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HISTORY OF THE MK 42 WARHEAD (U)

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Weapon Systems

Redacted Version

Information Research Division, 3434

Sandia Systematic Declassification Review
RETAIN CLASSIFICATION
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10/21/59	Proposed ordnance characteristics of the XW-42 Warhead presented to and accepted by the Special Weapons Development Board.
1/6/60	Director of Defense Research and Engineering requests Atomic Energy Commission to study the feasibility of providing an atomic warhead for the Navy's EAGLE missile.
10/60	Mk 42 Mod 0 Warhead design released.
12/20/60	Division of Military Application cancels Army requirement for XW-42/HAWK application.
12/27/60	Director of Defense Research and Engineering requests Atomic Energy Commission to provide warhead, preferably the Mk 42, for the EAGLE missile.
2/7/61	Military Liaison Committee approves military characteristics for a nuclear warhead for the EAGLE missile.
6/22/61	Military Liaison Committee informs Atomic Energy Commission that the Navy has canceled requirements for the EAGLE warhead.

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

The feasibility study report of atomic warheads for the guided air-to-air rocket was forwarded to the Division of Military Application August 17, 1956. Sandia felt that the report was not too conclusive, in that criteria for warhead kill and safe escape had not been adequately considered. Sandia also noted that safety restrictions on operational use were questionable.

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

The Assistant Secretary of Defense wrote to the Atomic Energy Commission September 19, 1956, noting that the Army was developing the HAWK guided missile for low-altitude attack, with quantity production scheduled by mid-1959. Preliminary studies indicated the desirability of a nuclear warhead for certain operational conditions. The Atomic Energy Commission was requested to join with the Army and the Armed Forces Special Weapons Project in a joint feasibility study of suitable warheads.[8]

An amendment to the joint feasibility study report was released November 9, 1956, with Sandia agreeing to the amended report. Two additional objectives had been studied: The feasibility of using nonplutonium-bearing warheads, and resolution of certain system studies defining desirable warhead characteristics (such as size, weight, and yield) and their effects on operational use of the weapon. Sandia noted that plutonium contamination was a problem, but could be controlled. The use of uranium-235 warheads would reduce the contamination problem, but this design would be costly.[9]

Picatinny Arsenal wrote to Sandia December 31, 1956, commenting on the feasibility study of an atomic warhead for the HAWK. The report had noted that

there were no fractional-kiloton warheads being designed or considered for development with availability dates as early as 1961, which would be compatible with an unmodified HAWK missile. This was due to the small size of the warhead compartment, which was about 13 inches long.

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

Since major modifications of the missile were required, it was felt that the implications of increased compartment length versus smaller warhead sizes should be studied further.[10]

The HAWK missile was designed for low-altitude defense and would be used in conjunction with the NIKE missile family. The HAWK weighed 1,250 pounds, and could operate from sea level up to 45,000 feet against single targets and to 30,000 feet against formation targets. It was capable of intercepting targets at ranges of 13 to 19 nautical miles with closing rates of 1,000 to 600 miles per hour.

Picatinny noted that the preliminary requirements included weapon kill as primary capability and carrier kill if weapon kill could not be achieved.

(b)(3)

Operation down to a 1000-foot altitude was desired, although 2500- to 5000-foot altitudes would be acceptable. Picatinny would proceed with a study of yield requirements and investigate the possibility of modifying the HAWK warhead compartment to accept nuclear warheads of the 10- to 12-inch-diameter class.[11]

On January 30, 1957, a member of Picatinny Arsenal met with representatives of Field Command, Radiation Laboratory, and Sandia.

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

and improve the missile performance.[17] A designation of XW-42 was assigned, as suggested by the Livermore Projects Committee.

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

Major modifications would have to be made to the HAWK missile to make it compatible with the warhead.

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

The Air Force Special Weapons Center wrote to Sandia December 12, 1957, noting that recent Air Force interest in guided air-to-air missile applications had brought the GAR-X nuclear warhead program to the fore.

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

Studies had indicated that, in a triple-sequence mission, high temperatures might be developed in the missile bay of the carrying aircraft, with a range from 350°F to 370°F being experienced for about a 4-hour period. Since the allowable weapon temperature was 165°F, it was requested that Sandia provide some form of thermal protection.[19]

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

(b)(3) It was requested that the Atomic Energy Commission proceed with development and it was suggested that the warhead selected be one of those in process of design for weapons of comparable size. The Department of the Army was designated the cognizant agency for the Department of Defense portion of the development program.[21]

The Assistant Secretary of Defense wrote to the Atomic Energy Commission January 13, 1958, referring to the letter of May 14, 1957, requesting development of a warhead for the SPARROW-X missile. The Navy had canceled this missile, and requirement for compatibility of a nuclear warhead with this missile was also canceled.[22]

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

The Assistant Secretary of Defense wrote to the Atomic Energy Commission April 4, 1958, noting that the Joint Chiefs of Staff had established a military requirement for and requested the Air Force to proceed with the development of the GAR-9 guided air-to-air rocket system capable of delivering a low-yield, small-diameter atomic warhead. Nuclear economy of any proposed design was important, since it was anticipated that a considerable number of warheads would be required.

