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SAND93–0943

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Printed June 1993

THIS DOCUMENT CONTAINS 48 PAGES

B53-1 Special Study Report (U)

Sandia National Laboratories

Los Alamos National Laboratory

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550
for the United States Department of Energy
under Contract DE-AC04-76DP00789

Classified by J. O. Harrison, Manager, Stockpile Improvement Department, March 31, 1993.

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AUTHORITY: DD	4. COORDINATE WITH:
NAME: L. W. Beckstead	5. CLASSIFICATION CANCELED
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B53-1 Special Study Report (U)

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Abstract (U)

This report describes the B53-1 and addresses all nuclear safety and security issues from an operational status to DOE dismantlement at Pantex.

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Classified by J. O. Harrison, Manager, Stockpile Improvement Department, March 31, 1993

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EXECUTIVE SUMMARY

Description

[redacted] After the retirement of the Titan missiles, the bomb was removed from Inactive Reserve and the DOE committed to performing a Stockpile Improvement Program (SIP) to enhance the nuclear detonation safety. [redacted] The B53-1 does not include a Permissive Action Link (PAL). The remaining stockpile is calculated to be one-point safe. The bomb incorporates only a tilt switch as an environmental sensing device and does not require the presence of aircraft power at bomb release to fire thermal batteries and initiate the arming and firing system. The bomb does not incorporate Insensitive High Explosive (IHE) or a Command Disablement system. The primary does not contain plutonium. [redacted]

Status

[redacted] Maintainability concerns for the DoD support equipment (e.g., the bomb racks) and the DOE parachute are being addressed in the B53 POG. Proposals for a replacement system are being discussed.

- [redacted]
- A TARC design for the bomb does not exist and is not being pursued because the size and weight are impractical.

Recommendations

- No force generation or alert exercises with the B53-1 should be allowed. We will work through the POG to ensure existing trainers meet requirements.
- Retirement of the B53-1 should be accomplished as rapidly as possible consistent with operational requirements and best safety practices.
- Continue to perform Alt 916.
- Define an Alt 900-series to remove the thermal batteries for the Inactive Reserve. Development work is underway to support reversibility. This Alt should be performed before off-site transportation or in conjunction with Alt 916.

DOE b(3)

- [redacted]
- The best mode for logistic transportation of the B53-1 must balance safety and security considerations as well as national security needs. Within its operational area, the SST fleet is the best method in today's security environment and should be used for all B53-1 logistic nuclear weapon moves.

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B53-1 Special Study

1.0 Purpose and Scope

This report was prepared to identify weapons system issues and make recommendations to DOE Headquarters. The scope of this special study examines the B53-1 from an operational status through subsequent logistics until the weapon is accepted by DOE at Pantex for dismantlement. The study covers the time frame from now through subsequent logistics consistent with P&PD 93-1. The weapon is described in sufficient detail to support safety and security issue discussions and recommendations.

1.1 History

[redacted] DOE b(3) The B53 was also fielded as a basic assembly (BA53Y1) for B-58 pod application. The BA53Y1/B-58 pod application and B53Y2 are no longer in stockpile.

Through the subsequent thirty years, the three assembly versions and one Mod were fielded; the Mod 1 is the only version remaining in stockpile.

Significant dates for the B53 bomb are:

Phase 3	Dec. 1958
Phase 4	July 1960
Phase 5 (Pilot production B53Y1)	Oct. 1961
Phase 6 (B53Y1)	Aug. 1962
Phase 3	Aug. 1962
[redacted] DOE b(3)	
Phase 6 (B53Y2)	Feb. 1963
Phase 6	June 1964
[redacted] DOE b(3)	
Production completed	June 1965
Phase 7 (B53Y1 - partial quantity)	July 1967
Phase 7 (BA53Y1 - total quantity)	Oct. 1970
Start of B53Y1-0 to B53Y1-1 retrofit	Jan. 1988
Completion of B53Y1-0 to B53Y1-1 retrofit	Sep. 1988

2.0 Description of the B53-1 Bomb

[redacted] DOE b(3) The B53-1 incorporates only one delivery option, timer controlled laydown. The B53-1 configuration is illustrated in Figure 1.

2.1 Nuclear System Description

[redacted] DOE b(3) The "basic assembly" portion of the B53-1 houses the nuclear system and the weapon electrical system (WES). The basic assembly

Figure 1 Cutaway of B53 Internal Layout

weighs approximately 6750 lb. and is 101 inches long and 37 inches in diameter.

