Environmental Impact Statement, which will address long-term storage issues related to the future nuclear weapons complex.

Subject to completion of the scoping process, the Department now envisions that the new Pantex Site-Wide Environmental Impact Statement will address all current and proposed facilities and activities at Pantex as well as storage requirements, including alternate locations, for all plutonium, highly enriched uranium, tritium, and classified weapons components, as appropriate, that result from the Pantex dismantlement activities. Scoping meetings for this Environmental Impact Statement will be held in Amarillo, Texas and at other sites that may be affected by the activities at Pantex no later than June 30, 1994.

Comment: ***Provide a statement that clearly indicates that the Department of Energy will cease max pack configuration after implementation of Stage Right.***

Response: Dismantlement at Pantex will continue and pit storage will be expanded in the Zone 4 Steel Arch Construction magazines consistent with the Environmental Assessment and the Final Safety Analysis Report for Zone 4 Magazines. Individual magazines will be loaded consistent with the preferred configurations in the Environmental Assessment.

Comment: ***Provide an inventory of pit age at Pantex.***

Response: The Pantex Zone 4 pit inventory as of September 27, 1993 is as follows:

Maximum Age In Years	Quantity of Pits
33	291
32	688
31	79
30	222
29	277
28	850
27	292
26	82
25	0
24	175
23	973
22	463
21	81
20	151
19-14	0
13	45
12	251
11	55

SECTION III

Response to Comments Received on the Revised Pre-Approval Environmental Assessment at the December 6, 1993 Public Meeting in Amarillo, Texas and during the Follow-on Two Week Comment Period from December 6 to 20, 1993

Introduction

On November 11, 1993, the Department issued a revised pre-approval Environmental Assessment. On December 6, 1993, the Department held a public meeting in Amarillo, Texas so that members of the public and the State could discuss the revised pre-approval Environmental Assessment and the Department's resolution of the comments provided through the State of Texas. Furthermore, the Department accepted written comments for a two-week period (December 6 to 20, 1993) after the public meeting. During this period, the Department received 14 comment letters which both supported and questioned the Department's proposed action. The majority of the comments submitted to the Department during this period were addressed in the public meeting and, in some cases, resulted in revisions to the Environmental Assessment. The transcripts have been placed in Department of Energy Public Reading Rooms in Amarillo and Panhandle, Texas and have been sent to individuals and organizations commenting on the Environmental Assessment. Additional copies of the transcripts are available from:

Mr. Thomas Walton, Public Affairs Officer
U.S. Department of Energy
Amarillo Area Office
P.O. Box 30030
Amarillo, Texas 79120
(806) 477-3120.

Response to Comments and Questions

Table 1 responds to written comments received during the two week comment period that question the Department's proposed action.

TABLE 1 - RESPONSES TO COMMENTS QUESTIONING THE PROPOSED ACTION			
COMMENT		DISPOSITION OF COMMENT	
Source of Comment	**Comment**	**DOE Response**	**Reference**
O'Brien, 12/6/93 Letter	Your pre-decisional finding fails to properly address... 1) "The wide gulf between the University of Texas Department of Economic Geology's work on water mobility and recharge rates from the playa lakes to the underground aquifers and Los Alamo's characterization of these findings as "unreasonable and unrealistic"."	The Department accepts that fact that recharge is focused at the Playa Lakes on the High Plains. In the original Los Alamos National Laboratory report, this fact is taken into account by assuming that the recharge rate at the lakes are ten times the average. The Department does not dispute these findings - the recharge rates used in the Los Alamos report were an estimate. In the response to comments provided by the Texas Bureau of Economic Geology, Los Alamos reanalyzed the transport scenarios based on the Texas Bureau of Economic Geology recharge rates and came to the same conclusion that the interim storage does not pose a significant threat to the Ogallala Aquifer.	December 6, 1993 Public Meeting Transcript, Pages 125 to 126
	2) "The failure to devote any detailed analysis to the possibility of terrorist attack."	Terrorist attacks have been addressed in the security plans and procedures for the Pantex Plant through such documents as the Master Safeguards and Security Agreement, which outlines the threats to the site and the risks of those threats. Security plans and procedures have been implemented to address those threats and these plans are evaluated and checked yearly through reviews and exercises.	
	3) "The adequacy of the World War II bunkers for storage."	The structural adequacy of bunkers is addressed in the Safety Analysis Report and appendices of the Environmental Assessment. Safeguards and security and material accountability aspects of storing pits is the same as that of storing weapons already being performed in Zone 4 and is addressed in security plans and procedures of the Plant. Storage will be carried out in a manner that the Department believes can be compatible with verification, although international agreements are not presently in place.	