The weapon system would be designed around the nuclear warhead and thus missile size and configuration could not be determined until the warhead physical characteristics were decided.

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

Completion of the study by June 15, 1958 was requested.[23]

A meeting of the study group for the XW-42/GAR-9 was held May 27, 1958. The warhead would be part of the WS-202A weapon system, which was composed of the F-108 aircraft and the GAR-9 missile. Entire responsibility for the weapon system, except for aircraft engines and warhead, had been contracted to North American Aviation. The system would be operational by mid-1963 and one Wing would be in active use by October 1963, although it was hoped to advance both these dated by 6 to 8 months. This system would provide long-range interceptor capability against enemy weapon carriers for protection of the continental United States and selected bases.

The F-108 was a two-place, all-weather, delta-wing interceptor with maximum range of 1,000 nautical miles, operational altitude of 70,000 feet, and speed of Mach 3. It could carry three GAR-9 missiles. The aircraft was 86.5 feet long, with wingspan of 53 feet, and tail height of 22 feet. The gross weight was about 99,000 pounds, of which about 47,500 was fuel, and the craft was powered by two J-93 General Electric engines.

The GAR-9 missiles, as designed by Hughes Aircraft and North American Aviation, would have a diameter of 15.5 inches, length of 150.5 inches, and wingspan of 33 inches. They would weigh 720 pounds at launch and 521 pounds at burnout. After launch at Mach 3 and at an altitude of 70,000 feet, the missile would attain a maximum speed of Mach 5.5 and be able to reach targets within ranges of 30 to 40 nautical miles and altitudes up to 100,000 feet. Missiles equipped with nuclear warheads would have a carrier-kill ceiling of 100,000 feet, weapon-kill ceiling of 85,000 feet, and the ability to attack targets down to sea level.

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

The figure for the diameter had been arrived at by deciding that space for insulation or cooling would have to be provided around the warhead and inside the missile. The length had been

determined by the requirement that the missile be able to carry either a nuclear or a high-explosive warhead. The lower weight was of importance, to allow the warhead to attain the higher attack altitudes.

Temperatures were of increasing concern. It had been calculated that the warhead would attain a temperature of 150°F in a missile bay environment of about 620°F, and would rise perhaps another 20 degrees after the missile had been launched and had attained its maximum speed.

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

contracting for the missile airframe. Picatinny Arsenal was responsible for the adaptation of warhead to missile, and W. L. Maxon Corporation was a subcontractor to Picatinny for the adaption kit. The Radiation Laboratory was responsible for the design and production specifications of all nuclear and high-explosive components and materials, and Sandia was responsible for all remaining warhead components and materials.

HAWK flight tests were scheduled to start in September 1959, and it was estimated that a total of eight warhead flights would be required to secure necessary warhead environmental and operational data. The warhead was being designed to withstand design-limit loads of 100 g's longitudinal and 50 g's lateral, but not in combination.

(b)(3)

An inertial switch for sensing missile acceleration, and which would prevent inadvertent firing prior to launching, would be provided, as well as a self-destruct system.[27]

By November 1, 1958 the study for the nuclear warhead for the GAR-9 and the EAGLE air-to-air missiles had been completed.

(b)(3)

The XW-42 would satisfy the EAGLE warhead requirements without modification.[28]

A report of the study for the HAWK and the GAR-9 was released February 27, 1959. This concluded that the XW-42 Warhead met all requirements of space, weight and yield for these two missiles. The study also included preliminary information on three Navy systems, SUPER-TARTAR, SUPER-TALOS and EAGLE.[29]

An amendment to the military characteristics for a nuclear warhead for the HAWK surface-to-air missile was approved by the Military Liaison Committee April 14, 1959.

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

A teletype of September 3, 1959, from Sandia-Livermore to Albuquerque, noted that the XW-42 was being studied for compatibility with GAR-9, EAGLE, SUPER-TALOS and SUPER-TARTAR. It was noted that the missile system was complicated by requiring the missile to carry both a general-purpose and a nuclear warhead. Since the HAWK would attack low-flying aircraft, possibly in close proximity to populated areas, it was felt that a nuclear warhead should not be used. The system had been equipped with a barometric switch to disable the warhead below 10,000 feet and also had a command self-destruct capability, but the reliability of this complex system was questionable.[31]

Report SC4806(TR), Proposed Ordnance Characteristics for the XW-42 Warhead, was presented to the Special Weapons Development Board at its meeting October 21, 1959.