2.2 Physical Characteristics

The B53-1 houses the "basic assembly", the parachute retardation system, and interconnecting cables in an aluminum honeycomb aerodynamic shape designed to survive the shocks encountered during weapon laydown delivery. The B53-1 weighs approximately 8890 lb. and is approximately 144.6 inches long and 50 inches in diameter. The design of the B53-1 and overall assembly of the bomb (including the basic assembly) is the responsibility of Sandia National Laboratory (SNL) and Los Alamos National Laboratory (LANL).

2.3 Power Sources and Sequence of Events

The B53-1 contains internal power sources, two MC1262 Thermal Batteries that are initiated by an internal Bisch generator (single-pulse source), which in turn initiates two MC1264 Main Thermal Battery Power Supplies which power the fuzing and firing of the bomb.

Prior to take-off, manual settings are made to (1) allow the bomb to be armed in flight, (2) select the laydown delay time, and (3) establish which aircraft weapons bay the weapon is in. Prior to weapon release, the Aircraft Monitor and Control (AMAC) system is turned on and appropriate signals are provided to the bomb to enable the strong-link switch and unlock the bomb fuzing control selector system. After bomb release, the entire arming and firing sequence are controlled by the bomb electrical system. The complete arming and firing sequence of events are provided in Appendix B.

2.4 Mods and Alts

The present stockpile consists only of B53-1 bombs. Only one Alt affects the continuing stockpile:

Alt 916 A reversible Alt that removes the reservoir from "inactive reserve" bombs. The Alt was performed by DoD teams at DoD locations.

2.5 Date and Currency of MAR

The current MAR, number 1-88 (Effective Date: 25 Feb. 1988) needs revision to remove the following deficiencies:

A. Delete the B53-0 (no longer in stockpile).

B. Reference the current STS for the B53-1 (references STS for the TX-53 bomb, dated 8 May 1961).

C. Include the exceptions and limitations stated in the B53-1 STS listed below:

(1) Transportability Considerations - The H794 Bolster/H795 Adapter have not been evaluated to the stated requirements in the STS.

(2) Normal Climatic Environments - The capability of the B53 bomb to

withstand laydown delivery under the stated limit wind conditions has not been evaluated.

[redacted]

DOE b(3)

[redacted]

DOE b(3)

Revision of the MAR awaits completion of a study to determine if DOE concerns (other than operational limitations and exceptions) should be documented in the MAR. The MAR will be revised when the study is complete and a format has been developed.

3.0 Description of Positive Measures

The B53-0 pre-dated Enhanced Nuclear Detonation Safety (ENDS) design methodology and components, Fire Resistant Pit (FRP) designs and the development of Insensitive High Explosive (IHE). When the retired B53-0 was to be returned to the active stockpile, the decision was made to perform a Stockpile Improvement Program (SIP) to improve the nuclear detonation safety characteristics of the bomb. The B53-1 retrofit improved nuclear detonation safety within the one-year time constraint. The following describe design features that provide some assurance to the requirements of the Nuclear Safety Rules.

3.1 Nuclear Detonation in Accidents

> **"There shall be positive measures to prevent nuclear explosives involved in accidents or incidents from producing a nuclear yield."**

The B53-1 design includes the following:

- All remaining B53 nuclear systems in stockpile are individually calculated ~~to be inherently one-point safe.~~ [redacted]

DOE b(3)

- Power pack/shroud zones provides isolation of critical circuits (high-voltage power supply, CDU, and detonators) from sources of electrical energy that could be applied from any external power source when the bomb is subjected to abnormal environments. This isolation is provided by enclosing those critical elements within the Power pack/shroud Zone. The only entry of electrical energy into this region is through a strong-link switch that is normally open and is securely fastened to the barrier.

The original design is shown in Figure 2 and the modified design is shown in Figure 3.

[redacted]

DOE b(3)

Figure 2. Original Design

[redacted]

DOE b(3)

Figure 3. Retrofited Design

There are abnormal environments that will eventually defeat their isolation features. In the B53-1, the strong-link switch is located in relation to existing B53Y1-0 elements that have functions critical to system operation such that these vital elements become irreversibly inoperative before the isolation features of the strong-link switch are bypassed. The weak-links in the B53-1 system are the X-Unit capacitors and the nuclear system high explosive.

