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RS3140/92/00001

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(1-15-92)

Final Development Report for the *Redacted Copy* B61-7 Bomb (U)

SAA 200034780000

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

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Classified by D. L. McCoy, Supervisor, B61/Stockpile
Improvement Division, 5111, February 22, 1985.

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APPENDIX A
Program Documents

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Sandia Laboratories

G. A. Fowler
Vice President, Systems

Albuquerque, New Mexico 87115

Major General Ernest Graves
Assistant General Manager for
Military Application
Division of Military Application
U.S. Atomic Energy Commission
Washington, D.C. 20545

Subject: Safety of Aircraft Delivered Nuclear Weapons Now in Stockpile

- Ref: 1. Uncl. letter, Major General Ernest Graves, DMA to G. A. Fowler, dtd 9/12/74
2. SRD, Stockpile-to-Target Sequence for the B61 Bomb, RS 3141NC/501382, dtd 15 February 1974
3. SRD, Military Characteristics for the Warhead for the Trident Mk4 Re-Entry Body (U), RS 3148-1/101274, dtd 30 August 1973
4. SRD, B77 MC's (Military Characteristics for a New FUFO Bomb (B77)) (U), RS 3141NC/501741, dtd 14 August 1974
5. SRD, "Project Crescent: A Study of Salient Features for an Airborne Alert (Supersafe) Bomb (U), SC-WD-70-879, RS 3110/2097, dtd April 1971
6. SRD letter, D. P. MacDougall, LASL and G. A. Fowler, SLA to Major General Ernest Graves, DMA, ADW-477, RS 3148-1/102306, dtd 2/15/74, and enclosure, B61-3 and 4 Safing/Denial Study, ADW-PM-74-53, RS 3148-1/102307, dtd 2/25/74

Most of the aircraft delivered nuclear weapons now in stockpile were designed to requirements which envisioned weapon stockpile operations consisting mostly of long periods of igloo storage and some brief exposure to transportation environments. Changing conditions in the early 1960's dictated different operational practices which included wide spread ground and air alert operations. Starting in 1968 new weapon STS's have gradually accounted for this change in weapon usage by providing more realistic abnormal environment definitions. Reference 1 acknowledges this trend toward recognizing realistic abnormal environments and suggests that future MC's, in consonance with this trend, should require that nuclear weapons be designed to meet current safety requirements in the presence of fault signals applied to the weapon. This philosophy is consistent with the wording of the new B61 STS (calls out fault signals as an abnormal environment), the W76 MC's and the B77 MC's (Ref. 2, 3, and 4). We agree with the validity of this approach and in the case of aircraft delivered weapons believe the need for this policy is well demonstrated by the many prearming incidents involving direct current driven Ready/Safe Switches (summarized in Attachment 1). Both the B61-3 and 4 and the B77 are being designed to meet these new requirements so long as the unique signal override feature remains in the NORMAL position which requires that the weapon receive a unique prearming signal and therefore cannot be inadvertently prearmed by any other power source in the aircraft or in handling or test equipment.

In 1968, Sandia Laboratories established a safety assurance program to study and understand the implications of designing nuclear weapons for safety in the abnormal environments. Reference 5 reports the results of a study commissioned by DMA related to aircraft/weapon safety. A product of this effort was the conception of the strong link/weak link/exclusion region principle on which the new safety technology is based. A study of the abnormal environment safety of stockpile systems was initiated in 1970 and was intensified late last year with priority given to aircraft delivered systems because of the frequency of Ready/Safe Switch incidents and the history of aircraft related accidents involving nuclear weapons.

Interim results from the priority portion of this review are now available and are provided along with Sandia Laboratories' conclusions and recommendations.

The following is a compilation of weapon safety requirements at the time of stockpile entry (Table I) and a brief description of each weapon safing scheme along with our conclusion regarding the adequacy of safety in the abnormal environments.

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TABLE I

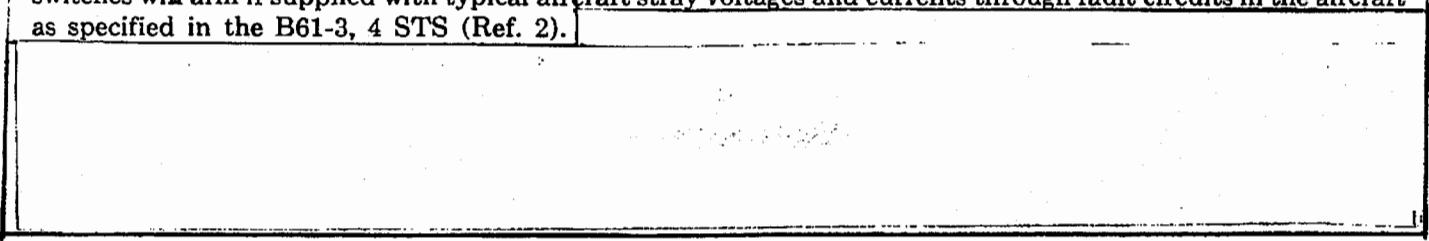
<u>System</u>	<u>Ø 3</u>	<u>Ø 6</u>	<u>Normal Env.</u>	<u>Abnormal Env.</u>
W25 (GENIE)	11/54	1/57		
W28 (HOUND DOG)	8/54	8/58		
B28 EX & RE	8/54	8/58		
B28 FI	9/60	7/62		
B43	10/56	2/60		
B53	12/58	8/62		
B57	1/60	1/63		
B61-0, 1, 2	1/63	1/68		
W69 (SRAM)	1/67	2/72		
W72 (WALLEYE)	5/69	9/70		

DoD
(b)(3)

- Note 1: Fire only abnormal environment specified.
- Note 2: In the absence of input signals except normal monitor and control.
- Note 3: Fire and shock only abnormal environments specified.
- Note 4: Fire, shock, F-4 aircraft crash, fragmentation, nuclear radiation, lightning, and flooding specified as abnormal environments.

The W25 and W69 warhead each contain a single environmental sensing safety feature, an integrating accelerometer. The W28 warhead contains no environmental sensing safety feature. It does contain a 28 volt DC motor-driven high-voltage safing switch, controlled by aircraft power. The W72 warhead contains a single environmental sensing safety feature, a velocity-sensing differential pressure switch.

