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Mk 7/ALIAS BETTY

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|---|---|
| 4/16/51 | Joints Chiefs of Staff request adaption of atomic warhead for underwater detonation. |
| 10/9/51 | Naval Ordnance Laboratory reports feasibility of project. |
| 2/6/52 | Military Liaison Committee reports that Joint Chiefs of Staff have established a requirement for development of an atomic bomb capable of inflicting lethal damage to submerged high-speed submarines. |
| 4/14/52 | Division of Military Application approves division of responsibilities for project. |
| 6/11/52 | Ad Hoc Committee meets and selects XW-7 Warhead. |
| 11/12/52 | Military Liaison Committee approves military characteristics for project. |
| 2/54 | Production authorization issued. |
| 7/29/54 | Mk 7/ALIAS BETTY Warhead installation design released. |
| 6/55 | Mk 7/ALIAS BETTY achieves production. |

Mk 7/BOAR

| | |
|---|---|
| 2/1/51 | Military Liaison Committee states that Bureau of Ordnance will develop an air-launched free-flight rocket capable of carrying an atomic weapon. |
| 6/6/52 | Initial meeting of project Steering Committee. Decision made to start active development, using either Mk 7 or Mk 12 Warheads. |
| 7/22/52 | Ad Hoc Committee meets and favors Mk 7 Warhead. |
| 10/21/52 | Military Liaison Committee establishes military requirements. |
| 11/54 | Mk 7/BOAR Warhead installation design released. |
| 10/24/56 | Final Development Report issued. No production authorized. |

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

Figure 1. The Warhead

The Mk 7 Mod 0 Warhead was released for production May 1952, and first appeared in stockpile August 1954, as a result of site conversion of bombs to warheads.

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

contact bursts were produced by a barium-titanate fuze.

The design was suitable for use with the CORPORAL missile, and also with the HONEST JOHN, which had been added to the list. Its use with certain missiles involved increased g-loadings produced by high accelerations, and it was felt necessary to provide a dual-motor nuclear insertion mechanism. The bomb had a flange, which was removed when the bomb was converted to a warhead. A new forward shape was proposed that would be applicable to the BOAR project and the Mk 7 Bomb, together with a new fuze that reduced the number of radars and incorporated a new barometric-switch design.

All the above modifications were included in a single program which, however, was disapproved by the Special Weapons Development Board.[9] A universal design was subsequently incorporated in the Mk 7 Mod 1 Warhead which was design-released November 1953, and which appeared in stockpile March 1955 as a result of site conversion of bombs to warheads. This design provided a warhead that was fully interchangeable between bombs and missiles.[10] A Mk 7 Mod 2 Warhead with dual-motor insertion mechanism was design-released July 1955, and achieved production October 1956 for use in the NIKE-B and BOAR weapons. This warhead could not be converted to bomb use. The Mk 7 Mod 3 warhead was provided with a permissive arming link, was design-released July 1963, and achieved production in August.