TABLE 1 - RESPONSES TO COMMENTS QUESTIONING THE PROPOSED ACTION			
COMMENT		DISPOSITION OF COMMENT	
Source of Comment	Comment	DOE Response	Reference
O'Brien, 12/6/93 Letter (Cont'd)	4) "The consideration of alternative sites for storage, either interim or long-term."	Alternative sites were considered and these analyses were documented in the Environmental Assessment.	Environmental Assessment, Pages 4-1 to 4-11.
Osborne Comments Paragraph 3	1) The Aircraft Hazards Analysis was unrealistic.	The Analysis does not focus on light aircraft, but uses physical arguments relative to the ability of this class of aircraft to penetrate the magazines to drop this from further consideration. All other categories (i.e., commercial, military, heavier general aviation) are still considered as potential threats to the magazines. Analysis of the potential consequences of crashes of these aircraft is dropped subsequently on probabilistic grounds.	Environmental Assessment, Appendix F, Page F-20
Paragraph 4	2) Since aircraft are landing and taking off, the in flight statistics used are inappropriate.	Inflight is defined as greater than five miles from an airport. Inflight statistics are appropriate for aerial crash analysis regarding the Pantex Plant (8.5 miles from the Amarillo International Airport).	December 6, 1993 Public Meeting Transcript, Pages 45 to 47, Environmental Assessment, Appendix, Page F-20
Paragraph 5	3) Military combat and training aircraft utilizing Amarillo International Airport are not normally destined to terminate the flight in Amarillo.	The Amarillo Federal Aviation Administration does not consider multiple "touch and go" by a single aircraft as one activity, but logs each as a landing or take off. This paragraph also includes the implicit assertion that all military combat and training aircraft utilizing Amarillo International Airport overfly Pantex; Federal Aviation Administration records and statements indicate that they do not.	December 6, 1993 Public Meeting Transcript, Pages 61 to 65
	4) The Aircraft Hazards Analysis bases the accident rate for military aircraft on data for a period from 1976 through early 1992, missing a number of major military accidents.	Aircraft crash data have been verified for the timeframe from 1976 to early 1992 in Section III of the Environmental Assessment.	Environmental Assessment, Section III, pages 13-15.

TABLE 1 - RESPONSES TO COMMENTS QUESTIONING THE PROPOSED ACTION			
COMMENT		DISPOSITION OF COMMENT	
Source of Comment	**Comment**	**DOE Response**	**Reference**
Osborne Comments (Cont'd)			
Paragraph 6	5) In assessing the hazard potential by aircraft coming down within the boundaries of the Pantex Plant, the impact angle was assumed to be 15 degrees, marginally consistent with a forced landing under controlled flight.	Use of the 15 degree impact angle is conservative in terms of estimating the impact probabilities. The Aircraft Crash Analysis does not limit impacts to that angle.	Environmental Assessment, Appendix F, Pages F-22, F-32, and F-33
Paragraph 7	6) Aircraft descending from an altitude of 2,300 feet will likely impact at an angle much higher than the 15 degrees used in the Environmental Assessment.	High impact angles are not excluded from the Analysis.	December 6, 1993 Public Meeting Transcript, Pages 45 to 46; Environmental Assessment, Appendix F, Pages F-28 and F-34
Paragraph 8	7) A comment was made regarding a typographical error in Appendix F regarding impact energy.	Cited reference to Appendix F has no relation to Aircraft Crash Analysis. Appendix C has the cited mistake in the impact energy value. This was corrected in the Environmental Assessment.	Environmental Assessment, Appendix C

