ANALYSIS OF THE SAFETY ASPECTS OF THE MK 39 MOD 2 BOMBS INVOLVED IN B-52G CRASH NEAR GREENSBORO, NORTH CAROLINA

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J. M. de Montmollin, 7118
W. R. Hoagland, 7162

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Approved by H. H. Patterson, 7110 D. R. Cotter, 7160 2/16

ABSTRACT

This report presents the results of the investigation and analysis of the safety aspects of the Mk 39 Mod 2 bombs involved in the B-52G crash near Greensboro, North Carolina. This investigation was conducted by Sandia Corporation subsequent to a preliminary investigation at the scene of the crash.

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Introduction

On January 24, 1961, a B-52G carrying two Mk 39 Mod 2 bombs broke up in mid-air and crashed near Seymour-Johnson AFB, North Carolina. During the mid-air breakup of the aircraft, the weapons separated from the aircraft. The parachutes of the weapon in the aft bomb bay (hereinafter called weapon No. 1) deployed, and in its retarded trajectory the weapon impacted approximately 1 mile short of the impact point of the major section of the aircraft. The parachutes of the weapon in the forward bomb bay (hereinafter called weapon No. 2) did not deploy, and the weapon impacted in the free-fall condition approximately 1500 feet past the impact point of the major portion of the aircraft fuselage.

An AEC team consisting of members from ALO, LASL, and Sandia Corporation went to the scene of the crash to assist in the preliminary investigation of the weapons involved in the crash. A report of the accident and the on-site investigation is contained in SCDR 106-61.* Subsequently, some components of weapon No. 2 were returned to Sandia Corporation for further analysis. Detailed post-mortem of these components, along with information from the preliminary investigation, has made possible a determination of the status of the weapons during the crash.

Summary of Results

Analysis of the components and reports from the crew of the aircraft indicate that none of the prearming functions required to release a live nuclear weapon had been performed prior to the time the weapon separated from the aircraft. However, some events normally requiring crew action must have occurred mechanically due to aircraft breakup. It is known that the safing pins were extracted from the Bisch generator actuation rods, and the rods themselves were extracted from the pullout assembly. On both weapons the fuzing sequences were initiated, but, due to the fact that the aircraft-controlled Arm/Safe switch was in the safe condition at time of release, neither weapon armed. This in itself would have prevented a nuclear explosion.

When the MC-772 Arm/Safe Switch of weapon No. 2 was recovered, there was an indication that the switch might have been armed. Post-mortem results indicated that the indicator drum had rotated to the ARM position, but that the switch contacts in all probability never actually closed in the ARM position. The rotation of the indicator drum was undoubtedly due to the impact shock; however, the impact shock also damaged the switch contacts to the extent that there was no continuity through the switch in either the ARM or SAFE position.

Weapon System Description

B-52G Aircraft

The B-52G has two bomb bays, each capable of carrying one Mk 39 weapon. The weapons are separately controlled through two T-249 Aircraft Monitor and Control units. The arming circuits to the weapons are interlocked by the T-380 Readiness Switch. The T-380, under the aircraft commander's control, must be placed in the ready position and the appropriate T-249 must be placed in the air or ground position in order to prearm either weapon. The aircraft is also equipped with lanyards from the bomb bays to the crew compartment to allow extraction of safing pins during flight.

*SCDR 106-61, Accident Report of B-52G Near Seymour Johnson Air Force Base, North Carolina, SRD, H. D. Bickelman, 7162-1, dated February 1961.

A modification program, ALT 187, was approved in January 1960. When incorporated, ALT 187 will make the lanyards for extracting the safing pins unnecessary in aircraft equipped with the T-380 Readiness Switch.

The aircraft system also incorporates a solenoid-operated lock which either allows the weapon to fall in free-fall trajectory or initiates parachute deployment at release. The static line from the parachute is attached to the solenoid lock, and, when the lock is operated, the parachute deploys at release.

