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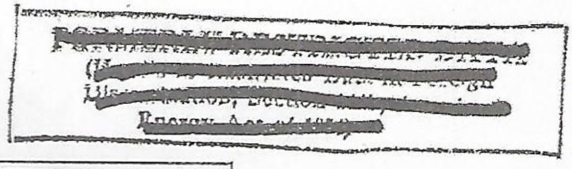
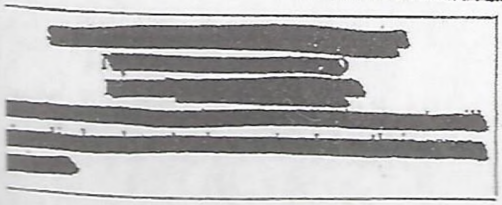
BOMARC AND NUCLEAR ARMAMENT 1951-1963

by THOMAS W. RAY





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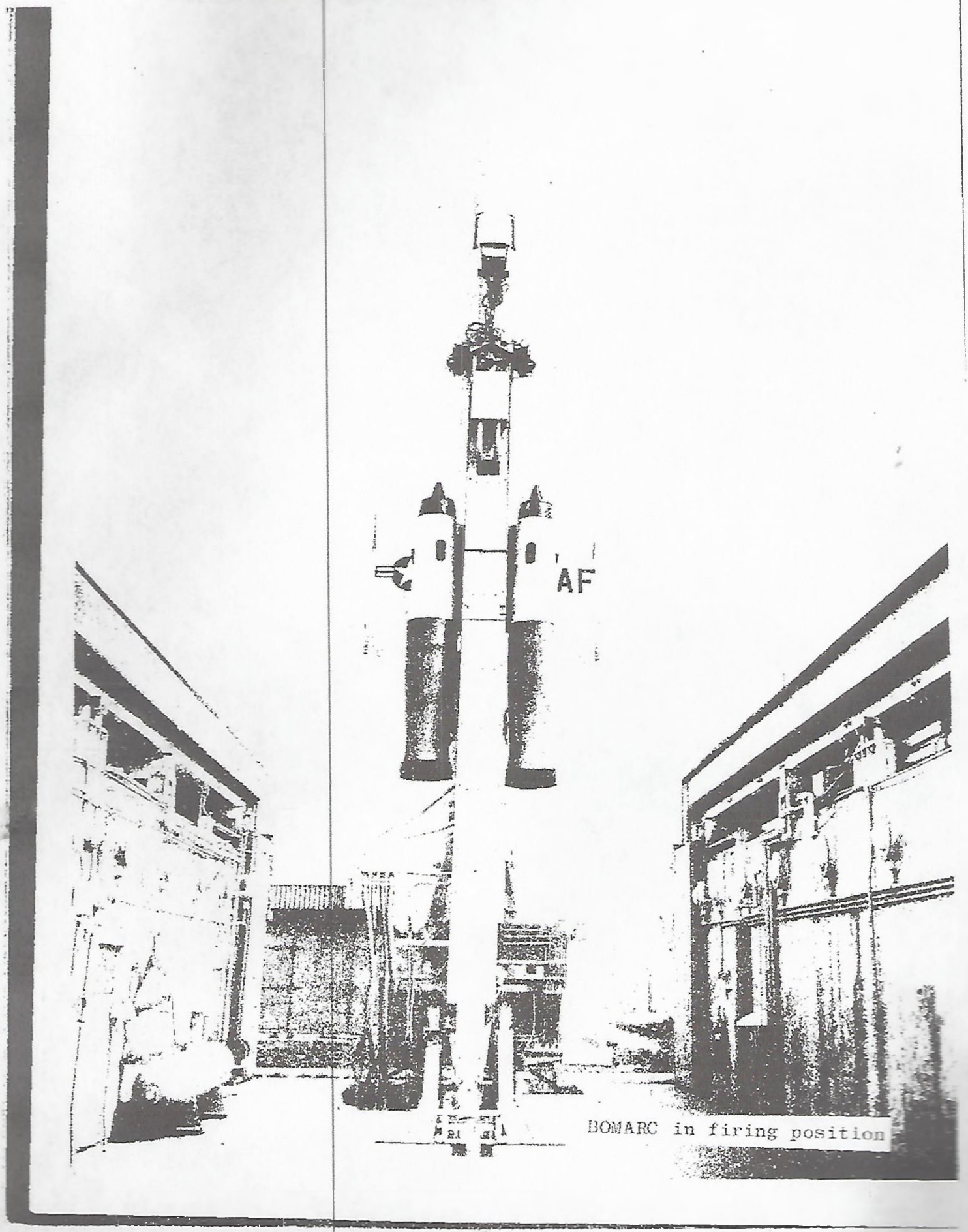