The power pack, which contains the strong-link switch is surrounded by the X-Unit capacitor bank. The power pack and the B53-1 system are divided into two zones:

A. Zone 1 contains the input circuits for the MC2969 and most of the B53Y1-0 carryover components.

B. Zone 2 is isolated from Zone 1 and external electrical sources by the MC2969 and the barriers. Zone 2 contains the power converter, the X-Unit capacitors, the trigger circuit, the detonator cables and the primary. The barriers between Zone 1 and Zone 2 are all steel material and varing from 0.03 inch to 0.1 inch.

[redacted]

DOE b(3)

- Lightning protection is provided against inputs to the bomb that could result from lightning strikes by a Lightning Arrestor Connector (LAC) at the bomb/pull-out cable interface. All signals entering the bomb case are routed through the LAC and the shell of the LAC is electrically connected to the bomb outer case. The LAC is designed to assure electrical breakdown from contact to shell before the breakdown voltage level of the MC2969 Strong-Link Switch is exceeded. Therefore, any high-energy electrical signals are shunted to ground through the case and the critical circuits remain isolated.

The following are design features offering protection in normal environments and cannot be relied on in accidents.

- Electrical unlock and mechanical force required to initiate the single pulse generator.
- Two independent (same source), continuous arming signals required.
- Thermal fuses in main battery output lines.
- Bleeder resistors shunt the capacitor bank.

3.2 Deliberate Unauthorized Arming

"There shall be positive measures to prevent deliberate prearming, arming or firing of a nuclear explosive except when directed by competent authority."

The B53-1 does not include a PAL, but the design includes the following:

- The Aircraft Monitor and Control (AMAC) system includes a Bomber Coded Switch (BCS), similar to a PAL.
- Arming cannot be completed until the Trajectory Sensing System has actuated. Trajectory arming is accomplished by the MC1268 Interval Timer (tilt switch). [redacted] The MC1268 consists of simple mercury switches and an electrical motor; therefore, its major contribution is to ground handling safety.

DOE b(3)

3.3 Inadvertent Arming

"There shall be positive measures to prevent the inadvertent prearming, arming, launching, firing or releasing of a nuclear explosive in all normal and credible abnormal environment."

The B53-1 design includes the following:

- The MC2969 Strong-Link Switch enabled by receipt of a pattern of dc pulses (unique signal). The generator for this signal is located in the aircraft and is controlled by the air crew such that transmission of the unique signal to the bomb indicates the intent of the crew to arm the B53-1.

3.4 Nuclear Explosives Security

"There shall be positive measures to ensure adequate security of nuclear explosives pursuant to the DOE safeguards and security requirements."

Security is handled by systems external to the weapon system. Such factors as fences, guards, two person control and Personnel Assurance Program (PAP) are examples of DOE (and DoD) security measures.

3.5 Plutonium Dispersal

"There shall be positive measures to prevent accidental, inadvertent, or deliberate unauthorized dispersal of plutonium to the environment."

The B53 primary is all Oralloy. This system does not contain any plutonium.

4.0 Summary of Past Safety Studies and Investigations

4.1 DOE and Laboratory Internal Studies

The B53-0 bomb is a weapon designed prior to the incorporation of the modern safety concepts of isolation, inoperability and incompatibility. The B53-1 retrofit improved nuclear detonation safety within the constraints of available implementation time. The B53-1 utilizes a measure of Enhanced Nuclear Detonation Safety (ENDS); however, it does not have IHE or FRP. The weapon does incorporate some safety devices that attempt to prevent nuclear detonation in a narrow range of defined single environments. [redacted]

DOE b(3)

4.1.1 Retrograde Surety

A study was conducted for the Executive Management Team for Dismantlement to identify options for enhancing surety during dismantlement. [redacted] A tabulation of these options and the relative improvements to nuclear detonation safety and Plutonium scatter is shown in the following chart. Additional comments on each option are provided below:

DOE b(3)

Option 1. Removal of the reservoir/valve assemblies (Alt 916) is authorized to be performed by the DoD.

DOE
b(3)

[redacted]

Option 3. Use of the Transportation Accident Resistant Container (TARC) in the B53-1 application would require the design of an entirely new TARC (the B53-1 is bigger than the existing TARC). The B53 contains no Plutonium.

Option 4. Restricting shipment of B53-1 bombs to the SST is the recommended option.

Option 5. Removing both the main thermal batteries and pulse batteries removes all internal power sources from the bomb and improves predictable responses in a transportation accident environment.

This option would have been easily achieved if performed in conjunction with Alt 916. However, this Alt has been completed. Given that SSTs will be utilized for future transportation, the safety enhancement may not be worth the resources required (approximately 16 man-hours per bomb).