Mk 39 Mod 2 Weapon

The Mk 39 Mod 2 is capable of either free-fall or completely retarded trajectories. It has a dual-channel, timer-armed and impact-fired, fuzing system. The firing signal at impact is derived from closure of a crush switch in the nose of the weapon. In addition, there is a trajectory-arming feature in this weapon which functions after separation from the aircraft; before arming is allowed, the weapon must undergo a pressure change corresponding to 1500 feet at sea level.

(b)(3) DOE

A detailed description of the pertinent components in this system follows:

MC-645 Bisch Generator Assembly --

(b)(3) ECI/ITAR

MC-640 Low-Voltage Thermal Battery Pack --

(b)(3) ECI/ITAR

MC-543 Timer --

(b)(3) ECI/ITAR

(b)(3) DOE

Figure 1. Single Channel Block Diagram of Mk 39 Mod 2

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Figure 2. Normal Trajectory Sequence of Mk 39 Mod 2

MC-832 Differential Pressure Switch --

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Pullout Valve Assembly --

(b)(3) ECI/ITAR

MC-772 Arm/Safe Switch --

(b)(3) ECI/ITAR

MC-788 High-Voltage Safing Switch --

(b)(3) ECI/ITAR

MC-641 High-Voltage Thermal-Battery Pack -- The MC-641 contains ten MC-583 or MC-818 thermal batteries. The batteries are connected in a series-parallel arrangement with five in each series leg. The complete assembly provides a total voltage of 2500 volts to charge the X-unit. Individual batteries are initiated when energy is delivered to their matches through an isolation transformer.

MC-787 Trigger Circuit -

(b)(3) ECI/ITAR

Crush Nose Switch --

(b)(3) ECI/ITAR

ALT 197 provides additional safing by introducing Arm/Safe switch contacts between the Bisch generator output and the low-voltage thermal battery matches. In this ALT, the MC-1288 Arm/Safe switch is installed in place of the MC-772. In addition to the contacts in lines presently controlled by the MC-772, MC-1288 contacts in the Bisch line insure that the thermal battery will not be operated if the weapon is released in the safe condition. A block diagram of the system with ALT 197 is shown in Figure 3. When this ALT is accomplished, it is considered that the system is adequately safe for alert flying without safing pins installed in the pullout rods.

ALT 193 is a modification to provide compatibility with the aircraft clip-in suspension system by adapting the Bisch and valve pullout connections to the clip-in supporting structure. The lanyard arrangement for removing safing pins in flight cannot be used with ALT 193. For this reason, ALT 197 must be performed at the same time or prior to completion of ALT 193.

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Figure 3. Block Diagram Mk 39 Mod 2 with ALT 197

Analysis of Weapon No. 1.

Observers reported that this weapon separated from the aircraft 7000-8000 feet above terrain. Fully retarded, it impacted in the near-vertical position, penetrated the earth approximately 18 inches, and remained in an upright position with the parachute hanging in adjacent trees. The weapon was intact with only minor damage, and it was possible to analyze the components at the scene.

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The probable trajectory sequence is shown in Figure 4.

From examination of the MC-845 Bisch generator assembly, it appears that the pullout rods were extracted in the normal fashion. There was no scoring or other physical damage to the assembly which would indicate that any unusual forces had been applied. Also, since the holes for the safing pins were not in any way damaged, it must be assumed that the safing pins were extracted prior to separation of the weapon from the rack. It is known that the aircraft broke up in mid-air and impacted the earth in several pieces, over a wide area. One intact safing pin and a portion of the lanyard were recovered, indicating that the pin must have been removed at the time the Bisch rods were pulled. It is believed that the lanyards attached to the safing pin in this weapon caused the safing pins to be extracted during the breakup of the aircraft.

This weapon appeared to have a completely normal retarded trajectory; therefore, it is assumed that the parachute solenoid locking device had been operated, securing the parachute static line to the aircraft structure.

From the information available on this weapon, it is apparent that all components behaved in the normal manner that would be expected if the bomb were released from the aircraft with the T-249 in the safe condition. Under these conditions, arming of the weapon is prevented by the MC-772 and the MC-788.