BOMARC in firing position

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INTRODUCTION: THE SIGNIFICANCE OF BOMARC WARHEADS

In September 1959, ADC began integrating nuclear-armed ground-to-air BOMARC missiles into its weapons inventory,* thereby strengthening and intensifying the command's capability to down bombers attacking America's northeastern industrial complex. But certain disadvantages accompanied their employment. If one BOMARC, equipped with [redacted] atomic warhead, accidentally exploded to full power while on the ground, the resulting damage would be considerable (as evidenced by the destruction of Hiroshima

Little Boy 13 KT

* For BOMARC planning, development, construction and testing from 1950 to 1962, see ADC Historical Study No. 14, History of Air Defense Weapons 1946-1962, pp. 162-89, 302-66. The story is continued to 1963 in ADC Historical Study No. 18, Interceptor Missiles 1962-1963.

in August 1945 by an atomic blast of twice this magnitude). Aside from the formidable blast damage and plutonium poisoning that would ensue, the entire structure of America's offensive-defensive posture could be jeopardized at home and abroad. Congress might see fit, in event of such an accident, to outlaw further use of atomic weapons inside the U.S.; while NATO nations presently permitting the United States to store and maintain atomic arms abroad would posssibly abrogate these privileges. America's military strength would be cut to a fraction, in consequence. Not to be overlooked was the possibility, admittedly remote, that an "accidental war" would be started. Thus, the importance of averting nuclear accidents with BOMARC warheads was, essentially, of staggering proportions.[1]

(U) (S) (RD) Warhead Planning and Development, 1951-1959. While planning for the BOMARC warhead started as early as 1951, several years elapsed before its development actually got underway. Between times, a number of things had to be ironed

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1. RESTRICTED DATA, Fred C. Ikle, et al, On The Risk of an Accidental or Unauthorized Nuclear Detonation (RAND Research Memorandum RM-2241), 15 Oct 1958; ADCM 355-1, Response to Nuclear Weapons Accidents, 1 Jan 1962; RESTRICTED DATA, AFM 122-1, The Nuclear Weapon Safety Program, 15 Sep 1961.

out. The strength of the weapon, together with its dimensions and weight, had to be decided; authorization and funding for its production had to be accounted for. It was USAF that apparently first seized the initiative, informing ADC in early 1951 that a study was in progress to determine whether or not BOMARC should be fitted with an atomic warhead. ADC announced on 31 January 1952 that a formal requirement existed for incorporating nuclear warheads in air defense weapons, including ground-to-air missiles like BOMARC. USAF, meanwhile, had contemplated use of two existing warheads for BOMARC -- the XW-7 containing a yield and the XW-12 containing a But the XW-7 was soon ruled out, chiefly because of weight and size factors, so that by late 1953, the prospects of adopting a warhead already available had lessened considerably.

