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AEC ATOMIC WEAPON DATA
Sigma 3

HISTORY OF THE MK 41 WEAPON (U)

SC-M-67-673

Redacted Version

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Information Research Division, 3434

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Classified By: Richard B. Craner
Classification Analyst, Org 4225
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Timetable of Mk 41 Events

(b)(1), (b)(3)

11/56 Feasibility study report released.

(b)(1), (b)(3)

6/20/57 Proposed ordnance characteristics of TX-41 Bomb and XW-41 Warhead presented to and accepted by the Special Weapons Development Board.

7/31/57 Warhead application canceled.

(b)(1), (b)(3)

10/15/58 Revised proposed ordnance characteristics presented to and accepted by the Special Weapons Development Board.

9/59 Mk 41 Mod 0 design released.

(b)(1), (b)(3)

9/60 Early production of Mk 41 Mod 0 Bomb achieved.

(b)(1), (b)(3)

(b)(1), (b)(3)

This latter design would require from 1 to 2 more years of development time and would cost about three times that of the nonlaydown weapon.[5] Nomenclature of TX/XW-41 was subsequently assigned to the project.[6]

(b)(1), (b)(3)

Meanwhile, Sandia studied possible component arrangements. The firing system would be entirely contained within the weapon assembly. A nose fairing would house a contact fuze and provide an aerodynamic shape.[8] External initiators, power supplies, baroswitches, safing switches, and contact devices developed for other weapons would be used wherever possible.[9]

(b)(3)

A non-laydown version of the bomb and warhead was requested, with the Air Force being designated cognizant agent for the Department of Defense portion of the work.[10]

The military characteristics for a high-yield, 10,000-pound weapon were approved by the Military Liaison Committee February 19, 1957.

(b)(3), (b)(1)

The bomb would be internally carried by Navy AHP and Air Force B-47, B-52, B-66

The Radiation Laboratory would have responsibility for nuclear components, and Sandia would be responsible for nonnuclear components. Project responsibility would rest with Sandia-Livermore, with Sandia-Albuquerque furnishing assistance on such items as nose fairing, afterbody, fins and fuzing system.

The weapon would have a diameter of 50 inches, warhead length of 120 inches and weight of 9300 pounds, and bomb length of 145 inches and weight of 10,000 pounds. The high-voltage power supply would be removable, but otherwise the entire weapon would be sealed, and the fuzing and firing system tested as a go/no-go assembly. Warhead fuzing would be provided by the missile contractor.

(b)(1), (b)(3)

Sandia wrote to the Air Force Special Weapons Center April 17, 1957, suggesting that a joint working group be formed to consider problems relating to the XW-41/NAVAHO.[16] A similar letter, dated April 22, 1957, requested the support of the 4925th Test Group (Atomic) in the bomb drop-test program. This program would prove out the fuzing and firing system and determine ballistic performance, and the series would consist of 42 drops, half of which would be parachute-retarded. Drops would start in November 1957, proceed at the rate of two or three per month, and be completed in early 1959. Releases would be made from B-47 and B-52 aircraft, flying at speeds of Mach 0.75 to 0.9 and at altitudes between 20,000 and 55,000 feet. About half the tests would be made over water and half over land, with the facilities of both Salton Sea Test Base and Tonopah Test Range being used.[17]

The Radiation Laboratory notified the Division of Military Application April 29, 1957 that there was a serious question concerning compatibility of the XW-41 Warhead in the NAVAHO warhead compartment.

(b)(1), (b)(3)

(b)(1), (b)(3)

The missile could be redesigned to provide more clearance between bulkheads and warhead, and it was proposed that the NAVAHO be made a desired, rather than a mandatory, carrier of the XW-41.[18]

On May 9, 1957, the Air Force Special Weapons Center requested Sandia to design a system for automatic deployment of the TX-41 parachute. By referring this design to Sandia, it became possible to include the retardation system within the sealed portion of the bomb. This provided better control of the parachute storage environment and extended the parachute repack interval.[19] Sandia subsequently designed a drogue-gun which, when fired, initiated the parachute deployment sequence.

The Assistant Secretary of Defense notified the Atomic Energy Commission May 27, 1957, that the Air Force had canceled the compatibility requirements for the XW-41 Warhead in the B-58 Pod application.

(b)(3)

The joint working group for the NAVAHO had been activated, but rumors had circulated that the missile would be canceled.[21] The Air Force Special Weapons Center notified Sandia June 5, 1957 that informal information indicated the program would be continued on an expedited basis, but not on the high priority it had enjoyed up to this point. Warhead flight testing would be delayed until mid-1960, with an operational date a year later.

(b)(3)

The Air Force Special Weapons Center notified Sandia November 25, 1958 that the Strategic Air Command had decided to always release the TX-41 from the B-47 and B-52 aircraft in the retarded condition. Thus, there was no requirement for an option-selector switch, and the bomb could be designed so that the parachute would always deploy upon bomb release.[48]

Sandia wrote to Field Command December 8, 1958, discussing the need for additional safing devices on the TX-41 Bomb. Sandia pointed out that the Air Force Nuclear Weapon Safety Group had reported that the TX-41 was completely acceptable from the standpoints of accidental or premature detonation, provided that the bomb was not released in an armed condition. However, during airborne alert missions, the human element was predominant, and safety during these periods would be controlled by the probability of an arming signal being inadvertently furnished.