Analysis of Weapon No. 2

This weapon probably separated from the aircraft between 2000 and 5000 feet above terrain. It impacted in a free-fall trajectory. The tail of the weapon was buried approximately 12 feet below the surface. The structure of the weapon was severely damaged, and there was considerable breakup due to the impact conditions; however, no HE explosion resulted. Components of the fuzing system, which are located in the aft portion of the weapon just ahead of the parachute (see Figure 5), were recovered relatively intact; however, the extent of the damage did not readily allow complete evaluation at the scene. The gas reservoir was essentially undamaged. The actuator had not been initiated and the gas remained in the reservoir. The MC-772 Arm/Safe Switch appeared to be intact when recovered from the unit, and the indicator drum indicated that the switch was in the ARM position. It was therefore requested that this component, along with other components of the fuzing system, be returned to Sandia Corporation for further analysis. Post-mortem results of various components at Sandia indicated that the fuzing sequence had been initiated similarly to weapon No. 1.

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Figure 4. Probable Trajectory Sequence, Weapon No. 1

(b)(3) DOE

Figure 5. Cutaway of Mk 39 Mod 2

(b)(3) DOE

The probable trajectory sequence of this weapon is shown in Figure 6.

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From the evidence available, it must be concluded that the MC-772 was in the SAFE position until time of impact. It is quite probable that the contacts of this switch never operated to the ARM position. The circumstances of this weapon up until the time of impact are very much the same as those of weapon No. 1, except that there was insufficient time between separation of the weapon from the aircraft structure until impact for the timer to operate; consequently, the high-voltage battery was not initiated.

Detailed post-mortem results on various components recovered from this unit are available in separate reports. They are summarized here to provide completeness to this report.

MC-772 Arm/Safe Switch --

(b)(3) ECI/ITAR

MC-640 Low-Voltage Thermal Battery Pack -- The MC-473 batteries were removed from the battery pack. Scorching of materials around the batteries indicated that they had been activated.

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MC-543 Timer -- The case on the MC-543 was severely distorted. The cover plate had been deformed so as to jam the gears on both timer channels. Figure 10 shows a comparison of this timer with a normal reset timer.

(b)(3) ECI/ITAR

MC-641 High-Voltage Thermal Battery Pack -- Each of the ten MC-583 Thermal Batteries was removed from the battery pack and opened. It was found that none of these batteries had been activated at any time. The squib switches used to indicate whether the battery had received an initiation pulse were also examined and it was found that they had not been activated.

MC-845 Bisch Generator -- The Bisch generator rods were found to have been extracted. There was no evidence of any unusual scoring or other damage which would indicate that the rods were extracted in other than a normal fashion. The holes through which the safing pins are installed appeared normal, and it is believed that the safing pins were extracted before separation of the weapon from the rack.

MC-788 High-Voltage Safing Switch -- The switch was crushed and severely distorted.

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(b)(3) DOE

Figure 6. Probable Trajectory Sequence, Weapon No. 2

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Figure 7. MC-772 Recovered from Weapon No. 2

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Figure 8. Internal View of Undamaged MC-772

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Figure 8. Internal View of MC-772 Recovered from Weapon No. 2

(b)(3) ECI/ITAR

Figure 10. Comparison of Reset, Undamaged MC-543 Timer with Timer Recovered from Weapon No. 2

MC-832 Differential Pressure Switch and the Pullout Valve Assembly -- The pullout rods had been extracted from this valve assembly and the valves were closed. No conclusions can be drawn from examination of the MC-832; but, since it received normal inputs, it can be assumed that it operated normally.

As in the case of weapon No. 1, the fuzing sequence on this weapon appeared to have been initiated when the weapon separated from the aircraft structure.

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Since the system was not armed at any time during the trajectory sequence, no nuclear explosion could have resulted.

Conclusions

1. The lanyard-controlled safing pins cannot be relied upon to prevent initiation of the fuzing sequence when the aircraft is involved in this type of accident.

2. The Arm/Safe switch prevented a nuclear detonation in these weapons as it was designed to do.

3. Since it is undesirable to have the fuze power supply activated except when a live release is intended, ALT 197 should be incorporated as rapidly as possible in all Mods of the Mk 15/39 family which are used in the airborne alert.