TABLE 1 - RESPONSES TO COMMENTS QUESTIONING THE PROPOSED ACTION			
COMMENT		DISPOSITION OF COMMENT	
Source of Comment	Comment	DOE Response	Reference
Osborne Comments (Cont'd)			
Paragraph 9	8) What is the possibility for penetration of storage facilities by objects separating from aircraft overflying the plant? A 7,900 pound engine falling from a C-5 at 2,300 feet would certainly be capable of significant damage to a storage facility.	The consequences from objects separating from aircraft overflying the Plant would be bounded by the analyses conducted for aircraft accidents. A summary of the release probability associated with the bounding crash scenario follows: 1) the conservative probability of any aircraft or its components impacting any magazine in Zone 4 West is approximately one in a million per year; 2) a conservative range of probabilities of any aircraft or its components penetrating or collapsing a magazine after impact is 0.001 to 0.5; 3) a conservative range probabilities for damaging magazine contents after penetrating or collapsing a magazine is 0.01 to 0.5; and 4) the reasonable range of probabilities for generating an energy source capable of dispersing radioactive material from damaged containers is 0.01 to 0.5. (NOTE: With regard to either an engine or a landing gear, no energy source would be available). Hence, it is demonstrated that a realistic probability for aircraft or component crashes to cause any consequence is much less than one in ten million per year. In addition, the source-term of released radioactive material will be greatly reduced because it must travel through tons of inert rubble.	
Paragraph 10	9) The long runway at Amarillo International Airport makes it a very attractive destination for an aircraft in distress.	While Amarillo International Airport may be an alternative choice for landings, not all such aircraft would overfly Pantex.	

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COMMENT		DISPOSITION OF COMMENT	
Source of Comment	Comment	DOE Response	Reference
Osborne Comments (Cont'd)			
Paragraph 11	10) A reconciliation of the terms "likely" "unlikely" and "extremely unlikely" would be helpful.	The Department of Energy defines "likely" as greater than 1 x 10^{-2}, "unlikely" as between 1 x 10^{-2} and 1 x 10^{-4}, and "extremely unlikely" as between 1 x 10^{-4} and 1 x 10^{-6}.	Environmental Assessment, Table 6-4B.
Gustavson, 12/20/93 Letter			
Paragraph 2	1) Provide references as to who are the soil scientists who agree that plutonium is relatively immobile.	Conclusions about plutonium immobility are based on Los Alamos National Laboratory experience in this area that ranges over 25 years. Results of studies on Yucca Mountain, the Trinity site, and the Los Alamos site suggest that plutonium is quite immobile in the subsurface. A list of references regarding actinide sorption and solubility is provided in Section 9.0 of the Environmental Assessment.	December 6, 1993 Public Meeting Transcript, Pages 117 to 119
	2) "Where were their studies completed and were these soils comparable to High Plains soils in mineralogy and texture?"	The studies conducted of the Trinity site examined an area approximately 70 miles northeast of the site including the High Plains of New Mexico, which has soil types that are similar to the Amarillo area.	December 6, 1993 Public Meeting Transcript, Page 121
	3) "What are remediable depths?"	Data from the Trinity site suggests that plutonium remains within a few inches of the surface after dozens of years.	December 6, 1993 Public Meeting Transcript, Pages 122 to 123
	4) "What steps has DOE initiated to identify and document preferential pathways that may exist in postulated area of contamination?"	The Amarillo Area Office has been asked to look at the feasibility of identifying all these pathways. That effort is underway right now with assistance from the Army Corps of Engineers. The next step will be to determine how best to eliminate the pathways or deal with them in the event of an actual release.	December 6, 1993 Public Meeting Transcript, Pages 123 to 124

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COMMENT		DISPOSITION OF COMMENT	
Source of Comment	Comment	DOE Response	Reference
Gustavson, 12/20/93 Letter (Cont'd)			
Paragraph 3	5) "The values used by Los Alamos National Laboratory for recharge rates are largely from earlier studies. Many of these studies did not recognize focused recharge through playas. A rate of only 3 cm/yr is unreasonable."	The Department accepts the fact that recharge is focused at the playa lakes on the High Plains.	December 6, 1993 Public Meeting Transcript, Pages 125 to 126
Paragraph 4	6) "Were the studies used by Los Alamos completed in areas closely comparable to the High Plains in terms of soil and sediment structure mineralogy and texture?"	References regarding preferential flow are provided in Section 9.0 of the Environmental Assessment. There are a limited amount of studies available on preferential flow. The references used in the Los Alamos study focused on preferential flow in agricultural areas.	December 6, 1993 Public Meeting Transcript, Pages 127 to 128
Paragraph 5	7) "What are the anticipated contamination levels prior to cleanup?"	30 microcuries in a contaminated area under 2 square kilometers.	December 6, 1993 Public Meeting Transcript, Page 130
	8) "...if prior cleanups have been successful, could this technology be applied to the Pantex area?"	The cleanup technologies used in the past are nothing very sophisticated. They basically have involved the removal and disposal of contaminated soil and this is the type of response that would likely be employed in the Pantex area. The high plains has got an advantage in terms of cleanup; it doesn't have trees and shrubs, which can complicate cleanup.	December 6, 1993 Public Meeting Transcript, Page 132
	9) Where would soil for removal be stored. "How would it be removed. What will happen to livestock, farm buildings?"	In the most likely scenario which requires removal of contaminated soil, the soil would be packed at Pantex in accordance with acceptance criteria and shipped to the Nevada Test Site for burial. The most probable method to clean contaminated livestock and buildings would be to use high pressure water to remove the contamination.	December 6, 1993 Public Meeting Transcript, Pages 133 to 134 December 6, 1993 Public Meeting Transcript, Pages 155 to 156