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

The report was accepted by the Board and by Field Command for forwarding to the Division of Military Application and others.[33]

A joint letter from Sandia-Livermore and the Lawrence Radiation Laboratory to the Division of Military Application was dated October 22, 1959.

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

Also, due to slippage in the development schedule of the initiator, as well as the time required for the above work, the operational availability date would have to be delayed 6 months.[34] This delay was subsequently accepted.[35]

A letter from the Director of Defense Research and Engineering, January 6, 1960, requested that a feasibility study of a warhead for the Navy's EAGLE missile be conducted.

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

The GAR-9 missile would not be considered in this study.

The Military Liaison Committee, in a letter of June 22, 1961, informed the Atomic Energy Commission that the Navy had canceled the requirement for a nuclear warhead for the EAGLE missile due to withdrawal of funds from the project. The Department of Defense noted that the characteristics for the EAGLE warhead were similar to those of the Mk 60, for which a development authorization would be released in the near future.[43]

Report SC4828(WD), Description and Status at Design Release of the Mk 42 Mod 0 Warhead System, was issued in September 1961. The report noted that the warhead had no missile applications.

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The basic design could be varied by changing the amount of high explosive or fissionable material.

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

The electrical system of the warhead incorporated an explosive ferromagnetic transducer and dual arming and firing circuits. Environmental sensing devices prevented application of undesirable signals to firing circuits. Functions of nuclear arming, transfer of boosting gas to the pit, and excitation of ferromagnetic transducer were blocked until environmental sensing devices actuated.

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

Field Command -- The local office of the Armed Forces Special Weapons Project (Defense Atomic Support Agency), located on Sandia Base, Albuquerque, New Mexico.

Firing System -- The electrical system of the weapon that produces and applies a high-voltage current to the detonators.

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

Joint Chiefs of Staff -- A group composed of the Chiefs of Staff of the Army, Navy and Air Force, to determine policy and develop joint strategic objectives of the Armed Forces.

Kiloton -- A means of measuring the yield of an atomic device by comparing its output with the effect of an explosion of TNT. A 1-kiloton yield is equivalent to the detonation effect of 1000 tons of high explosive.

Lawrence Radiation Laboratory -- A change of name for the University of California Radiation Laboratory (which see), effective October 1958.

Lenses -- As applied to nuclear weapons, lenses are elements of the high-explosive sphere, which are designed to produce an implosion. The lens charge is composed of high explosives of different burning rates and is so constructed and shaped as to change the explosion initiated by the detonators into an implosive force which converges smoothly on the nuclear materials.

Los Alamos Scientific Laboratory -- A nuclear design organization located at Los Alamos, New Mexico,

Mach -- A measure of speed. Mach 1.0 is the speed of sound, or 738 miles per hour at sea level.

Military Characteristics -- The attributes of a weapon that are desired by the Military.

Military Liaison Committee -- A Department of Defense committee established by the Atomic Energy Act to advise and consult with the AEC on all matters relating to military applications of atomic energy.

Nautical Mile -- A naval measurement of length. One nautical mile is equivalent to 6076.1033 feet, or the length of 1 minute of arc (1/21,600) of a great circle of the earth.

Neutron -- An uncharged particle of slightly greater mass than the proton.

One-Point-Safe Weapon -- A weapon that will not produce a nuclear yield when detonated at one point on the surface of the high explosive.

Operation Plumbbob -- See Plumbbob.

Operation Redwing -- See Redwing.

Picatinny Arsenal -- An arsenal of the Army, responsible for design of nuclear weapons for the Army.

Pit -- The hollow metal sphere at the center of an implosion bomb which receives the nuclear capsule when it is inserted.

Plumbbob -- A less-than-full-scale test series held at the Nevada Test Site. Series of 29 tests, starting May 28 and ending October 7, 1957.

Plutonium-238 -- An isotope of plutonium-239.

Plutonium-239 -- A radioactive heavy element, atomic number 94.

Redwing -- A full-scale nuclear series of 17 tests held at the Pacific Proving Grounds from May 4 to July 21, 1956.

Reservoir -- As used in this history, a container for deuterium-tritium boosting gas.

Safing -- Putting a weapon in condition such that it cannot fire.

Self-Destruct Unit -- A device that will destroy the warhead, should the missile miss its target.

Special Weapons Development Board -- Change of name for the Sandia Weapons Development Board, effective May 14, 1952.

Subsonic -- Any speed below that of Mach 1.0, which is the speed of sound, or 738 miles per hour at sea level.

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University of California Radiation Laboratory -- A laboratory established at Livermore, California. Initially founded for work on thermonuclear designs.

Uranium-235 -- A radioactive element, an isotope of uranium-238.

Uranium-238 -- A radioactive element, atomic number 92. Natural uranium contains about 99.3-percent uranium-238; the rest is uranium-235.

Warhead -- A weapon carried to the target by missile.

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