(U) Nevertheless, other efforts toward gaining atomic ordnance for BOMARC bore fruit by this time. ARDC, during Project Heavenbound (late 1952-early 1953), established the feasibility of mating a nuclear warhead with BOMARC; and the Joint Chiefs of Staff, about the turn of the year (winter of 1952-53), sanctioned their marriage. What

remained, therefore, was to pick a warhead that would not demand serious changes in the BOMARC missile then under development.[2]

(U ~~S/RD~~) When on 27 January 1953 the JCS notified the Atomic Energy Commission that a military requirement obtained for an atomically-armed surface-to-air missile for air defense purposes, the XW-12 warhead adapted to BOMARC was in mind. And when ADC on 23 March 1953 reaffirmed its need for integrating atomic warheads into future BOMARC's, USAF answered with strong reassurances that some warhead was in the offing. But it was not destined to be the XW-12, which weighed about 600 pounds and measured about 22 inches long. In late 1953, the BOMARC project officer bargained for a lighter warhead, as yet undeveloped, because the XW-12, if used, would reduce the BOMARC range to 75 miles or less, according to studies then completed. Accordingly, a 250-pound warhead was asked for on 16 November 1953, that would be eighteen inches in diameter by 30 inches long. The best destructive power expected from a warhead

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2. ADC Historical Study No. 2, Nuclear Weapons in the Air Defense System, 1953; Wright Air Dev Center, ARDC, The Development of the BOMARC Guided Missile 1950-1953, Jan 1956, pp. 34-36.

this small was estimated at Warheads were comparatively heavy because, in addition to carrying their together with other features of the nuclear system, they contained a nuclear safing system, an implosion system (composed of High Explosive and a system of detonators arranged to cause, when fired, a symmetrical implosion), plus a firing system along with interconnecting framework and circuitry. Joined to the warhead was an adaption kit containing arming and fuzing systems, power supply and the network of hardware and circuitry essential to operate them (see glossary).[3]

(U) Scarcely was the request made for a 250-pound warhead when the conclusions of a Boeing study were circulated declaring that BOMARC could accomodate, without sacrificing range, a warhead up to 500 pounds in weight and 22 inches in diameter. On 14 April 1954, therefore, AEC was forwarded a formal requirement for developing a BOMARC warhead characterized preferably by a diameter of 22 inches, a weight of about 350 pounds and a length of 30 inches, but in any

3. ADC Historical Study No. 2, op. cit., 1953; Wright Air Dev Center, ARDC, op. cit., Jan 1956, pp. 36-37; Notes from Memo, C/S USAF, "Military Requirement for the Development of a Weapons System Utilizing an Atomic Warhead for the F-89 Interceptor," 23 Mar 1953 [HRF].

case not to exceed 500 pounds in weight, 22 inches in diameter and 35 inches in length. As to warhead yield, the comparatively [redacted] was still prescribed. Particular emphasis was focused on safety devices and techniques to insure positive warhead control at all times -- while in storage, on alert and in flight.[4]

(u) But even these characteristics, though compatible with the BOMARC missile, were subjected to further changes. Subsequent target destruction studies revealed the advisability of pocketing greater nuclear yields; and the ever-advancing state of the art conduced to the packaging of greater yields in smaller, proportionately lighter, containers. Not till Fiscal Year 1956 were revised warhead needs balanced sufficiently with BOMARC capabilities, however, to permit development of the then-called XW-40 warhead (later redesignated MK-40). As finally evolved, the MK-40 warhead contained a [redacted] weighing (with associated equipment attached) about 350 pounds and measuring 17.9 inches in diameter by 31.64

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4. Wright Air Dev Center, ARDC, op. cit., Jan 1956, pp. 36-37; Ltr and Ind, USAF to ADC, "Glossary of Terms and Military Characteristics for 22-inch Outside Diameter Atomic Warheads for use in Air Defense," 29 Jun 1954 [DOC 1].

inches in length. It possessed the self-contained "one-point" safety feature* designed to insure against premature nuclear explosions. Because of its heavy weight and sizeable dimensions, special tools, including a warhead loading device, were fabricated together with a general installation dolly, for purposes of handling, positioning, installing, removing and transporting the warhead.[5]

(U~~/FRD~~) For some time before the MK-40 was even authorized, let alone developed, there existed a standing requirement for a less powerful, non-nuclear High Explosive warhead. To further diversify BOMARC capabilities, another plan called for use of a second type nuclear warhead of greater

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* "One-point" safety meant that the MK-40 was a sealed pit warhead in which fissionable materials were sealed in a container that rendered contamination impossible as long as the container remained intact. Unless intentionally triggered (by deliberately performing a prescribed number of positive, independent actions in proper sequence to energize the arming, fuzing and firing systems) the MK-40 could not experience a full-scale nuclear explosion, according to expert opinion. Before the arming system inside BOMARC could actuate the fuzing and firing mechanisms that ignited the warhead, the missile had to be properly launched and travel a certain distance from the ground.