Each of the bombs contains one active environmental sensing safety feature for each option; integrating accelerometers, velocity-sensing differential pressure switches, or hydrostats (B57, ASW). In addition, they each contain one or two 28 volt DC motor-driven safing switches, controlled by aircraft power. None of these safety switches (Ready/Safe and Environmental Sensing), with the exception of the W69 ESD, have any hardening features which would help to assure safety during exposure to abnormal environments. All of the 28 volt DC safing switches will arm if supplied with typical aircraft stray voltages and currents through fault circuits in the aircraft as specified in the B61-3, 4 STS (Ref. 2).



In summary, all of the current stockpile of aircraft delivered weapons (and the B61-2 entering stockpile this fiscal year) have serious shortcomings when evaluated against current abnormal environment nuclear safety standards. These shortcomings stem from the inability of existing safing devices to assure the maintenance of a predictably safe state through exposure to abnormal environments, the possibility of these safing devices being electrically bypassed through charred organic plastics or melted solder and finally the susceptibility of the safing devices themselves to premature operation from stray voltages and currents which may be present in the abnormal environments.

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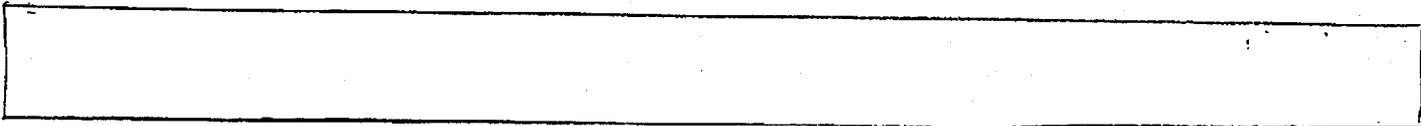
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It appears that the safety of the aircraft delivered stockpile could be greatly improved over the next decade in the following manner:

1. Retire the following weapons or retrofit them with two independent safety devices utilizing the strong link/weak link concept:
 - W25 (GENIE)
 - W28 (HOUND DOG)
 - B57 (ASW)
 - B53
 - B61-0, 1, 2
 - W69 (SRAM)
 - W72 (WALLEYE)
2. Replace the following weapons as indicated:
 - B28 EX/RE - Replace with B61-3,4,5 and B77
 - B28 FI - Replace with B77
 - B43 - Replace with B61-3,4,5 and B77
 - B57 (TAC) - Replace with new FUFO MRR and/or NATO bomb

(S)



As you pointed out in our conversation earlier this month, a plan to modernize or replace the aircraft-delivered weapons to improve safety is a subset of a broader stockpile modernization and retirement plan. Perhaps the urgency associated with the safety question will serve to stimulate the effort associated with the overall plan. We will be glad to help in any way we can either with the abnormal environment safety plan or with the broader question.

/s/Glenn A. Fowler

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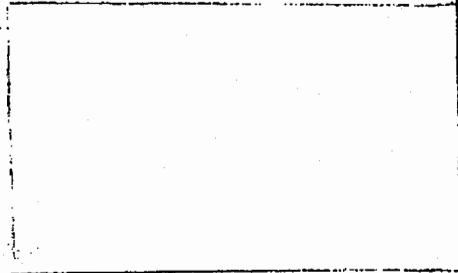
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AMAC/BOMB FAULTS

Summary (1961-1974)

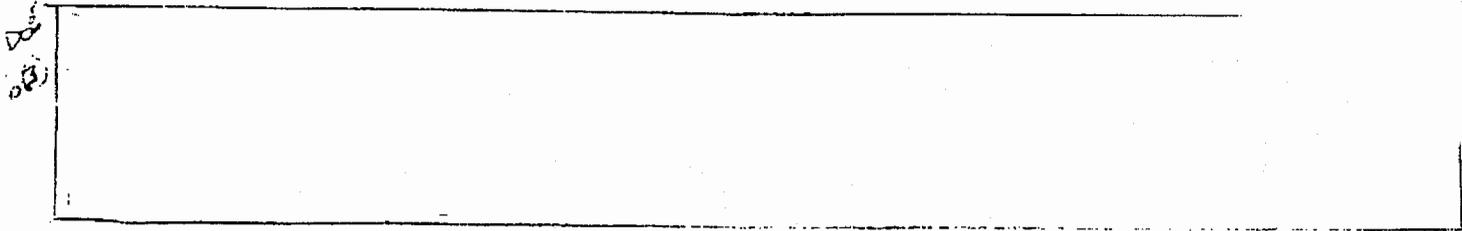
Number of Occurrences
 Number of Bombs Involved
 Operation of R/S Switch
 Ready
 Intermediate
 Other Than R/S Switch Operation
 Weapons Not Affected

DOE
b(3)



W25 (AIR-2A) INCIDENTS

1963-64



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- Added emphasis on security—to include the peacetime threats to security through sabotage and terrorism.
- Added emphasis on safety—to include abnormal environments and the need to further lower the probability of nonnuclear explosions and the scattering of special nuclear materials.
- Additional command control capabilities—to enhance positive NCA control over use of nuclear weapons and allow added execution flexibility—to include better integration with security and safety devices.
- Reduced costs—to include those involved in operations, training and maintenance as well as those associated with acquisition.

Adjustments to the stockpile should reflect the stabilizing effect of arms control agreements but include prudent "hedges" in the event of failure of arms control measures.

Simplification of the Stockpile

The stockpile now contains approximately sixty weapon types and modifications. Each of these types and mods require individualized handling, testing, and maintenance with commensurate DoD training and manning implications. Simplification of the stockpile, with attendant reduction in weapon types, design variation and complexity, can offer significant economies and ancillary benefits while potentially improving the utility of our nuclear forces.

Besides the obvious process of reducing and consolidating elements of the stockpile, simplification should involve meeting new system requirements through the use of available warheads, either in development or production, whenever feasible. Maximizing commonality in development will conserve scarce RDT&E dollars and allow more effort to be applied to the research and advanced technology base. A combined DoD/ERDA move toward stockpile simplification is a natural approach to reducing the difficulties associated with safety, security, command control, fiscal constraints, training, testing, and manpower.