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COMMENT		DISPOSITION OF COMMENT	
Source of Comment	**Comment**	**DOE Response**	**Reference**
Gustavson, 12/20/93 Letter (Cont'd) Paragraph 7	10) The Nativ report was available when the Turin Report was being prepared.	The Los Alamos National Laboratory did not have access to Nativ (1988) while preparing Turin et al. (1992), and, therefore, did not cite it. However, the critical information from the report was evaluated with no significant impact noted.	Comment Response Document, Page E-6
Hutchison, 12/20/93 Letter	1) Not clear that shielded forklift will be available.	An electric forklift with shielding for radiation protection is available.	Environmental Assessment, Page 3-2
	2) Can forklifts be designed to be entirely remote control?	No, but the shielded forklift operator will be inside the magazine during operation.	Environmental Assessment, Page 3-2
	3) Not clear how repairs would be made on the forklift.	The shielded forklift is not attached to the "tracking system." If the forklift breaks down while in the magazine, it will be withdrawn by pulling it from the magazine; the forklift is equipped with a hitch to accommodate this operation if required. In addition, the forklift is also equipped with an escape door that affords the operator a means of egress should the situation arise.	
	4) How would it be removed from the tracking systems or withdrawn from the building?	Same response as above.	
	5) What would the estimated worker exposure be during such an operation?	Shielding on the forklift should provide a dose reduction factor of at least 20 over current inventory methods. No more than 3 minutes would be required for either the exit of the forklift operator through the escape door or for another worker to hitch a line to the forklift. This being the case, any increased exposure would be minimal.	Environmental Assessment, Page 3-2

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COMMENT		DISPOSITION OF COMMENT	
Source of Comment	Comment	DOE Response	Reference
Hutchison, 12/20/93 Letter (Cont'd)	6) The statement that this proposed action would not involve long-term or permanent storage is incredible... DOE is already planning to move pits from other "interim" storage at Rocky Flats to Pantex.	The Department is not planning on moving pits from other sites to Pantex. The Department has increased interim storage of pits at Pantex up to 12,000 until other decisions, expected to be made in the next three years from the date of the Finding of No Significant Impact, determine longer-term storage alternatives.	Finding of No Significant Impact, Pages 1-3.
	7) Any serious suggestions that this decision does not support long-term storage at Pantex must outline the length and the capacities that this Environmental Assessment will cover. This should be accompanied by a schedule of future decisions about storage and a full description of the process by which such decisions should be made.	Interim storage is defined as storage until a long-term storage facility is identified and operational. Essentially, this suggestion has been adopted. The Finding of No Significant Impact covers interim storage for 12,000 pits until decisions can be made on the longer-term future storage / disposition of this material. These decisions will be made following National Environmental Policy Act reviews and include decisions resulting from: 1) New site-wide Environmental Impact Statement for Pantex Plant expected to be completed in November 1996. This Environmental Impact Statement, while not yet scoped, is expected to address: continued operation of the Plant, mitigation of the impacts of operations, and storage of material; 2) Reconfiguration Programmatic Environmental Impact Statement expected to be completed in 1995. Among other complex features, this Programmatic Environmental Impact Statement addresses long-term storage of these materials; and 3) Presidential Interagency Task Force on Plutonium Disposition. The task force, chartered on September 27, 1993, is to make recommendations on the disposition of surplus plutonium. Any Departmental implementation of task force recommendations will be fully subject to the National Environmental Policy Act.	Finding of No Significant Impact, Pages1-3.