Option 6. Spiking the capacitor bank is non-reversible. The capacitors are oil-filled and development of a tool to perform spiking and sealing is required.

There are no spare X-Units available; thus, if a requirement for returning a bomb to the ready category was established, considerable design effort would be required to develop a replacement X-Unit.

4.2 TWG Reports

In 1975-76 there was a joint ERDA(DOE)/DoD effort to characterize "older weapons" in abnormal environments and combinations of these abnormal environments. The reports generated by these studies are referred to as "TWG Studies'" (Technical Working Group). The findings of these working groups are common across the services, only the individual accident scenarios differ.

4.2.1 Air Force Study

Air Force/ERDA -- Joint Nuclear Stockpile Safety Evaluation of SAC Aircraft Weapon Systems Report, dated 22 March 1976

The TWG study pre-dates fielding of the B53-1. The TWG addressed the B53-0 and the response to the various abnormal environments individually are summarized in Table 1 (see Appendix D). Air Force Accident Scenarios envisioned by the Technical Group and the B53-0 responses are summarized in Table 2

Option #	Option Description	Relative Safety Improvement				Relative Increase In Time, Dollars, or People	Nuclear Detonation Safety And Scatter Effectiveness Ranking (1 = Best)		Weapon Security Improvement	New Equipment or Procedures	Ranking And Whether To Do or Not Do (1 = Best)		Comments
		During Transportation		During Storage									
		Nuclear Yield	Pu Scatter	Nuclear Yield	Pu Scatter		Trans.	Storage			Ranking	Do or Don't	
1	Remove D-T Gas Reservoir	None	N/A	None	N/A	Med	-	-	None	None	-	Do	Alt 916
2	Disconnect Input Cables to X-Unit	Med	N/A	Med	N/A	Med	5	3	Low	Low	4	-	Impractical
3	Provide TARC	Med	N/A	N/A	N/A	High	2	N/A	Low	High	5	Don't	No Pu, too big etc.
4	Use SST Only	Med	N/A	N/A	N/A	Low	1	N/A	High	None	1	Do	
5	Remove Thermal Batteries	Med	N/A	Med	N/A	Med	4	2	Low	Low	2		
6	"Spike" the X-Unit Capacitors	Med	N/A	Med	N/A	Med	3	1	Med	Med	3		

Chart 1. Retrograde Surety, B53-1 Safety Options

(see Appendix D). These tables are presented to show the concerns prior to the B53-1 retrofit. [redacted]

DOE b(3)

4.3 Last NWSSG Study

Special Safety Study of Older Weapons (B-52G/H Weapon System)[10]

The Special Safety Study was conducted to meet the requirements of the Assistant to the Secretary of Defense for Atomic Energy [ATSD(AE)] for a study of older weapons. The NWSSG concluded that the B-52G/H weapons system (with SRAM not considered) will meet the DoD Nuclear Weapon System Safety Standards. [redacted]

DOE b(3)

4.4 Last NESS

The latest Nuclear Explosive Safety Study at Pantex was performed in 1988[11] and addressed disassembly operations for retirement and surveillance testing. The study group concluded that B53-1 disassembly operations meet the nuclear explosive safety criteria of DOE Order 5610.3 and AL Order 5610.3.

During this study, the plant safety rules for the B53-1 were established and test equipment not used on the B53-1 (previously used on B53-0) were deleted from the Master Tester List.

4.4.1 Specific Nuclear Safety Rules, Pantex Facility

Ref. AL5610.11, Chapter XII

Specific Safety Rules for the B53-1 Bomb:

A. Upon bomb return and before disassembly operations are performed, the MC2969 strong-link switch shall be electrically monitored to verify the safe condition of the switch.

B. The thermal batteries shall not be electrically disconnected from the electrical component assembly interconnecting box in the nuclear explosive area.

C. In the NEA, the cover shall not be removed from the J7 connector on the MC4065 power pack.

DOE b(3)

4.5 [redacted]

DOE b(3)

DOE b(3)

5.0 Summary of Known Safety or Security Issues While in DoD Custody

5.1 Storage

DOE b(3)

5.2 Transportation

DOE b(3)

Surface transportation of the B53-1 is limited to one per SST. Thus, a number of SSTs would be required if a mass move of the B53-1 were required.

