

to continue the use of vacuum tubes. It was also concluded that a mechanical redesign of the guidance section would be required in order to achieve a higher missile reliability than obtained in the AJAX. The missile nose location in the solid propellant missile afforded more available volume for improvements in design and layout of electronic guidance components.

(U) The new GS-19672 (Mushroom) guidance unit was about 30 percent larger in volume than the Stovepipe design, its diameter being increased to use the available cross-sectional area and its length being somewhat shortened. In addition to improving the overall missile reliability, the modular construction of the new guidance section provided better immunity to shock and vibration and facilitated mass production and field maintenance. Flight tests of prototype models of the Mushroom guidance set started in August 1958 and development was completed a year later. In July 1959, the Stovepipe guidance section was phased out of production and all new missiles produced were equipped with the new Mushroom guidance set.⁴⁷

Warhead Development

(U) In addition to the primary (nuclear) warhead, the HERCULES MC's called for development of an alternate high-explosive, fragmentation, rod, or other type conventional warhead. The nuclear payloads developed included large- and small-yield heads for use against formations of aircraft and single aircraft, respectively. The T45 fragmentation and T46 series cluster warheads were developed for use against low-altitude targets, but the latter was

⁴⁷ (1) Army Ord Tech Ln Rept for Dec 54, BTL/Whippany, pp. 20-21. RHA Bx 13-595. (2) BTL/DAC Rept, NH Sys & Adv Design NH Sys Presn at Ft Bliss, 6 Feb 58, pp. 27-31. Hist Div File. (3) INH DCR at BTL, 2-4 Jun 59, pp. 6-9 - 6-10. Hist Div File. (4) INH Dev Test Plan, ARGMA TP-5, Oct 59, p. 7. RHA Bx 13-657.

never released for troop use. Because of the security classification involved, this study is limited to a brief summary of the conventional warheads.

(U) In the early phase of the R&D program, primary emphasis was placed on development of the T45 blast-fragmentation warhead as the interim armament for both the AJAX and HERCULES, pending availability of the T46 cluster warhead. The T45 head was generally considered to be more economical and easier to fabricate and to have a shorter development period than the more complex T46 warhead. The latter warhead, however, offered the HERCULES missile system two major advantages. It would provide a greater kill probability than the T45 against targets at all ranges and altitudes, particularly in the low-altitude region; and, in comparison with the primary warhead, it would not contaminate or damage the territory below its bursting point, permitting firings over friendly territory.⁴⁸

⁴⁸(1) OTCM 35495, 9 Sep 54. RSIC. (2) PA Tech Memo DW-322, Feb 61, subj: Mins of T46E1 Whd Review Mtg for FETP, ET/UT & RI, p. 7. RHA Bx 13-595. (3) Army Ord Tech Ln Rept for Oct 55, BTL/Whippany, pp. 7-8. Same File.

⁴⁹(1) NIKE Blue Book, p. 247. (2) SRI TR 24, Aug 61, p. 51. RHA Bx 13-592.

(U) The fact that the cluster warhead would present many difficult development problems had been recognized by BTL as early as October 1953.⁵¹ Aircraft Armaments, Inc., began design studies of the proposed T46 cluster warhead in early May 1954 under Contract ORD-1620. By July, problems incident to application of the warhead to the HERCULES missile were identified and it was concluded that a new and different type cluster design would be required.⁵² In the formal development program that began in September 1954, two approaches to the problem were investigated.

⁵⁰ (1) TIR 2-3-1A1(2), OCO, Feb 59, subj: Dev of GM Whd, M17 (T45). (2) OTCM 36833, 10 Jul 58, & OTCM 36913, 20 Nov 58. (3) TIR CD-1, OCO, Jun 60, p. 32. All in RSIC.

⁵¹ See above, pp. 42, 44.

⁵² (1) Army Ord Tech Ln Rept for Jul 54, BTL/Whippany, pp. 4, 7-8. RHA Bx 13-595. (2) The technical problems encountered in the subsequent T46 program were very similar to those experienced in the attempted development of the AJAX cluster warhead system. The latter effort was undertaken in the product improvement phase of the AJAX program to provide a more lethal warhead while awaiting delivery of the HERCULES system. The AJAX cluster warhead was originally scheduled for troop delivery by mid-1958; however, inadequate funds and problems associated with the ejection and fuzing systems delayed the program about 18 months. The first and only sled test of the cluster warhead system, conducted on 12 April 1957, was unsuccessful. In the absence of adequate funds to continue the program on a timely basis, the Chief of R&D, DA, on 6 June 1957, directed that development of the cluster warhead for the AJAX be terminated. OTCM 36677, 9 Jan 58. RSIC.

(U) Although a significant improvement over the basic T46 design, the T46E1 warhead system still lacked the desired effectiveness and was expensive to produce. The Chief of R&D, DA, therefore requested that necessary action be taken to complete the development and test effort and to effect an orderly

⁵³ (1) Army Ord Tech Ln Rept for Oct 55, BTL/Whippany, p. 9. RHA Bx 13-595. (2) TIR 2-3-1A2(5), OCO, Dec 61, p. 1. RSIC.

⁵⁴ (1) *Ibid.*, pp. 1-5. (2) PA Tech Memo DW-322, Feb 61, subj: Minutes of T46E1 Warhead Review Meeting for FETP, ET/UT, & RI, pp. 8, 20, 23. RHA Bx 13-595.

termination of the program. The Secretary of the Army approved the formal termination of the T46 project on 21 September 1961.⁵⁵

(U) The R&D contract cost of conventional warheads for the HERCULES missile totaled \$3,679,985. Of this amount, \$260,430 went for development of the M17 (T45) fragmentation warhead and the remaining \$3,419,555 for development of the T46 cluster warhead.⁵⁶

Ground Guidance Equipment

(U) The ground guidance equipment for the Basic HERCULES consisted of four primary subsystems: the acquisition radar, the target tracking radar, the missile tracking radar, and the computer. This equipment was housed in two van-type trailers, two dropped trailers carrying the precision track antenna mounts and the acquisition antenna assembly. Since the missile design would permit intercepts beyond 50 nautical miles, the detection range of the acquisition radar on the 650-knot target was extended beyond 80 miles, and the target tracking capability was extended beyond 75 miles. In the redesign of AJAX ground guidance equipment to increase the range performance, BTL effected improvements in overall reliability, operability, and maintainability.

(U) The function of the acquisition radar was to detect aerial targets and provide a display of those targets on a plan position indicator. An electronic reference system facilitated the acquisition of any desired target by the target tracking radar. The maximum presentation range was 250,000 yards, or about 125 nautical miles. The acquisition antenna was mounted on a tripod-supported drive unit capable of rotating (the antenna) at speeds of 5, 10, or 15 revolutions per minute (rpm). A new traveling-

⁵⁵OTCM 37853, 21 Sep 61. RSIC.

⁵⁶See Table 6.