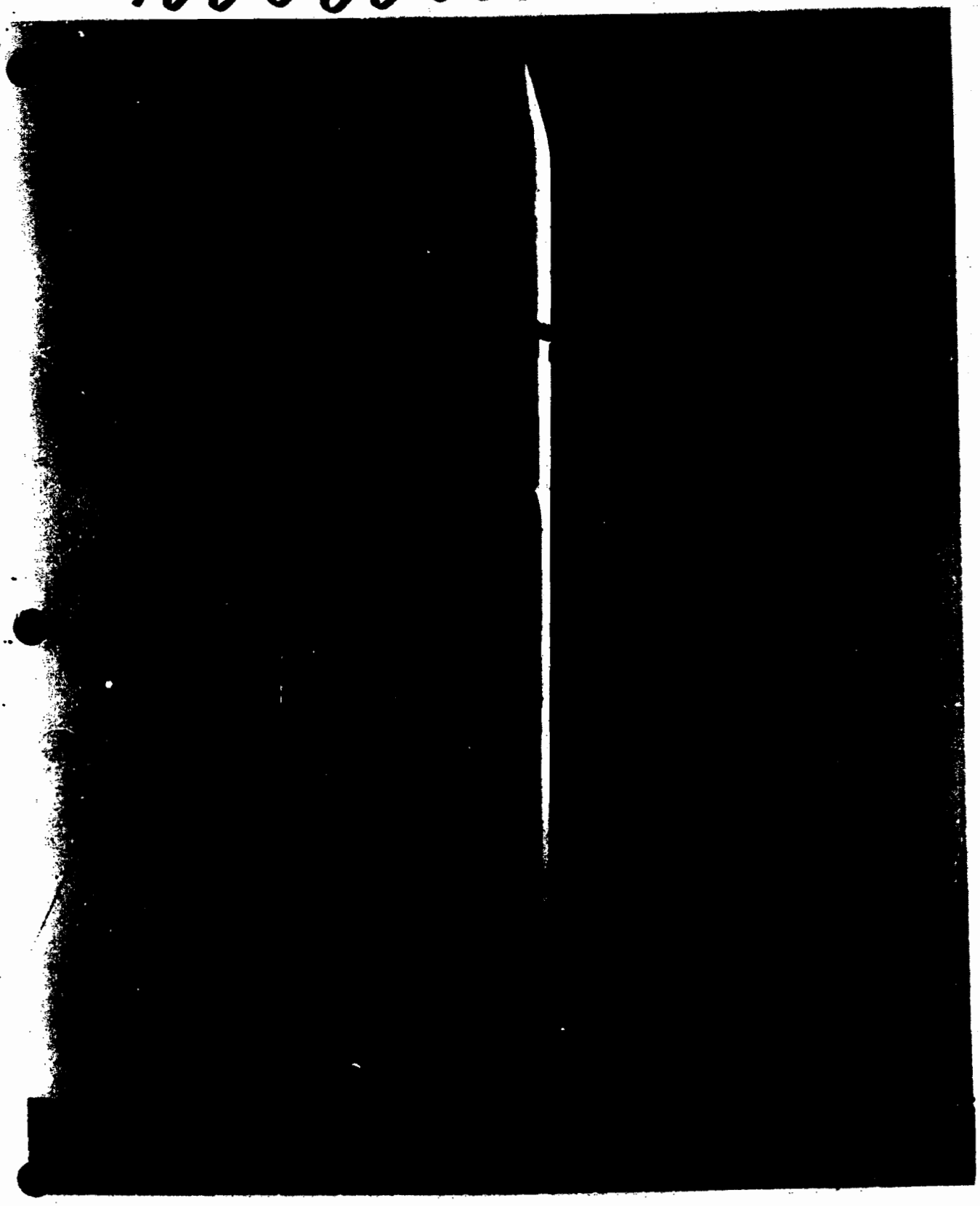

Figure 2. CORPORAL Missile

command-arm ability would be lost. However, a supplemental radar could be used to track the missile and, in conjunction with a computer, determine whether or not the expected impact point would fall within enemy territory. Arming could then be accomplished over a Doppler channel.[11]

It was hoped that the warhead system could be made ready for flight tests in April 1952, and the Group recommended that Sandia develop an interim fuzing system using components from the Mk 5 and Mk 7 Bomb programs.[12] This proposal was accepted by the Sandia Weapons Development Board June 27, 1951, although a request was made that both Sandia and the Ordnance Corps continue parallel design of an optimum fuze for a ballistic missile. Responsibility for developing an interim arming system would be divided between the Ordnance Corps and Sandia--the Ordnance Corps to be responsible for determination of the data upon which the decision to arm or not to arm would be based, the transmission of this arming signal from the ground, and the reception of this signal in the missile; and Sandia to be responsible for applying this arming signal to the warhead to cause arming.[13]

The layout of the CORPORAL warhead compartment made it advisable to support the warhead from a single flange of the high-explosive sphere assembly, and this configuration required new fuzing and firing component support structures. Special access had to be provided, as well as protection to electrical circuits on account of the high altitude reached by the missile, and the resultant possibility of arc-over. The nuclear insertion mechanism could not be operated by a weaponeer before release, as in the case of weapons dropped from airplanes, and a circuit to accept a command signal in flight had to be devised. Pullout wires were no longer feasible, and barometric devices for arming and fuzing required lockout circuits on the ascending portion of the trajectory to prevent operation until the descent toward the target.

The use of barometric fuzing was proposed and, at first, was considered feasible. The terminal dive of the missile reached a speed well over

launch) and arranged the X-arm relay circuit so that subsequent closure of this baroswitch on descent would start an inverter and charge the X-unit.

The arming or nuclear insertion signal was transmitted to the missile by the ground command station, together with the range correction signal previously mentioned. (b)(3) /At a short time interval later, depending on the desired burst height, the radars ranged and fired the X-unit. The contact fuze acted as backup to the air-burst fuze.

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

/However, the Albert was delayed in design and two Abees were used in the Mk 7 Mod 0/ CORPORAL installation.

A fast-firing system, which was required to assure proper operation of the contact fuze, included a probe-triggered spark gap, replacing a relatively slow-acting mechanical switch. In this system, a potential of 2000 volts was applied to the plates of two thyratron tubes. The detonation signal from the radars discharged one of these tubes, activating a pulse transformer and ionizing the spark gap. The gap was thus made conducting and discharged the X-unit output to the detonators of the high-explosive sphere. The contact fuze operated in a similar manner, by applying output voltage of piezoelectric crystals to a thyratron tube.