5. Ltr, ADC to USAF, "Atomic Weapons in Air Defense," 8 Jan 1954 [DOC 2]; Ltr, ADC to USAF, "Nuclear Warheads for the IM-99 (BOMARC)," 4 Jun 1957 [DOC 3]; AMC (Wright-Patterson AFB), History of the BOMARC Weapon System 1953-1957, Feb 1959, pp. 44-48.

power, called the XW-30,

capability into the BOMARC nuclear warhead. But one by one, for reasons of economy or impracticability, these programmed variations were cancelled, so that by 1959 when they first began trickling in, MK-40's were the sole warheads produced for tactical use with both the CIM-10A liquid propellant (formerly designated IM-99A) and the CIM-10B solid propellant BOMARC (formerly designated IM-99B).[6]

(S) General Safety Considerations. Maintaining ADC's future atomic arms free from unauthorized or accidental detonation (without disabling them of their nuclear impact when needed) entailed guarding them against three categories of vulnerability: (1) technological imperfections and malfunctions; (2) human errors that traditionally had figured high -- over fifty per cent -- in accident causation; and (3) deliberate attempts to trigger them without authorization (either by saboteurs or persons of unbalanced mentality). The first category, technological imperfections

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6. Ltr, ADC to USAF, "Nuclear Warheads for the IM-99 (BOMARC)," 4 Jun 1957 [DOC 3]; AMC, BOMARC History 1953-57, op. cit., Feb 1959, pp. 39-52; Hist of ADC, 1958, pp. 249-50; Hist of ADC, Jan-Jun 1959, pp. 309, 317-18.

and malfunctions, included not only defective apparatus inside and attached to the BOMARC warhead, but also ground handling equipment, storage and checkout facilities, and launching equipment coming into direct or indirect contact with the MK-40. Fortunately, ADC was not alone in facing these problems; other USAF commands (including AFSC, AFLS and ATC), the Atomic Energy Commission, the Joint Chiefs of Staff, and various prime contractors, among others, were also deeply involved.[7]

Warhead Facilities and Safeguards. Years before BOMARC sites sprang up to loop their protective ring around the industrial complex of northeastern United States,* much thought and considerable planning was concentrated on adopting a ready storage posture for the CIM-10A and B best suited from the standpoints of efficiency, tactical effectiveness, economy, and safety. So, while they might be launched and matched, at a moment's notice, against oncoming hostile targets, they would be afforded, as much as was

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7. RESTRICTED DATA, Ikle, et al, op. cit., 15 Oct 1958.

* In September 1959, McGuire became the first of eight U.S. BOMARC sites to become operational, the others joining McGuire from December 1959 to 1962.

possible, continuous protection against the three categories of vulnerability described above. To house nuclear-armed, Boeing-made CIM-10A/B missiles in a ready storage status (wherein each CIM-10A was capable of being launched within a period of two minutes, and each CIM-10B in 30 seconds, during any time of day or night), rectangular shelters made of reinforced concrete were engineered and spaced in clusters of 28 in compliance with explosive safety-distance criteria, with a view to confining any damage resulting from an accidental detonation of warhead HE or rocket motor propellant. Inside each of these concrete shelters, a single alert missile attached to a launcher erector mechanism laid in a horizontal attitude.