A Proposed Modernization Program

The optimization and simplification of our current and future nuclear stockpile requires an integrated effort by the DoD and ERDA to meet common goals. The desire to correct all present deficiencies through the introduction of new weapons must be tempered with the realization that under existing development capabilities, new weapon developments initiated now would not enter the stockpile before 1980. Therefore, our efforts to improve the present stockpile must include (1) those immediate actions that can be taken which do not require hardware modifications, (2) near-term actions involving modification of existing weapons or redirection of ongoing developments and (3) restructuring our approach to long-term weapons acquisition.

The Department of Defense must determine what military characteristics and capabilities are desired for the nuclear weapon stockpile of post-1985. Concurrently and in conjunction with ERDA, we should review the present stockpile to determine major deficiencies in the areas of safety, security, command control, and operational flexibility.

When this stockpile review is complete, we should determine how we can eliminate or reduce the impact of identified deficiencies through immediate measures such as retirements, change in deployments, procedure changes, etc., and those weapon modifications, external devices procurements, (NEDS, strap-on destruct, etc.) or restructuring of ongoing developments that could be accomplished within the next three to five years. Finally, we must emphasize the concept of warhead commonality and stockpile simplification, starting with the Phase 1 and 2 studies to develop nuclear warhead options for new weapon systems. The choice for Phase 3 Engineering Development could then be made with the emphasis on conserving RDT&E, production, and operating dollars.

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R. L. Peurifoy, Jr.
Director
Weapons Systems Development

Sandia National Laboratories

Albuquerque, New Mexico 87115

November 30, 1977

To: Distribution

Subject: Transmittal of Study

I am circulating the attached draft study for your review and consideration. It is incomplete in refinement but I believe that it can serve a useful purpose as a background document for several time-urgent CTB related tasks and for our work in response to Mr. Cotter's theater modernization study. The report is in a briefing format, hard copy of vugraphs on the right with accompanying words on the left. Much of the study material including many of the sensitivities and excursions that Dick wanted to include in the report were omitted because of the time available, yours and ours.

We assumed that the currently projected force structure and weapon mix is valid and did not pursue innovative weapon applications, question roles and missions, or propose redistribution of weapons among categories—not because we believe that these areas don't deserve close scrutiny, but because such an effort must involve the DOD as the lead agency. There are two ways the attached work may be viewed: if additional pressure for modernizing nuclear forces by new weapon replacement does not surface we need to undertake a substantial refurbishment effort; if we take innovative steps in further modernization of our nuclear forces, we can avoid having to divert resources to update less capable, existing weapons.

Dick will appreciate receiving your comments and suggestions on the report.

/s/R. L. Peurifoy, Jr.

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November 30, 1977

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U. S. NUCLEAR WEAPON INVENTORY**

R. N. BRODIE

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**ATOMIC WEAPON DATA
PRODUCTION AND STOCKPILE INFORMATION**

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FY 79: P&PD Plan

DOE (b)(3)

Weapon	Action	Quantity	Priority	Type
B28FI	Interim - Enhanced Electrical Safety Mod [redacted] Replaced by B77 FY82-85	[redacted]	1	Field Retrofit
W25 (Genie)	Change Safety Rules to Prevent Peacetime Loading Use Retired Denuclearized Warheads for Training		1	Factory (Pantex)
B53	Remove from Normal Peacetime Alert		1	Administrative
B61-2	Upgrade to B61-5 Configuration All [redacted]		2	Field Retrofit
W53 (Titan II)	Enhanced Electrical Safety Mod [redacted]		2	Field Retrofit
W70 (Lance)	Mod 0, -1's to -2 Configuration with Enhanced Electrical Safety Mod		2	Factory Rebuild

FY 80: P&PD Plan

DOE/DoI (b)(3)

Weapon	Action	Quantity	Priority	Type
B28FI	Complete Enhanced Electrical Safety Mod	[redacted]	1	Field Retrofit
W31 (Nike Herc)	[redacted] Enhanced Electrical Safety, MCCS, & Non-Violent Command Disable		1	Field Retrofit
B61-1	[redacted] Include Enhanced Electrical Safety, IHE, MCCS, and Non-Violent Command Disable (B61-X, High Yield)		2	Factory Rebuild
B61-0	[redacted] to B61-X		2	Factory Rebuild
B61-2	Complete Upgrade to B61-5		2	Field Retrofit
W53 (Titan II)	Complete Enhanced Electrical Safety Mod		2	Field Retrofit
W70 (Lance)	Complete Upgrade to W70-2 Configuration With Enhanced Electrical Safety		2	Factory Rebuild

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Major General Joseph K. Bratton, USA /
Director of Military Application, HQ

EXECUTIVE SUMMARY, "STOCKPILE MODERNIZATION STUDY"

The subject report documents a DOE study which examines the U. S. nuclear weapon inventory and recommends specific weapon modernization programs. The study was undertaken in the broad context of maintaining a viable and credible nuclear deterrent force capable of supporting a wide range of options. Although the nuclear weapon stockpile has been relatively stable over the last 15 years with theater weapons being essentially fixed, the technology associated with threat scenarios and our understanding of the threats, have made substantial advancements. Therefore, the thrust of the study and the resulting recommendations recognize a growing conviction on the part of DOE that unless greater attention is paid to adjusting the stockpile to meet more rigorous demands of safety, security, and command control, concerns about the present adequacy of these features could bring about constraints on our nuclear posture and reduce its deterrent value.

The study used as a planning base the joint DOD/DOE stockpile projection provided to ALO via P&PD 78-0. It was presumed that unlimited resources would not be available for complete stockpile modernization and, therefore, a methodology was required for setting priorities and proposed corrective actions. Goals, objectives and priorities were defined in terms of DOE's understanding of national policy and consequences. The presently projected nuclear stockpile was evaluated on a weapon-by-weapon basis to establish a priority of concern according to:

- Military use-related deficiency(ies),
- Consideration of the exposure to potential safety, security, command control problems and the susceptibility of the weapon to those problems, and
- The degree that national policy would likely be affected.

For example, a nuclear weapon could be susceptible to electrical fault signals when mated to a missile. Concern for this susceptibility could be moderated if the weapon was not mated to a carrier missile in peacetime, or increased if it was mated to a missile on continuous alert. The deployment conditions and location of the alert missile could also moderate or increase the likely degree of national implications, e.g., a missile deployed underground in an isolated CONUS area versus deployed above ground near a politically sensitive NATO population center. The physical susceptibility of individual weapons to various environments used in the study were those determined by DOD/DOE technical working groups chartered during the joint stockpile safety study and the JCS stockpile improvement study.