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COMMENT		DISPOSITION OF COMMENT	
Source of Comment	**Comment**	**DOE Response**	**Reference**
Hutchison, 12/20/93 Letter (Cont'd)	8) In Paragraph 4.0., DOE introduces a discussion of the alternatives of the proposed action. It is appalling that protection of the environment and worker and public safety and health are not included in this introduction and programmatic goal.	Protection of the environment and workers and public safety and health are the basis for the Environmental Assessment process.	
	9) The Environmental Assessment must provide a more comprehensive and honest evaluation of alternatives. The question is not simply whether or not environmental benefit can be derived but whether adverse environmental impacts can be avoided. The Environmental Assessment does not address this.	Based on the Environmental Assessment and in accordance with the National Environmental Policy Act, the Department believes that the proposed action (interim storage of up to 20,000 pits) does not significantly affect the quality of the human environment.	Finding of No Significant Impact, Pages 1-3
	10) Page 4-6, Footnote 11. Footnote is insufficient to explain whether DOE/DoD missions incompatibilities truly make storage impossible at active conventional weapons facilities.	If a Department of Defense facility were selected, time delays would occur and disassembly would need to be curtailed because appropriate infrastructure in the way of security, material accountability, and management would need to be put in place.	Environmental Assessment, Section 4.4
	11) Page 4-8, Footnote 13. Not clear from the footnote if Type B shipping containers will be purchased anyway.	It is likely that the Type B containers will eventually be purchased for all pits placed in storage.	
	12) Page 4-9, Table 4-1. Clarify whether the "President's dismantlement objectives" and "President's weapons reduction initiatives" are the same or different.	The "Introduction and Background" section of the Environmental Assessment makes this relationship clear. They are the same.	Environmental Assessment, Page 1-1
	13) Page 6-2, Table 6-1. The phrase "100% corrosion inspection is incorrect because DOE does not intend to inspect 100 percent of the containers for corrosion, but rather do a random spot check.	This was an assumption used to make a conservative calculation of radiological exposure.	
	14) Environmental Assessment, Page 6-2, 6-3: the word "natural" must be struck in both instances where it refers to "incidents of fatal cancer".	After review of the comment, the Department has decided that no change is needed.	

TABLE 1 - RESPONSES TO COMMENTS QUESTIONING THE PROPOSED ACTION			
COMMENT		DISPOSITION OF COMMENT	
Source of Comment	Comment	DOE Response	Reference
Hutchison, 12/20/93 Letter (Cont'd)	15) Environmental Assessment, Page 6-2: the stock paragraph containing the statement "we're operating within guidelines" does not actually indicate clearly what the exposure risk to a worker would be.	Worker radiation dose would be maintained below the established Pantex annual administration operating unit (1 rem per year).	Environmental Assessment, Page 6-2
	16) Page 6-4: when DOE invokes the "one in one million" acceptability ceiling DOE should note that this ceiling has been arbitrarily determined by agencies responsible for public health and safety and has not been subjected to public consent.	This is accepted practice.	
	17) DOE suggests that because the potential for a large plane crash into a pit storage igloo is calculated to be less than one in one million, such a possible crash can be discounted.	After consideration of the comment, the Department believes that the Aircraft Crash Analysis should remain without change.	Environmental Assessment, Appendix E
	18) Page 6-5: the second paragraph under the heading 6.2.4 Forklift Operational Accidents makes an assumption that in the case of a puncture of a container plutonium would be uniformly dispersed.	In the scenario, the plutonium which finally escapes is given a very conservative assumed dispersion.	Environmental Assessment, Appendix D, Page D-1
	19) Page 6-5: in a container puncture accident, a worker would risk serious exposure. The Environmental Assessment does not make clear if the forklift operation shielded cab is air tight.	It does not need to be because no more than 3 minutes would be required for either the exit of the forklift operator through the escape door or for another worker to hitch a line to the forklift. This being the case, any increased exposure would be minimal.	
	20) The statement that a worker would receive "no immediate or long-term health effect as result of an accident of this type" is not supported by health studies to date.	In the scenario, a worker would receive 0.02 microcuries; a worker in the immediate vicinity of the site could receive a marginal radiation dose. No significant health effects would be expected. (See National Council on Radiation Protection 1993 Report.)	Environmental Assessment, Page 6-5.
	21) Page 6-6: DOE's discounting of a potential aircraft crash is not acceptable.	The approach taken in the Aircraft Crash Analysis is conservative.	Environmental Assessment, Page 6.6

Although most questions that were asked in the public meeting were answered at that time, a few were not. The following is a summary of comments that were unanswered during that public meeting and the Department's response:

<u>Comment:</u> Although the Department of Energy found that an aircraft crash was not credible, the Department should continue planning for emergency management scenarios.