The two radars were initially arranged to fire in series; this required that both radars produce ranging signals. If no fire signal was supplied at the proper altitude, the fuzing baroswitch connected the radars in parallel at an altitude about 1000 feet below the radar setting, so that ranging of either radar then fired the weapon.

The acceleration switch consisted of a spring-loaded piston in a cylinder. An acceleration of 1/2 g or greater caused the piston to move, forcing air

through a calibrated orifice which controlled the maximum speed of travel of the piston. At the end of its travel, the piston closed an electrical switch. The requisite acceleration would have to exist for a certain period of time before this switch could close and latch in the closed position.

With the exception of the nuclear insertion mechanism, all parts of the electrical system were provided in duplicate, with the relays of half the system being cross-connected with the relays of the other half. Safing plugs were used to safe or arm the circuits. These plugs were colored green or red and were provided with streamers of the same color for better visibility.

A proposal had been made that the Ad Hoc Working Groups be reconstituted as Joint AEC-DOD Committees.[19] This was accepted and, September 15, 1953, the CORPORAL Group met, dissolved, and reconstituted itself as the Mk 7/ CORPORAL Warhead Installation Joint Committee.

Sandia proposed use of a barometric fuze, plus other changes, in the November 18, 1953, meeting of the above Committee.[20] A baro-sensing probe was subsequently evaluated and found to have an estimated error of from 350 to 500 feet in burst height. This was felt to be excessive, and the project was disapproved.[21]

Meanwhile, it had been decided to transfer custody of all adaption kits to the Ordnance Corps July 1, 1954.[22] The transfer was subsequently delayed, but finally was effected January 1, 1955.

A meeting of the Joint Committee was held January 13, 1955. The Ordnance Corps proposed some changes to the adaption kit, including a dual-channel nuclear insertion mechanism, additional missile access doors, and some circuit improvements. Sandia submitted a proposed Scope of Work to cover this design effort, which was approved by the Atomic Energy Commission and Picatinny Arsenal.[23]

There was still a question as to the warhead's ability to operate when subjected to the spin that stabilized the rocket in flight. It was felt necessary to overtest the warhead by firing it in BIG STOOP rockets, which essentially were HONEST JOHN's 50 feet long, fitted with twin rocket motors.[30] However, efforts to obtain these BIG STOOP vehicles were unfruitful, and eventually Sandia fabricated its own overtest rockets by attaching a cluster of smaller DEACON rockets to an HONEST JOHN, thus creating what was called a FATHER JOHN WITH CHILDREN test vehicle.[31,32] By this means, a 25-percent overtest was produced, which was absorbed without damage by the XW-7 Warhead.

The Division of Military Application issued an interim authorization September 7, 1951, for development of a Mk 7 Warhead for free rocket application, which was followed by full development authorization after the spin tests were completed.[33] Rocket marriage programs were to be conducted under the same auspices as those for guided missiles, with the Sandia Weapons Development Board functioning as coordinating agency. The Joint Chiefs of Staff authorized a production program for the XW-7/ HONEST JOHN February 1, 1952.[34]

Two events required close control. One was the time (and place in the trajectory) at which nuclear insertion took place, and the other was the point at which detonation occurred. The signal for the first event could be controlled by measuring the acceleration of the missile, with both fluid integrators and timer escapement mechanisms being considered. Radar could not be used to determine the detonation point, as the missile had a low trajectory at short range, and a timer afforded the only practical solution.

A contact fuze was developed to provide backup in the event of timer malfunction. The operation of this fuze was investigated by mounting an HONEST JOHN nose, equipped with contact-fuze network, on an expendable sled. This sled was then rocket-propelled to a velocity of 860 miles per hour and impacted against both frangible and solid targets. These tests

Meanwhile, interest had developed in a closer-firing HONEST JOHN, with a range of about 3 miles.[43] The Ordnance Corps was assigned responsibility for the development of an adaption kit for this application, which was called the DEMI-JOHN.[44]

In August 1954, Sandia proposed a 4-month delay in the XW-7/HONEST JOHN-X1 program, to allow design changes to be made to the integrating accelerometer so that it could be used with the DEMI-JOHN.[45,46] This delay was approved by the Ordnance Corps, as it would provide a more complete capability at an earlier date than would separate programs. A scope of work was authorized December 20, 1954, providing a single adaption kit for both the X1 and the DEMI-JOHN programs.[47]