Once each missile was firmly in place and fully attached, its nuclear warhead was installed; for it was only while in the shelter, properly fastened, that the BOMARC and its warhead were mated. For purposes of launching, the shelter roof opened at the center, separating so the missile could be raised by the launcher erector to stand, like a sentinel on guard, vertically erect. When the missile finally reached, within seconds, an attitude perpendicular to the floor, the launcher erector that ordinarily held it automatically released its grip and descended, leaving the

missile, still standing vertical, awaiting lift-off instructions from the SAGE Center that provided its computerized command guidance signals. Besides "one-point" safety devices installed to prevent full-scale blasts on site or prematurely in flight (described above), a low-altitude self-destruction system was incorporated, and ordinarily set between 7,000 and 10,000 feet altitude, to protect ground personnel from atomic scorching. The warhead was armed during the terminal phase of BOMARC flight, then fired by an influence fuze when within the target's range of destruction. Those MK-40 warheads not mated with BOMARC's were stored in the nearby Warhead Storage and Maintenance Building. Also contained in this building were tools, instruments and facilities employed in receiving, inspecting, checking, and testing the warheads, which were subjected to a confidence check every 30 days. To guard against unauthorized penetrations, a chain-link security fence over seven feet high was wrapped around the entire BOMARC compound. A proportionately large-sized air police force guarded each access gate to bar admittance to all but authorized persons, forming, moreover, a sabotage alert team; while anti-intrusion detection and alarm devices and flood lights turned on to brighten certain areas at night, provided further sureties against unwanted

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penetrations. To guarantee that even a person who, ostensibly, was authorized admittance could not gain access to a warhead while alone when he might, if mentally unbalanced or serving as an enemy agent, try to trigger a detonation, the "buddy-system," later redesignated "two-man concept," was rigorously enforced. Before access was allowed to a warhead for any purpose, at least two persons knowledgeable of the intricacies of the task at hand were required to be present.[8]

SAFETY RULES AND DEVICES, 1959-1963

As suggested above, the warhead could be mated with BOMARC missiles only under certain carefully defined conditions fully controlled by technicians trained in this craft. The processes involved, together with all other activities of warhead-impregnated BOMARC's, were painstakingly thought out long in advance of BOMARC's advent on the air defense scene, to guarantee the utmost in nuclear safety. Safety rules that governed warhead activities were first developed and tested by USAF's Nuclear Weapons Systems Safety Group

8. Wright Air Dev Center, ARDC, op. cit., Jan 1956, p. 45; ADC, Headquarters USAF Air Defense Command Operation Employment Plan for the IM-99B. Jan 1960; ADCM 27-9, Program Control Plan IM-99A, 15 May 1959; ADCM 27-11, Program Control Plan IM-99B, 15 May 1959; Hist of EADF, Jan-Dec 1959, pp. 127-30.

[redacted]

(NWSSG), reviewed by the Joint Chiefs of Staff and Department of Defense, then upon approval, were sent for the President's signature. Hereupon they became the certified safety rules. To insure that the safety rules were implemented to the letter, check lists, technical orders and SOP's were drawn up and published to spell out, in minute detail, each operation in the sequence of operations, so that technicians, working as a team, were enabled to double check each step taken in the progression of steps involved.

Not till December 1959 -- several months after the first CIM-10A squadron was pronounced operational -- were interim safety rules approved for mating the MK-40 with the CIM-10A. Delay stemmed in part from objections raised by the NWSSG that included concern over the absence of physical restraints for BOMARC missiles mounted on their launcher erector mechanism in a ready storage, horizontal position. An important purpose of safety rules was to preclude all chances of inadvertantly launching a BOMARC; but the lack of horizontal restraints seemed like an invitation to trouble from this quarter. What was to check the forward progress of a missile if its boost rocket accidentally ignited? Consequently, USAF purposely withheld authorization

[redacted]

for mating MK-40 warheads with CIM-10A's until April 1960, by which time arrangements had been made to apply the needed restraints.[9]