Sandia noted that any improvement in overall safety would have to reduce the foregoing possibility. All the systems studied had involved the installation of additional arming control switches in the aircraft at a crew station remote from the aircraft monitor and control station. Another possibility would be to install an additional switch at the aircraft monitor station, such that both switches were in series for weapon arming and in parallel for weapon safing. The first design would cause a slippage in time scales or require weapon retrofit, increase weapon complexity, and introduce logistics and compatibility problems, and Sandia recommended the second system.[49]

Field Command notified Sandia January 9, 1959 that the Air Force Special Weapons Center had again changed the requirements, and now desired selective free fall or retarded capability of the TX-41 Bomb. Reinstatement of the option-selector switch was requested.[50]

Meanwhile, Sandia had made a study of the TX-41 weapon features that would impede or deny access to bomb arming circuits, and proposed certain changes to Field Command.[51] These modifications were accepted February 9, 1959, and included deletion of the need for removal of the battery.[52] This change decreased weapon handling and increased the resistance of the bomb to actions of saboteurs and psychotics. It was noted that the firing set was inert and would only respond

to external signals furnished in a definite order. Additionally, between low-voltage battery and firing set, there were three separate safing devices that had to be armed in order for power to reach the firing set.[53]

The Mk 41 Bomb was released for pilot production in April 1959.[54] Subsequently, full design release was authorized in September 1959, with the publication of Report SC4813(TR), Description and Status at Design Release of the TX-41 Bomb.[55] This report noted that the bomb was 50 inches in diameter, 148 inches long, and weighed 10,500 pounds. (b)(1), (b)(3)

The report was presented to the October 21, 1959 meeting of the Special Weapons Development Board and accepted.[56]

The Division of Military Application had requested that a formal study be made of the compatibility of the bomb with B-70 aircraft.[57] The Radiation Laboratory, now renamed the Lawrence Radiation Laboratory, reported in a teletype of October 16, 1959 that the B-70 would subject the Mk 41 to a severe heat environment that would damage the nuclear components. There appeared to be two possibilities; to design a bomb capable of withstanding the temperature, or provide bomb cooling or insulation. The first approach would require a close study before it could be determined whether a new nuclear test would be required. The second approach appeared immediately feasible, but the modification would have to be made by the Air Force and the aircraft contractor.[58]

Meanwhile, much work had been done on the development of the aerodynamic shape of the Mk 41. Initially, three different shapes were tested in the wind tunnel; one similar to the Mk 21, another the same as the Mk 27, and a finless shape. A large nose flat on each model provided adequate space for mounting the contact-fuze crystals. The first wind-tunnel tests showed that a nose flat greater than 0.577 of the body diameter would produce dynamic instability.

The finless shape was found to be unstable. A decision was then made to use the Mk 21 shape, since it provided more room for fuzing-and-firing components, and stability was increased by adding a spoiler band. The Air Force reported that a

The fuzing and firing system used baro arming and fuzing in the air-burst option, and baro arming and impact-crystal operation in the ground-burst option. The impact crystals provided backup for the air-burst mode. Before takeoff, the baroswitch was set to the desired air-burst altitude and the safing switch turned to STRIKE. Inflight selection of either air burst or ground burst caused the fuzing-system control selector to unlock arming rods and open or close a 28-volt line to the fuzing elements.

When the bomb was released from the carrying aircraft the low-voltage thermal battery was connected to the weapon circuits, pullout generators activated low-voltage thermal batteries and started a timer, and two holes in the bomb afterbody were uncovered for pressure sensing. Timer contacts closed 9 seconds after release of the bomb, and deployed the parachute.

(b)(1), (b)(3)

Closure of arming contacts in the baroswitch provided an input to the rotary chopper. The output of this chopper charged the X-unit and armed a trigger circuit and external initiators. The bomb detonated on closure of fuzing elements in the baroswitch if air burst had been chosen. If ground burst had been selected, the bomb detonated when a firing signal was produced by the impact fuze.[64,65]

Field Command notified Sandia January 9, 1961 that Report SC4822(TR), Final Evaluation Report of the Mk 41 Bomb, had been reviewed in coordination with representatives of the interested Services. This review established that the design met all the requirements of the military characteristics, with some minor exceptions.

(b)(1), (b)(3)

The desired weight of 10,000 pounds had been exceeded by 500 pounds, but this was also acceptable in view of Department of Defense desires for the maximum possible yield. It had not been determined whether the bomb would be compatible with Weapon Systems 110A and 125A, since these aircraft were not yet available. Slight deviations in fuzing accuracy were acceptable, in view of the barometric system and the inherent errors of climatology. Thus, the design was declared acceptable to the Department of Defense.[66]

Glossary of Mk 41 Terms

Air Force Nuclear Weapons System Safety Group -- Formed by action of the Air Force Special Weapons Center January 6, 1958, to perform safety studies of carrier-store combinations and to report the results of such studies to the appropriate development agencies.

Air Force Special Weapons Center -- That element of the Air Force Systems Command having to do with compatibility testing of nuclear devices with aircraft. Located at Kirtland Air Force Base, Albuquerque, New Mexico

Albuquerque Operations Office -- The local office of the Atomic Energy Commission (AEC) concerned with the operations of Sandia Corporation.

Armed Forces Special Weapons Project -- An interdepartmental agency formed to handle military functions related to atomic weapons.

Assistant Secretary of Defense -- Created by Department of Defense directive, June 30, 1953, as part of DOD reorganization. Handles research and development activities of the DOD.

Barometric Switch (Baroswitch) -- A switch actuated by air pressure.

Boosting -- The technique of increasing the yield of a nuclear device by introducing deuterium-tritium gas into the implosion process to increase fission activity.

(b)(1), (b)(3)

Defense Atomic Support Agency -- An interdepartmental agency formed to handle military functions related to atomic weapons. Originally called the Armed Forces Special Weapons Project.

Department of Defense -- The Armed Forces, i.e., the Army, Navy and Air Force.

Division of Military Application -- An AEC office that functions as liaison between the Military and weapons designers and producers.

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(b)(3)

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