<u>Response:</u> The Department of Energy Emergency Preparedness Plan (EPP-1000) addresses possible emergency scenarios. Furthermore, the Department has committed to review that plan and to ensure it adequately addresses the consequences of an aircraft crash.

<u>Comment:</u> Review a memoranda written by Chris Kimura, Lawrence Livermore National Laboratory, dated April 9, 1993, and determine if a discrepancy exists regarding the number of aircraft destroyed in flight.

<u>Response:</u> The Kimura memoranda observes that the number of aircraft shown in the Environmental Assessment (Appendix E, Table E-7, Summary of Military Aircraft Crash Rates) as "destroyed in flight" for the C-5 and B-1B is incorrect. Specifically, Kimura's information shows five C-5 and seven B-1B occurrences where aircraft were destroyed. It was inferred that this information was not properly considered in the Department's analysis.

It appears that Kimura used Department of Defense Class A designated aircraft damage statistics for the observations made in the memorandum. Class A damage consists of a fatality or a total cost criteria, including "uneconomical to repair". Class A damage must be distinguished from aircraft "destroyed in flight". The data used in the Aircraft Crash Analysis (Appendix E, Reference 9) specifically identifies aircraft "destroyed in flight", where "in flight" is defined as greater than five miles from an airport. Accidents that occur on the runway, during takeoff, landing or low level training exercises are clearly not applicable.

Four of the C-5 occurrences cited in the Kimura memoranda do not fall within the timeframe (1976 through early 1992) of the Aircraft Crash Analysis data. The remaining C-5 occurrence did not meet the "destroyed in flight" criteria. Of the B-1B occurrences, one was outside of the timeframe of the Aircraft Crash Analysis data and the remaining six did not meet the "destroyed in flight" criteria.

Accident data pertinent to those identified in the Kimura memoranda are summarized in Table 2, along with additional data for accidents not reported by Kimura that were Class A accidents. These data are obtainable from various sources, including newspaper reports of the accidents. The dates of each accident are included in Table 2.

Based upon a comprehensive review, the Department concludes that the data reported in the Environmental Assessment are correct and no changes need to be made. Differences in Kimura's data and the data used in the Environmental

Assessment are due to one or more of the following reasons: 1) not applicable to the timeframe of the data base; 2) not an in flight accident; or 3) not an aircraft crash. The Department identified and included all of the aircraft crashes that Kimura had identified over the timeframe used for the Aircraft Crash Analysis data.

Mr. Kimura also suggests that F-16 and F-18 aircraft operations should have been considered in the Aircraft Crash Analysis. These aircraft were not observed in the Pantex area during the timeframe when actual aircraft counts were made. The goal of this aircraft accident analysis was to obtain a realistic overall average estimate of accident rates for military aircraft which would then be used with the overall estimate of actual flights.

In summary, the Department concludes that the accidents identified by Kimura and consideration of Class A do not cause the military aircraft crash rate determined in the Aircraft Crash Analysis to change. Therefore, the analysis performed for the Environmental Assessment (Appendix E, Reference 9) remains applicable.