Flight tests using spoiler plates at the tail of the missile, to increase drag and decrease the range, produced vibrations that damaged many of the HONEST JOHN components.[48] Dive brakes were tested but these also adversely affected component operation, and the DEMI-JOHN program was eventually canceled September 1955.[49]

A decision had been made to transfer all responsibility for the HONEST JOHN program to the Army.[50] This became effective January 1, 1955, but Sandia continued design work under the scope of work for the X1 improvements. This revised design was to be design-released September 30, 1955, but word was received from the Army September 27, 1955, to cancel all work in progress on the warhead adaption kit. The program was later merged with the XW-31 Warhead.[51]

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

Figure 5. BOAR Missile

its space coordinates to a ground computer, a tracking radar to skin-track the target, a radar to track the NIKE from launch to intercept, and a ground computer that acted as nerve center for the system. This computer furnished a continuous steering-to-intercept course for the NIKE, determined the nearest point of interception, and transmitted a firing command to the warhead.[76]

An XW-7/NIKE B Joint Project Group was formed and held its first meeting September 17, 1953. Subcommittees were named to handle specific phases of the program, such as arming and fuzing, test and handling equipment, and flight-test scheduling. The NIKE B would be operational in a record time of about 36 months, since guidance and control designs were already well under way for the nonnuclear missile versions.

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

Lower altitude targets would be intercepted on the downward leg.

The universal Mk 7 Warhead would be used, together with arming and fuzing components being produced for the CORPORAL and HONEST JOHN programs. The high acceleration of the missile would probably require a dual-motor nuclear insertion mechanism, and this would improve the weapon reliability. Missile propulsion tests would start in October 1954 and guidance tests early in 1955. The flight-test program would require about 40 missiles and be completed by mid-1956. A proposal was made that a contact fuze be provided, to operate upon contact of the missile with enemy aircraft, but it was felt that such device would complicate the fail-safe system designed to detonate the missile should radar tracking be lost. The warhead installation was to be in production by January 1957, about 3 months ahead of the missile production date.[77] A scope of work covering Sandia's assistance to the Ordnance Corps in the project was approved April 17, 1954.[78]

A self-aligning probe (zero angle of attack) was designed and tested in a wind tunnel at speeds of Mach 0.5 to 3.5. These tests showed that flow phenomena affected sensing accuracy, and that the error was dependent on

Glossary of Mk 7 Warhead Terms

Accelerometer, Integrating -- A device for measuring acceleration, capable of summing up the total acceleration in any given direction.

Adaption Kit -- Those items peculiar to the warhead installation of a weapon less the warhead; namely, the arming and fuzing systems, power supply, and all hardware, adapters, and the like, required by a particular installation. Adaption-kit components are normally grouped into: A complement, radars (if required), and power supply (if required).

Arming -- The act of arming a weapon, that is, preparing it for firing.

Barium-Titanate Fuze -- An assembly which, when squeezed or struck, produces a pulse of electricity.

Baro -- A pressure-sensitive device used in weapons to actuate circuits. Stands for "barometric switch," sometimes referred to by the contraction "baroswitch."

Bazooka Rocket -- An electrically fired rocket, launched from a tube open at both ends.

Bureau of Ordnance -- That part of the Navy Department having to do with design and procurement of ordnance.

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

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(b)(3)

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(b)(3)

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76. TSRD Ltr, RS LXI-2230, Division of Military Application to Santa Fe Operations Office, dtd 4/17/53, subject, Military Requirement for the Development of a Surface-Launched Guided Missile with an Atomic Warhead, Air Defense Weapon System. SC Files.

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81. SRD TWX, Department of the Army to Picatinny Arsenal, dtd 12/2/55. AEC Files, MRA-5, Warhead, 7/55-4/56.

82. SRD Minutes, RS 3466/82347, Special Weapons Development Board to Distribution, dtd 12/12/56, Minutes of 104th Meeting, Part I. SC Archives, Transfer No. 48217.

83. SRD Ltr, Military Liaison Committee to U. S. Atomic Energy Commission, dtd 5/6/57, subject, Status of the XW-7/NIKE HERCULES Warhead Installation at Design Release. AEC Files, MRA-5, NIKE, 7/56.

84. SRD Report, Joint Committee on NIKE Warhead Installations to Distribution, dtd 6/15/54, subject, Progress Report of XW-7 and XW-31 NIKE Warhead Installations. SC Central Technical Files, XW-7/NIKE HERCULES.

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86. SRD Ltr, Santa Fe Operations Office to Sandia Corporation, dtd 2/16/53, subject, Military Characteristics, Atomic Demolition Munition, Project B. SC Central Technical Files, XW-7, 1950-3.

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