5.3 Maintenance

The quantity of spare parts to support maintenance of the B53-1 is extremely low. Thus, it is possible that units may have to be retired due to lack of parts. [redacted] DOE b(3)

6.0 Summary of Other Issues

6.1 Reliability/Maintainability Issues

b3 [redacted] Current plans are to support one flight test per year starting in calendar 1994. Due to the lack of flight test hardware, a new Joint Test Assembly configuration is being developed which will be utilized starting in 1995.

6.2 Personnel Safety Issues

DOE b(3) [redacted]

7.0 Findings and Recommendations

7.1 General

DOE b(3) [redacted] Mod 1 did add an intent operated strong-link. The B53-1 does not have IHE or FRP, but has an all Oralloy primary. The B53 was designed without PAL or command disable. [redacted] DOE b(3) The following issues prevail:

Nuclear Detonation Safety. The B53-1 does not employ modern ENDS. It has partial ENDS with only a single strong-link and a Power pack/shroud zone.

Plutonium Scatter Safety. Although the B53-1 has neither IHE nor FRP, it is an all Oralloy system.

DOE b(3)

[redacted]

Reliability/Maintainability. Current plans call for one flight test per year starting in calendar 1994.

DOE b(3)

[redacted]

7.2 Recommendations

1. [redacted]

b3

2. All shipments of the B53-1 should be by SST.

   Since all B53s are CONUS, there should not be a need for logistic transport of these weapons by air. The use of SSTs is the best safe and secure means of transporting the B53-1.

3. Reservoir removal (Alt 916) should be performed per schedule and removal of the main and pulse thermal batteries should be considered.

   Now and during the retirement process the LLCE intervals must be observed. Alt 916 should be performed to stay within this interval.

   Removal of both the main and pulse thermal batteries removes the sources of electrical energy within the bomb electrical system which further enhances nuclear detonation safety. This would be a first principle enhancement to nuclear detonation safety. Little additonal time is required to perform this function.

4. [redacted]

DOE b(3)

5. B53-1 TARCs should not be built.

   Use of the TARC, in the B53-1 application would require the design of an entirely new TARC and the B53 contains no Plutonium.

6. Options should be explored to address replacement of the conventional HE and incorporation of a complete ENDS design.

APPENDIX A

NUCLEAR SYSTEM DESCRIPTION

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Primary Assembly [redacted] DOE b(3)

1. [redacted]

DOE b(3)

2. [redacted]

3. [redacted]

DOE b(3)

[redacted]

DOE b(3)

Figure 4. [redacted]

DOE
b(3)

[redacted]

Figure 5. Cutaway of Type 76 Pit

Reservoir - Type 2A-24 Deuterium-Tritium (D-T) gas reservoir and valve assembly

DOE
b(3)

[redacted]

Each Type 1A squib contains an electro-exploding device (EED) that initiates 25 mg of lead styphnate, which in turn initiates 175 mg of Ball Powder (black powder). The Type 1A valve assembly contains a visible thermal plug that is designed to open in a fire environment (operating temperature 104°C). If the actuator squibs fire with the thermal plug open, the gas generated by the actuators is vented to the outside and the plunger will not be forced onto the reservoir and pit tubes with enough velocity to cut the tubes. Cutting these tubes is the only way of transferring the D-T gas to the pit.

DOE b(3)

[redacted]

Cycle Life - The interval from the fill time to the time that the gas no longer meets the weapon yield certification because of Tritium decay. This life is used to determine the normal LLCE requirements.

Extended Cycle Life - The interval from the fill time to the time that "unacceptable" yield degradation results from Tritium decay and helium generation. This time is greater than the cycle life and less than or equal to the limit life.

Limit Life - The interval from the fill time to the time that the structural integrity of the reservoir, including an appropriate factor of safety, may be compromised, resulting in an increased probability of a Tritium leak.

Stockpile Life - The total number of years that a reservoir can be exposed to a Tritium environment. It may limit the number of times a reservoir can be refilled.

Secondary [redacted]

DOE b(3)

[redacted]

DOE b(3)

Nuclear System Basic Components and LANL Drawing Numbers [redacted]

DOE b(3)

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APPENDIX B

ARM AND FIRE, SEQUENCE OF EVENTS

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The B53-1 sequence of operation is given in Figure 6.

[redacted]

DOE b(3)

Figure 6. Sequence of Operation

A. Before take-off:

1. [redacted]

DOE b(3)

2. MC4072 Interface Unit is manually set to FWD or AFT depending on the aircraft weapons bay being used.

3. MC1199 Electrical System Safing Switch is manually operated to the armed position. [Aircraft Monitor and Control (AMAC) system must be on and in the SAFE position.] Selection of FREEFALL or RETARD also results in laydown option.