In formulating the proposed modernizing action program, full account was made of the new nuclear weapon production currently planned. For example, the enhanced electrical safety retrofit of the B28FI strategic bomb recommended in the plan falls short of an adequate long-term solution for the concerns associated with air-carried strategic alert weapons. Instead, the B28FI retrofit is intended as an interim improvement until a modern strategic high yield bomb which meets all strategic alert requirements is available. Also, not all existing B28FI's may need to be retrofitted since only the weapons on actual alert create the combined susceptibility/high exposure environment.

This quantity may vary depending on the future alert requirement mix of B28's and Modern Strategic Bombs.

Inherent in trying to limit the proposed modernization actions to a prudent minimum is an assumption that not all units of a weapon system or a class of weapons have to be modified to provide a substantial improvement in posture.

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In any case, only a portion of the B57 stockpile should be modernized; the remainder should be withdrawn to main operating bases for storage under optimized security conditions.

The proposed modernization program for the existing nuclear weapons extends over the next eleven years—a period of high anticipated production and, as a result, limited capacity. Because of this potential limitation, many of the highest priority concerns can be addressed through field retrofit kits which minimize capacity impact. Modifications to upgrade existing B61 bombs have been defined in detail and make maximum use of existing hardware now in production. While many of the other modernization proposals could utilize existing hardware, the production complex constraints require an execution time scale that could allow a more studied approach to the selection of candidate replacements similar to the normal Phase 2 and 3 development process.

Resource constraints seem to dictate a natural division of the proposed modernization program into two parts. The first consists of those actions which we are able to define in detail at this time and the second, those remaining actions that cannot be accommodated under current planning and assumptions in the production complex until the mid-80's. It should be noted that operating requirements to support the recommended modernization have not been requested or included in the budget requirements submitted to MA.

The initial program (listed by priority established in the report) which can be approved and implemented immediately consists of:

- 1. [redacted] B28FI strategic bombs for enhanced abnormal environment nuclear safety.
- 2. [redacted] W25 Genie warheads for training and mass loading usage in lieu of using War Re-
- 3. [redacted] W31 Honest John [redacted] Nike Hercules (if required) missiles for enhanced abnormal environment nuclear safety and a multicode command control system (an integral command disable retrofit is likely not feasible).
- 4. Preparation for factory retrofit of B61-0 and 1's to B61 Mod X version [redacted] with IHE, enhanced electrical safety, modern PAL and command disable. This preparation can consist of producing "preproduction kits" in anticipation of released capacity at Pantex because of WR program slips or workload leveling schedule manipulations. If released capacity at Pantex does not materialize, these kits will be incorporated when the capacity is generated by the study's recommendation on capital funding.
- 5. Preparation for factory retrofit of B61-2 and 5's to B61 Mod Y version [redacted] with IHE, enhanced electrical safety, modern PAL and command disable. This recommendation also would require "preproduction kits."

Doc (b)(3)

Doc/Dod (b)(3)

A tabular summary of the total modernization program is presented in Enclosure 1.

While it is recommended that the initial modernization program begin with the actions defined above, the remaining program should be approved or endorsed in principle in order to program for the necessary R&D design definition and capacity related production requirements.

Herman E. Roser
Manager

WPW:NSD

Enclosures:

- 1. Table, "Modernization Program," SRD
- 2. Report, "Stockpile Modernization Program," SRD

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Maj. Gen. Bratton

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DEPARTMENT OF DEFENSE
MILITARY LIAISON COMMITTEE
TO THE
DEPARTMENT OF ENERGY
WASHINGTON, D. C. 20301

20 March 1979

Major General Joseph K. Bratton
Director of Military Application
Department of Energy
Washington, D. C. 20545

Dear General Bratton:

(U) In response to your September 22, 1978, letter concerning the stockpile modernization program, we strongly support the goal of improving the overall safety and security of nuclear weapon systems and the incorporation of enhanced safety and security features where appropriate.

(U) Modernization should emphasize:

- The incorporation of modern safety and security features in new weapons as a first priority; and
- The modification of current systems on a non-interference basis with new weapon production and under a system of priorities which considers the operational/basing modes of the systems and their projected service life.

(C) Based on these criteria, specific modifications for those systems recommended for improvement were made considering previous safety evaluations, recommendations by each Service, ongoing long term theater nuclear force and strategic weapon system modernization studies, and short term deployment goals. For consistency, the Goals, Definitions, and Priority Level Descriptions provided in your study have been used as a framework for the recommended safety and security improvements.

(S) In reference to the recommended DoE/DoD guidelines concerning DoD weapon system modifications, there are ongoing efforts to incorporate Unique Signal Generator (USG) aircraft monitor and control (AMAC) units in aircraft to be compatible with those weapons with USG strong links.

(S) (U)

[Redacted]

Although we realize that the safety goal (1×10^{-6} probability of a detonation in an abnormal environment) cannot be guaranteed during operational circumstances, the USG feature will be used during the majority of the stockpile-to-target sequence thereby obtaining the safety goal during a major portion of the credible abnormal environment scenarios.

(U) Specific weapons recommended for modernization are at Appendix A. Included are the scope of the modernization, the number of weapons suggested for modification, and relative priorities.

(C) I concur in the proposed modifications for the B28F1 and B61 bombs. The recommended number of weapons to be modified has been changed to coincide with current requirements for both systems.

(C) Modifications are also recommended for the W31 (for both the HONEST JOHN and NIKE HERCULES) and the B54. However, these modifications differ from those recommended in your study. Resolution of these differences is necessary before actual modifications are programmed and funded. In particular, we need to assure adequate security protection.

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(SFRD) The Navy and the Air Force have extended the requirement for a limited number of B43Y1 bombs through at least the late 1980s. Modifications similar to that proposed for the B28FI should be considered.

(CFRD) Denuclearizing of W25 warheads is not required; a modification to improve the electrical safety of retained W25s is recommended.