Apart from re-emphasizing the necessity for erecting security fencing and implementing the "two-man concept," the interim safety rules outlined procedures for accomplishing 30-day tests on ready storage missiles armed with the MK-40 and for conventional control of the missiles while serving in alert ready storage status. As to the first, the shelter safety plug was removed (to preclude the reception of "fire-up" signals) as was the warhead arming plug (where a safety plug was placed in its stead). Among tests that ensued was a continuity check of the arming programmer and a functional checkout of the primary and secondary fuzes. Pressure and electrical continuity checks were made on the warhead. BOMARC CIM-10A's ordinarily in ready storage status were protected against inadvertent launches by a requirement for deliberate, coordinated efforts by persons at two geographically separated points, the BOMARC site and the SAGE direction center. The special BOMARC switches (accessible only to the

9. Hist of ADC, Jan-Jun 1959, pp. 229-31; Hist of ADC, Jul-Dec 1959, pp. 139-41; Hist of ADC, Jan-Jun 1960, pp. 117-22.

Senior Director and Senior Weapons Director at the SAGE center), one of which had to be actuated when launching a BOMARC, possessed mechanical guards that were kept safety sealed. When the interim safety rules were first issued, a condition of maximum readiness was required before the seal could be broken on a Special BOMARC switch. But a need existed to actuate the switch during the Systems Readiness Check (SRC), to provide SAGE sector commanders with confidence that CIM-10A's would respond properly to fire-up and pre-launch SAGE signals. So the CIM-10A safety rules, which had been granted final approval by the DOD in February 1961, were accordingly amended to permit use of the special switch during an SRC, providing the missile involved was rendered inert. Safety rules governing CIM-10B operations (similar to those authorized for CIM-10A) received interim DOD approval at mid-1961.[10]

10. RESTRICTED DATA, Msg AFCFN-N, USAF to ADC, 11 Dec 1959 [Doc 153 in Hist of ADC, Jul-Dec 1959]; ADCM 27-9, op. cit., 15 May 1959; ADCM 27-11, op. cit., 15 May 1959; Hist of ADC, Jan-Jun 1960, pp. 119, 122-23; Hist of ADC, Jul-Dec 1960, pp. 189-90; Hist of ADC, Jul-Dec 1961, pp. 249-53; RESTRICTED DATA, ADCSA-M 423, ADC to 26 and 30 ADs, 24 Feb 1961 [DOC 4]; RESTRICTED DATA, Msg ADCSA-M 548, ADC to Dep IG for Safety, 15 Mar 1961 [DOC 5]; RESTRICTED DATA, Msg ADCSA-M 1379, ADC to 26 AD, et al, 30 Jun 1961 [DOC 6]; RESTRICTED DATA, Msg AFIIS 85030, USAF to CINCNORAD, 12 Jul 1961 [DOC 7].

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But a serious hitch was discovered in January 1962 as regards CIM-10B safety. During a USAF CIM-10B safety survey of the 22 ADMS (Langley), it was learned that a psychotic or subversive individual having knowledge of CIM-10B operations conceivably might trigger an unauthorized launch of an CIM-10B by himself, either from the operations center at the CIM-10B site (IMSOC), or the parent SAGE direction center. Several methods were feasible, including the manual insertion of a track identified as hostile onto certain computer tapes. While a solution was being sought, the "two-man concept" was implemented at the critical areas in the IMSOC containing control equipment vulnerable to such manipulation. Whenever access to the equipment was necessitated for making adjustments or repairs, two persons familiar with its operations were present. After considerable study and analysis, an ironclad inspection, storage and control system was established (using the "two-man concept" under certain conditions) to assure the validity and inviolability of computer programming tapes employed to help activate CIM-10B's.[11]

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11. Hist of ADC, Jul-Dec 1961, pp. 150-51; Msg AFINS 3-B-2-50-62E, Dir Nuc Safety to AFSWC (Kirtland), 15 Feb 1962 [DOC 8]; Msg ADODC 455, ADC to 26 AD, 15 Feb 1962 [DOC 9]; RESTRICTED DATA, Msg AFIDF-A-3-2-8E, Dep IG for Safety to

[redacted]