B. Before weapon release:

1. AMAC is system turned on and positioned in either the AIR or GND position, unlocking the pullout rods in the MC1200A Fuzing System Control Selector.

2. Unique signal is provided by the AMAC to enable the MC2929 strong-link switch (requires approximately 25 seconds).

C. **Weapon release:**

1. Pullout rods are extracted from the MC1200A Fuzing System Control Selector:

   a. Pullout switches in the main thermal battery output lines closed.
   b. Pulse generators in the MC1200A are actuated initiating the MC1262 Thermal Battery Packs (fast-rise batteries) and MC1315 Sequential Timers (parachute timers).

2. MC1262 fast-rise batteries provide 12-volt power:

   a. T_0 contacts in MC1315 timers close.
   b. MC1315s initiate the MC1264 Thermal Batteries (main batteries).

3. 28-volt power is applied to contacts in the MC1268 Interval Timer.

4. [redacted] DOE b(3)

   a. MC1315 parachute timer contacts close, completing circuits between the MC1262 fast-rise batteries and the MC1060 Electric Detonators in the automatic parachute deployment system.
   b. MC1315 provides a signal to cut the retardation parachute suspension lines, and the parachute deployment sequence occurs.

      (1) Automatic deployment cover is separated from the rear case section by mild detonating fuze (MDF) system.
      (2) Automatic deployment cover deploys the pilot parachute.
      (3) Pilot parachute deploys the retardation parachute.
      (4) [redacted]
      (5) [redacted] DOE b(3)

5. Laydown parachute drag causes the MC1268 Interval Timer (trajectory sensing device) to operate toward the armed position. [redacted] DOE b(3)

6. After the MC1268 contacts close, main battery power is applied to:

   a. MC1178 laydown timer motor and contacts.
   b. MC1199 safing switch explosive motors which lock MC1199 in armed position.

7. [redacted]

DOE b(3)

8. [redacted]

DOE b(3)

D. **Weapon detonation:**

1. MC1178-T_3 switches close, activating the explosive firing switches in the MC1204 switch pack which apply main battery outputs to the pulse transformer trigger circuit.

2. Trigger circuit output pulses the spark gap tube in the MC744B X-unit, discharging the X-unit capacitor bank into the detonators and triggering the neutron generators.

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APPENDIX C

INTERNAL STUDIES NARRATIVE

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DOE b(3) [redacted] DOE

- The B53 physics package contains conventional High Explosives rather than Insensitive High Explosives.

DOE b(3) [redacted]

- The B53 bomb was designed prior to the development of Enhanced Nuclear Detonation Safety (ENDS) concepts. The modification to the B53-1 utilizes a measure of ENDS, incorporating Power pack/shroud Zones and one hard-link (intent switch) and it does incorporate a barrier around vital circuits for isolation.

DOE b(3) [redacted]

- The weapon contains an Environmental Sensing Device that is intended to block critical circuits until the intended use environment is sensed. The MC1268 interval timer senses a change in bomb attitude when the weapon is dropped.

[redacted] DOE b(3)

- [redacted] DOE b(3)

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APPENDIX D

TWG SUMMARY

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The following tables present the findings of the 1976 Air Force/ERDA Technical Working Group (TWG) Study. The TWG addressed the B53-0 and the following tables are presented to show the concerns prior to the B53-1 retrofit. Table 1 summarizes the response to the various abnormal environments individually and Table 2 summarizes the B53-0 responses to Air Force Accident Scenarios envisioned by the Technical Group.

The anticipated responses to environments were characterized as one of three predefined conditions:

> ***PREDICTABLE*** A predictable response is one in which a critical component, subsystem or system can be depended upon with a high degree of confidence to respond in a manner that is known and safe.
>
> *UNPREDICTABLE* An unpredictable response is one in which a component, subsystem or system responds in a manner that is not always repeatable and may contribute to the weapon being unsafe.
>
> ***UNDESIRABLE*** An undesirable response of a critical component or subsystem is one in which it is expected to respond in a manner that contributes to a weapon being less safe. An undesirable response for a system is one in which it is expected to respond in a manner that is unsafe.

The B63-1 retrofit design intent was to change the *Unpredictable* responses to *Predictable*.

Table 1. B53-0 Response To Abnormal Environments, TWG Summary

DOE
b(3)

Table 2. B53-0 Responses To Air Force Accident Scenarios

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APPENDIX E

REFERENCES

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