(CFRD) Due to the ongoing Navy/DoE Phase 1 nuclear ASW weapon system study and the Air Force/DoE Phase 2 feasibility study for the ASALM, proposed modifications for the B57 depth bomb, W44 (ASROC), W55 (SUBROC), and the W69 (SRAM) should be held in abeyance pending completion of these studies. Proposed modifications to the W70 LANCE should not be considered at this time pending an Army/DoE feasibility study to address the alternative of modernizing the LANCE or replacing it with a follow-on system. The Army is currently drafting a Mission Element Need Statement for a Corps Support Missile System. Modifications to the tactical B57 are not recommended at this time. The potential risk to the B57 will be reduced as tactical alert requirements are satisfied with B61 bombs. However, safety and security improvements to the B57 will be considered if continued deployment, particularly in an overseas environment beyond the 1980s, is necessary. A summary and rationale for those systems which are not recommended for modernization at this time are in Appendix B.

(SFRD) Current DoD policy pertaining to emergency destruct and emergency disablement is being reviewed. Meanwhile, we are continuing to evaluate emergency disable capabilities. It is requested that you continue in your effort to determine the cost and feasibility of providing disablement capabilities for theater weapon systems to include remote arming and activation. It is also requested that the DoE, jointly with DoD, determine the potential to integrate such a capability with the planned physical security equipment command, control, and communications network.

(S) To insure that this program is being pursued in an effective manner, the status of the modification effort should be jointly reviewed at least yearly, preferably prior to the annual budget submissions. This will provide the opportunity to make appropriate changes to requirements or to consider the impact on production or costs. Accordingly, the DoD recommends and supports the modernization program outlined in Appendix A subject to resolution of the differences in the W31 and B54 modifications and, when developed, a review of the costs and feasibility assessment associated with DoD changes to your modernization proposal for the W25, B43, and B53. Based on the DoD recommendations, your modification capability (rate/timing) is requested.

(U) I suggest our staffs recommended and arrange for the appropriate program reviews. My action officer for these matters is Major Jerry Davis, 695-1097.

Sincerely,

/s/James P. Wade, Jr.

James P. Wade, Jr.
Chairman

Enclosures 2

1. Appendix A - Modernization Program (SRD)
2. Appendix B - Summary of Systems Not Recommended for Modernization (SFRD)

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APPENDIX A

Modernization Program

Recommended Systems (Priority Ordered)	Modifications Desired	Modifications Required	Schedule	Comments
B28F1 (Strategic Bomb)	Field retrofit for enhanced electrical safety. Replace HVTB and high voltage arm/safe switch with low voltage transverter power supply and unique signal strong link switch. [Redacted]	[Redacted]	FY81 <i>DoE (b)(3)</i>	
W25 ¹ (GENIE)	Field retrofit for enhanced electrical safety. Replace HVTB with low voltage transverter, redesign arm/safe switch, improve ESD and lightning/EMR immunity features.	[Redacted]	FY81	Feasibility and cost of modifications required. Number and schedule dependent on feasibility and future requirements for new air defense system.
W31 ¹ (HONEST JOHN and NIKE HERCULES)	Field retrofit for enhanced electrical safety and improved command and control. Isolate HVTB inputs.	[Redacted]	FY81	Resolution of recommended electrical safety improvements required. Planned Army modifications to NH and MCCS should be considered.
B61-0, 2, 5 (Theater Nuclear Bomb)	Factory rebuild to include IHE, EES, CD, CAT D PAL, and unique signal strong link [Redacted]	[Redacted]	FY83	Schedule dependent on DoE factory capability.
B61-1 (Strategic Bomb)	Factory rebuild to include IHE, EES, CD, CAT D PAL, and unique signal strong link [Redacted]	[Redacted]	FY83 <i>DoE/DoD (b)(3) →</i>	Schedule dependent on DoE capability. Retrofit should not exceed [Redacted]
B54 ²	Field retrofit to provide a unique signal switch to interrupt ferro-electric transducer output.	[Redacted]	FY83	Resolution of recommended electrical safety improvements required. Alternate methods of providing enhanced command and control features should be investigated.
B43Y1 ¹	Field retrofit for enhanced electrical safety to include unique signal strong link switch [Redacted]	[Redacted]	FY83	feasibility and cost of modifications required.
B53 ¹	Field retrofit for enhanced electrical safety with transverter firing system and unique signal strong link switch [Redacted]	[Redacted]	FY83	Feasibility and cost of modifications required.
W53 ³	Field retrofit for enhanced electrical safety to include new ESD/power supply/trigger circuit package.	[Redacted]	FY81	Final decision to modify W53 is dependent upon Air Force to determine impact associated with incorporating unique signal capability.

¹Modification and schedule dependent upon cost and feasibility review.

²Resolution of recommended safety improvements required.

³Modification and schedule dependent upon Air Force review of incorporating unique signal capability.

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B28FI

PROGRAMMED QUANTITY
END OF

[Redacted]

MODERNIZATION QUANTITY

[Redacted]

← DoE/DoD (b)(3) →

MODERNIZATION

Field retrofit as recommended by DoE,

[Redacted]

DoE (b)(3)

REMARKS

[Redacted]

Based on current planning

projections the advisability of incorporating MCCS should be considered.

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W25

PROGRAMMED QUANTITY
END OF

[Redacted box]

← DoE/DoD (b)(3) →

MODERNIZATION QUANTITY

[Redacted box]

MODERNIZATION

Modify with low-voltage transverter, redesigned arm-safe switch, improved environmental sensing device and lightning/EMR immunity features.

REMARKS

Exposure of weapon system will continue to be limited to quarterly loading exercises. The feasibility of the above retrofit in lieu of denuclearization should be examined by DoE as to whether or not it can be accomplished and, if so, whether it requires a factory or field retrofit. If feasibility is agreed upon between DoD and DoE, the retrofit should begin in FY81 and planned over a ten-year period. If a new air defense aircraft with modernized air defense weapons is designated which negates the requirement for a nuclear air defense missile, the W25 retrofit should be terminated.

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W31 (HJ) (NH)

PROGRAMMED QUANTITY
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← DoE/DoD
(b)(3) →

MODERNIZATION QUANTITY

HONEST JOHN
NIKE HERCULES

--

MODERNIZATION

Field retrofit to isolate the high voltage thermal batteries.