TABLE 2 - AIRCRAFT ACCIDENT DATA

AIRCRAFT TYPE	ACCIDENT DATE	ACCIDENT DESCRIPTION AND COMMENTS	PHASE OF OPERATION	APPLICABLE TO PANTEX ENVIRONMENTAL ASSESSMENT
C-5	5/25/70	Beyond applicable data timeframe.	N/A	No
C-5	10/17/70	Beyond applicable data timeframe.	N/A	No
C-5	9/27/74	Beyond applicable data timeframe.	N/A	No
C-5	4/4/75	Beyond applicable data timeframe.	N/A	No
C-5	9/19/76	Class A, destroyed. Not a crash. Number 2 Eng/pod fire, chafing hyd/elec lines.	Landing	No
C-5	11/28/78	Class A, destroyed. Not a crash. Turbine failure, fire.	Takeoff	No
C-5	1/16/80	Class A, not destroyed. Not a crash. Number 2 Eng. blade retainer failed. Fire.	Takeoff	No
C-5	6/8/82	Class A, not destroyed. Not a crash. Number 1 Eng. inner liner failed, cowl damage.	Takeoff	No
C-5	7/31/83	Class A, not destroyed. Crashed on landing 200 feet before threshold. A/C from Travis AFB to Shemya AFB, Alaska.	Landing	No
C-5	11/17/83	Class A, not destroyed. Crashed on landing at Travis AFB on runway because landing gear up.	Landing	No
C-5	3/16/86	Class A, not destroyed. Not a crash. Number 1 hyd pump failed	Landing	No
C-5	7/19/89	Class A, not destroyed. Crashed on landing 1,300 feet short of threshold. Slid onto threshold.	Landing	No
C-5	8/29/90	Class A, destroyed. Ramstein AFB, crash during takeoff 4,000 feet from end of runway.	Takeoff	No
B-1	8/29/84	Class A, destroyed. Twenty-two nautical miles from Edwards AFB. Low level training flight	Low Level	No
B-1	9/28/87	Class A, destroyed. From Dyess AFB. Crashed 102 nautical miles from Peterson AFB. Low level flight. Kimura gives 9/27/87 as date.	Low Level	No
B-1	11/8/88	Class A, destroyed. Landing crash. Four nautical miles from Dyess AFB. Fire in wing fairing area.	Landing	No
B-1	11/17/88	Class A, destroyed. Crashed on landing at Ellsworth AFB. One thousand feet off end of runway. Kimura gives 11/18/88 as date.	Landing	No
B-1	6/26/90	Class A, destroyed. Not a crash. Instructor pilot qualifying check. Landed and refueled then damaged discovered.	Unknown	No
B-1	10/4/90	Class A, not destroyed. Not a crash. Lost engine in low-level flight	Low Level	No
B-1	12/19/90	Class A, destroyed. Not a crash. Fan blade failure (inside right Engine No. 3). Landed without incident	In Flight	No
B-1	3/24/92	Class A, not destroyed. Mid-air collision with KC 135. Both landed safely.	In Flight	No
B-1	5/21/92	Class A, not destroyed, Not a crash. Landing gear failure.	Low Level	No
B-1	6/19/92	Class A, not destroyed. Not a crash. Foreign object while in climb. Beyond applicable database timeframe.	In Flight	No
B-1	12/1/92	Class A, destroyed. Crashed. Low level terrain following operation. Beyond applicable database timeframe.	Low Level	No

Comment: ***Provide a definition of interim storage and indicate how long and to what capacity the Environmental Assessment covers.***

Response: Interim storage is defined as storage until a long-term storage facility is identified and operational. The Department will complete an Environmental Impact Statement covering dismantlement and storage of the resulting nuclear materials and classified weapons components and will issue a record of decision within three years of issuance of this Finding of No Significant Impact. This is in addition to the Nuclear Weapons Complex Reconfiguration Programmatic Environmental Impact Statement, which will address long-term storage issues related to the future nuclear weapons complex.

Subject to completion of the scoping process, the Department now envisions that the new Pantex Site-Wide Environmental Impact Statement will address all current and proposed facilities and activities at Pantex as well as storage requirements, including alternate locations, for all plutonium, highly enriched uranium, tritium, and classified weapons components, as appropriate, that result from the Pantex dismantlement activities. Scoping meetings for this Environmental Impact Statement will be held in Amarillo, Texas and at other sites that may be affected by the activities at Pantex no later than June 30, 1994.

Comment: ***Provide a statement that clearly indicates that the Department of Energy will cease max pack configuration after implementation of Stage Right.***

Response: Dismantlement at Pantex will continue and pit storage will be expanded in the Zone 4 Steel Arch Construction magazines consistent with the Environmental Assessment and the Final Safety Analysis Report for Zone 4 Magazines. Individual magazines will be loaded consistent with the preferred configurations in the Environmental Assessment.

Comment: ***Provide an inventory of pit age at Pantex.***

Response: The Pantex Zone 4 pit inventory as of September 27, 1993 is as follows:

Maximum Age In Years	Quantity of Pits
33	291
32	688
31	79
30	222
29	277
28	850
27	292
26	82
25	0
24	175
23	973
22	463
21	81
20	151
19-14	0
13	45
12	251
11	55