REMARKS

Safety and a review of improved command and control modifications are required for both the NIKE HERCULES and HONEST JOHN systems.

The Army has approved Product Improvement Proposals (PIP) for the NIKE HERCULES system. These would isolate electrical inputs to the NIKE HERCULES adaption kit, and isolate electrical inputs to booster and sustainer motor ignition circuits for the NH.

A review is required to reconcile the different views held by the Army and DoE for modernizing the W31. This review should include consideration of incorporating MCCS with the Army recommendation, and the DoE recommended improvements without MCCS.

The review should include the safety and security benefits, possible operational restrictions, timing and a detailed cost analysis of all options.

Actual modifications should be scheduled to begin in FY 1981.

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B61-0, B61-2, B61-5

PROGRAMMED QUANTITY
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MODERNIZATION QUANTITY

B61-0
B61-2
B61-5

[Redacted box for programmed quantity]

[Redacted box for modernization quantity]

← DoE/DoD
16/33 →
↓

MODERNIZATION

Factory retrofit to B61-MOD X and B61-MOD Y weapons, as recommended by DoE, [Redacted]

REMARKS

Priority II is appropriate. The order of retrofit, by type, should be B61-2, B61-5, and B61-0. To insure a high degree of theater nuclear force readiness, this retrofit should be accomplished [Redacted] month throughout the duration of the modernization.

Modification should commence in FY83.

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B61-1

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[Redacted box]

MODERNIZATION QUANTITY

[Redacted box]

DoE/DoD
b(3)
← →
↓

MODERNIZATION

Factory retrofit to B61-MOD X weapons as recommended by DoE, but with the addition of hardware to make the modified warheads compatible with non-USG aircraft.

REMARKS

The entire stockpile should be modified and the modification should begin in FY83 (as DoE recommended) but at [Redacted] This is necessary so that the retrofit coincides with B-52D/G/H and FB-111 modifications planned to satisfy SAC Required Operational Capability (ROC) 6-76. An annual review of the status of the aircraft and bomb modifications must be conducted to insure proper phasing of the programs. Continuation of the bomb modification program must be contingent upon continued funding support for the aircraft modification program.

[Redacted box]

Modification should commence in FY83.

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B54 (SADM)

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END OF

[Redacted box]

MODERNIZATION

[Redacted box]

MODERNIZATION QUANTITY

[Redacted box]

← DoE/1000
5j(3) →

Incorporate a unique signal switch to interrupt ferro-electric transducer output.

Investigate feasibility of incorporating a remote command disable capability and improved command and control system.

REMARKS

As a result of DoD safety perception and intended deployments, upgraded electrical safety is desired. Evaluation of an internal emergency disablement system should continue within the EDS program.

The DoE proposal to use an MCCS to control access into a steel container containing the B54 would increase the weight and complexity of the system thereby reducing its military utility. Resolution of the recommended safety improvements and continued evaluation to improved command and control features are required.

Modification should commence not later than FY83.

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B43Y1

PROGRAMMED QUANTITY
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[Redacted]

Doi/DoD
(b)(3)

MODERNIZATION QUANTITY

[Redacted]

MODERNIZATION

Field retrofit for enhanced electrical system including unique signal prearming

[Redacted]

Doi/DoD
(b)(3)

REMARKS

Navy storage of the B43Y1 will be limited to igloos in U. S. and/or to shipboard below-deck magazines. Use of modernized strategic bombs in the tactical role as a replacement may prove feasible.

Doi/DoD
(b)(3)

[Redacted]

In consideration of the small quantity of weapons and their limited storage, cost and feasibility of the proposed modification is required.

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B53

PROGRAMMED QUANTITY
END OF

[Redacted box]

*DoD/DoS
2(3)*

MODERNIZATION QUANTITY

[Redacted box]

MODERNIZATION

Field retrofit to include changing chopper converter to a transverter firing system and strong link intent switch

REMARKS

Modifications dependent on cost and feasibility study. The advisability of incorporating MCCS should be considered.

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W53

PROGRAMMED QUANTITY
END OF

MODERNIZATION QUANTITY

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← DoE/DoD
b(3) →

MODERNIZATION

Field retrofit to include a unique signal (trajectory) ESD and associated strong link switch transverter power supply and firing trigger circuits as recommended by DoE.

REMARKS

Final determination on the modification and schedule dependent upon Air Force review of incorporating unique signal capability in the launch control facility.

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APPENDIX B

Summary of Systems not Recommended
for Modernization*

System	Reason
W70 MODs 1, 2, 3	Army feasibility study to consider the alternatives of modernizing the LANCE or replacing it with a follow-on system. Army MENS for a Corps Support Missile System is being drafted.
B57 TAC	Tactical alert requirement to be satisfied by B61s. System should continue to be reviewed.
B57 DB	Navy/DoE ASW Phase 1 Study.
W44 ASPOC	Navy/DoE ASW Phase 1 Study.
W55 SUBROC	Navy/DoE ASW Phase 1 Study.
W69 (SRAM)	Air Force Safety Feasibility Review and Air Force/DoE ASALM Phase 2 Study.
W33	Replacement.
W45 (MADM)	Retirement.
W45 TERRIER	Replacement, modification or retirement should continue to be reviewed.
W48	Replacement.
W50	Replacement.
W56, W58, W62, W68, W76, W78	Safety and security such that replacement, modification or retirement should continue to be reviewed.

*Modernization to enhance safety and security for these systems is not recommended at this time due to production/retirement projections and exposure levels. These systems should be reconsidered in conjunction with the periodic review of the ongoing program.

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G. C. Dacy
President

Sandia National Laboratories
Albuquerque, New Mexico 87185

Maj. Gen. William W. Hoover
U.S. Department of Energy
Office of Military Application
Washington, D.C. 20545 (M1382)

Subject: Stockpile Improvement Program (U)

In August 1978, reference 1 recommended nuclear-detonation safety and radioactive-material-scatter safety upgrades for selected stockpiled weapons with high exposure to possible abnormal environments and with potentially troublesome responses to those environments. In April, 1979, with DOD concurrence (Ref. 2), we initiated development activity on the B28FI aimed at providing field retrofit kits to enhance the nuclear-detonation safety of that weapon. Although delayed one year because of production funding problems, the design is now complete. In addition to enhanced nuclear-detonation safety, the refurbished B28FI will incorporate a Category D PAL, improved EMR/EMP resistance, and a "hot drop" feature which requires aircraft power at release. More recently, because of capacitor reliability concerns we and BKC have added a provision to screen returned firing sets at BKC. I understand that BKC expects first kit shipment to the Air Force in April 1983 on schedule.

Development start-up on the W31 was delayed at DOD's request pending the resolution of differences between the DOE proposal and the Army's recommendations (Ref. 2). A joint Army/DOE study was chartered to resolve these differences, and this group provided recommendations to the Army Staff in September 1979. The Army staff responded in October 1980. This apparent lack of interest by the Army coupled with other demands placed on our weapon development activities during the intervening 21 months prior to the receipt of reference 3 have caused us to commit fully our weapon development resources through FY 1982. Following receipt of reference 5, we initiated action to examine ways of reprogramming FY 1982 resources so that W31 development could begin early next fiscal year (FY 1982). This reallocation process has not been completed; consequently, we are unable, at this time, to commit the improved W31 design to a specific date. We expect to complete this reallocation activity within a few months and will provide our schedule assessment at that time.

The B61 improvement which was also agreed to by the DOD (Ref. 2) was started concurrent with the B28FI in April 1979.

Reference 6 provided BKC's assessment of their ability to support the production schedules. It concluded that B61 improvement schedules could be supported provided that needed engineering releases occurred in the approximate time frames identified in the production planning assessment. This assessment called for early engineering releases commencing in April 1981 and continuing through September 1981 for component parts such as semiconductors, castings, connectors, and forgings. Further, releases for subassemblies were required in August 1981 to continue through December 1981. Because of the added features noted above, design maturity and development status did not and do not support the issuance of all releases needed at this time. This factor coupled with heavy demands on Sandia weapon development resources for FY 1982 suggest that a prudent approach would be to slip the B61 Phase 6 FPU by approximately 9 months. We believe this action is necessary to allow for a more orderly and less risky B61 development and production program if the design is to retain the additional features.

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Although we endorse the inclusion of these additional features and believe this design should be pursued on modified timescales, another option still exists which we believe can support the existing schedule.

5/3/84

If support of the existing schedule is considered more important than provisions for these additional features, a decision must be made now while a design alternative still exists that supports the FY84 Phase 6. If we decide to accept a delay in B61-7 Phase 6, I suggest that you consider using that released production capacity to accelerate the build of the additional B61-4's now authorized.

We support and will continue to pursue the present baseline definition with all the features previously mentioned unless you notify us that current schedules must be protected.

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MO659 - ALO, R. G. Romatowski
MO737 - LANL, D. M. Kerr

References

1. SFRD letter with SRD enclosure from Herman E. Roser to Maj. Gen. Joseph K. Bratton, dated 8/15/78; Subject: Stockpile Modernization Study. (This study was transmitted to James P. Wade By General Bratton on 9/22/78 - copy not available at Sandia.)
2. SFRD letter from James P. Wade to Maj. Gen. Bratton, dated 3/20/79
3. SFRD letter from James P. Wade to Maj. Gen. Hoover, dated 6/2/81
4. SFRD letter from Maj. Gen. Hoover to James P. Wade, dated 7/24/81
5. SFRD letter from Maj. Gen. Hoover to Messrs. Clark, Sparks, Cook, Kerr and Batzel, dated 7/30/81, subject: Stockpile Improvement Program for the W31 Warhead (U)
6. Uncl. memo, J. A. Morrison, BKC, to J. R. Nicks, DOE-KCAO, dated 8/4/81, Subject: Preliminary Assessment of Capability for B61 Stockpile Improvement Schedule Support

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Maj. Gen. W. W. Hoover, MA

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November 15, 1985

Major General George K. Withers, Jr.
Director of Military Application
Department of Energy
Washington, D. C. 20545

Dear General Withers:

The Design Review and Acceptance Group (DRAAG) assessed the B61 Mod 7 bomb on 17 July 1985. The DRAAG concluded that the Military Characteristics (MCs) for the B61 Mod 7 has been met with two minor exceptions.

Additionally, the DRAAG concluded that the Stockpile-to-Target Sequence was not detailed enough in regard to radiation dose rate to evaluate MCs compliance adequately. The test environment used by the Department of Energy was determined to be acceptable.

The Final Development Report (FDR) should be published reflecting the changes agreed to at the DRAAG review, particularly those identified in the DRAAG minutes. The DRAAG was extremely laudatory concerning the quality of the FDR. The DoE Laboratories should be commended for their excellent effort.

The B61 Mod 7 is accepted as a standard stockpile item. A copy of the DRAAG minutes is provided for your information.

Sincerely,

RICHARD L. WAGNER, JR.
Chairman

Attachment
B61-7 DRAAG Minutes, 17 Jul 85 (SFRD)

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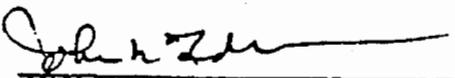
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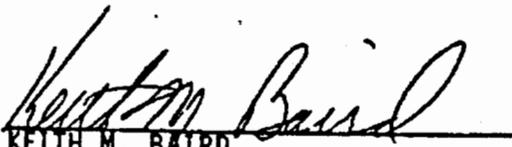
MINUTES OF FINAL
DESIGN REVIEW AND ACCEPTANCE GROUP (DRAAG)
MEETING ON THE
B61 MOD 7 BOMB DESIGN
17 JULY 1985



JOHN M. LEDERER
AIR FORCE WEAPONS LABORATORY
CHAIRMAN B61 MOD 7 DRAAG



JAMES M. MESNARD
AIR FORCE WEAPONS LABORATORY
AIR FORCE MEMBER



KEITH M. BAIRD
PROJECT MANAGER FOR NUCLEAR MUNITIONS
ALBUQUERQUE FIELD OFFICE
ARMY MEMBER



ROBERT T. BRANDT
SENIOR WEAPON SYSTEMS ENGINEER
NAVAL WEAPONS EVALUATION FACILITY
NAVY MEMBER

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B61-7 FINAL DRAAG

17 JULY 1985

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Don McCoy	Sandia 5111	(505) 844-6889
K. M. Timmerman	Sandia 5111	(505) 846-4390

B61-7 DRAAG AGENDA

July 17, 1985

- 1) Introduction/Opening Remarks All
 - II) Los Alamos Design Presentation Jim Conn
 - III) Sandia Design Presentation
 - a) Mechanical Don McCoy
 - b) Electrical Jim Harrison
 - IV) MC/STS Exceptions Don McCoy
 - V) Use-Control Discussions LANL/Sandia
- Restricted Attendance

*Breaks as necessary

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MINUTES OF FINAL
DESIGN REVIEW AND ACCEPTANCE GROUP (DRAAG)
MEETING ON THE
B61 MOD 7 BOMB
HELD AT SANDIA NATIONAL LABORATORIES ALBUQUERQUE
17 JULY 1985

1. (U) Pursuant to the provisions of DOD Instruction 5030.55, "Joint AEC-DOD Nuclear Weapons Development Procedures," 21 January 1974, and AF Regulation 80-9, "Nuclear Weapons Development Procedures," 17 May 1976, a final DRAAG meeting to review the design of the B61 Mod 7 Bomb was held at Sandia National Laboratories, Albuquerque, NM on 17 July 1985.

2. (U) Participants in the review were representatives of the Air Force Weapons Laboratory (representing the Air Force); Naval Weapons Evaluation Facility (representing the Navy); and the Project Manager for Nuclear Munitions, Albuquerque Field Office (representing the Army). Presentations at the meeting were made by Sandia National Laboratories, Albuquerque and Los Alamos National Laboratory. An attendance list and agenda are attached.

3. (U) The design review addressed the B61 Mod 7 design as presented in the Draft Final Development Report (FDR) for the B61 Mod 7 Bomb and the Use Control Addendum for the B61 Mod 7 Bomb, both dated Jun 1985, and compliance by the DOE with the design specifications contained in Ammendment 29, Section II of the B61 Military Characteristics (MCs), 19 November 1984, and the B61 Stockpile-to-Target Sequence (STS), Revision 6 15 April 1984. Fifteen comments from the services and corresponding responses from the DOE laboratories relative to the design were discussed.

A. (U) Items specific to the B61 Mod 7.

(U) The following aspects of the B61 Mod 7 deviate from specifications in the B61 Mod 7 MCs and STS

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[Redacted]

(2) (U) Safety: The probability of a premature nuclear detonation in the normal environments described in the STS shall not exceed: (MC para 2.5.1.3) "After release and prior to fuzing: 1×10^{-6} per occurrence." (Where "fuzing" is defined as receipt of a fire signal from the radar, timer, or contact crystal, as appropriate) The DOE assesses the probability as 1×10^{-6} during the period after release and prior to expiration of the safe separation time. The probability of premature nuclear detonation is estimated to be 2×10^{-6} during the period from safe separation time to fuzing.

(3) (U) STS Environments: The nuclear environments specified in Table 3.14 of the STS for Stage 6 (Release and Free flight) are not adequately defined for testing purposes. The sensitivity of the MC 3637 Programmer and MC 3638 ICU to gamma dose and dose rate has been explored in laboratory tests.

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B. (U) B61 Mod 7 Conclusions:

(U) The B61 Mod 7 design deviations noted in para A above are considered minor and should result in no important impact on SACs planned operational use of the B61 Mod 7.

C. (U) General Items:

(U) In response to the Service Comments on the Draft FDR for the B61 Mod 7, the DOE agreed to include the following items in the Final Development Report.

(1) (U) The operating characteristics of the MC 3640 Trajectory Sensing Signal Generator will be shown, including the no-operate and operate limits.

(2) (U) DOE will expand the description of the MC 3554 Neutron Generator to explain its noise immunity.

(3) (U) The discussion of the Lightning Arrestor Connector will be expanded to show how the MC 2969/2935 Strong Link Switches add to lightning protection. A SNLA report on (LAC/SLS) reliability will be referenced.

(4) (U) An expanded discussion and analyses of credible combined abnormal environments will be included.

(5) (U) The discussion of the T 1563 APC and T 1572 PDM will be combined and expanded.

(6) (U) The FDR will reference specific sections and/or pages relative to compliance with the MCs.

(8) (U) Functional Block Diagrams of the B61 Mod 7 Bomb will be included in the FDR.

4. (U) Recommendations:

A. (U) B61 Mod 7 DRAAG Specific Recommendations:

(1) (U) Exceptions from the design requirements mentioned above be accepted for the B61 Mod 7 Bomb.

(2) (U) Changes to the Draft FDR and FDR Addendum agreed at the DRAAG meeting and listed in C above be published in the final reports.

(3) (U) The B61 Mod 7 be accepted as a standard stockpile item.

B. (U) DRAAG General Recommendations:

(U) The DRAAG did not have approved Military Characteristics at hand, but only verbal assurances of what had been approved by the MLC. The DRAAG cannot function effectively without official written approved MC's and changes. It is recommended no DRAAGs be convened on specific nuclear weapons until approved MC's on those weapons have been made available to the DRAAG members. We also recommend the DRAAG chairman receive information copies of DRAAG related documents (MCs, DRAAG Minutes, Policy guidance, etc) which are forwarded to ATSD(AE) anQ DOE/MA by Service Staffs and ATSD(AE) respectively.

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March 27, 1986

Dr. Thomas B. Cook
Executive Vice President
Sandia National Laboratories
Albuquerque, New Mexico 87185

Dear Dr. Cook:

The purpose of this letter is to authorize the publication of the final weapon development report (FWDR) for the B61 Mod 7. I have been informed by Dr. Richard L. Wagner, Jr., Chairman, Military Liaison Committee, that the Department of Defense accepts the B61 Mod 7 as a standard stockpile item and approves the publishing of the FWDR. I concur with this recommendation.

I am aware of the tremendous effort it has taken all the people of the B61 Mod 7 project group to bring this program in on schedule and with a minimum of startup problems. Please convey my appreciation for a job well done.

Sincerely,

George K. Withers, Jr.
Major General, USA
Director of Military Application

Enclosure:
Ltr Wagner to Withers
dtd 11/15/85 w/att (S/FRD)

cc:
Mr. Raymond G. Romatowski, Manager
U.S. Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, New Mexico 87115

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