By the end of 1962, NWSSG concluded that the CIM-10B fire circuitry from the SAGE Center to the CIM-10B site must somehow be altered to require a deliberate, conscious manual action on the part of authorized personnel at both locations before an CIM-10B launch could be triggered. In May 1963, therefore, ADC called for proposals from the field to this end, resulting in two promising suggestions. Both suggestions were then sent to OOAMA for evaluation. After further study, OOAMA recommended the one that had emanated from the 26th Air Division, proposing that a blank unwired telephone plug be inserted into the data input jack of the AN/GSA-28 prelaunch translator's impedance matching panel. OOAMA also believed that attaching a red fabric streamer to the blank plug would be helpful, since the blank plug had to be removed manually to restore the circuitry to its former tactical configuration and the streamer would call visual attention to the plug's position. In July 1963, ADC adopted this method for use, ordering that the streamers be made to extend at least ten inches long. The IMSOC duty

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[Cont'd] ADC, 20 Feb 1962 [DOC 10]; RESTRICTED DATA, BLACK BEAR 163, Msg ADCSA-W 615, ADC to Air Divs, et al, 2 Mar 1962 [DOC 12]; Msg ADOOP-WM 704, ADC to AFSWC, et al, 13 Mar 1962 [DOC 13]; Msg AFINS-3-B-6-19-62-E, Dir Nuc Safety to ADC, 12 Jun 1962 [DOC 14]; Msg ADOOP-EO 1674, ADC to Air Divs, 19 Jun 1962 [DOC 15].

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officer was designated the individual responsible for removing the blank plug when properly directed by the SAGE Direction Center.[12]

Weeks after CIM-10B safety was assured, Canada, in August 1963, indicated its willingness to grant something it had withheld for years -- authorization for equipping two Canadian CIM-10B BOMARC sites (North Bay and La Macaza) with nuclear warheads maintained under U.S. control. An agreement to this end was consummated on 18 October 1963. Safety rules, which had been drawn up to govern MK-40 operations and insure their control by U.S. representatives, were given interim approval in November 1963, signaling the go-ahead for delivering warheads to the Canadian sites.[13]

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12. Msg ADCSA-W 603, ADC to Dir Nuc Safety, 28 Feb 1963 [DOC 16]; Msg ADCSA-W 620, ADC to 26 AD, 1 Mar 1963 [DOC 17]; Msg ADOOP-WM 1719, ADC to 26 and 30 ADs, 2 May 1963 [DOC 18]; NOFORN EX CANADA, Msg 30-OOP-M S-0785-63, 30 AD to ADC, 14 May 1963 [DOC 19]; Msg ADOOP-WM 2019, ADC to OOAMA, 3 Jun 1963 [DOC 20]; Msg OONAT 447, OOAMA to ADC, 20 Jun 1963 [DOC 21]; Msg BLACK BEAR 63-55, ADOOP-WM 2809, ADC to 26 and 30 ADs, et al, 26 Jul 1963 [DOC 22].

13. RESTRICTED DATA, USAF, Current Status Report, Aug 1963, p. 3-2 [HRF]; ADC, ADLPW-A, Weekly Act Repts, 14 Jul and 21 Aug 1963 [HRF]; Msg AFXOPN 64861, USAF to CINCONAD, 22 Oct 1963 [DOC 23]; Msg CEOC-F X-258, CINCONAD to JCS, 23 Oct 1963 [DOC 24]; NOFORN EX CANADA, Msg ADCSA-W 5743, ADC to CANAIRHEAD, et al, 27 Nov 1963 [DOC 25].

[redacted]

Aside from safety rules and devices, certain command measures were taken to re-inforce the structural framework of the safety program. The ADC Directorate of Missile/Nuclear Safety (subsequently redesignated Weapons System Safety Division) -- originally established under the Chief of Safety in late 1958 -- was expanded to encompass nuclear safety problems peculiar to BOMARC. The "Black Bear" communications system,* among other innovations, was adapted to the needs of BOMARC squadrons, while BOMARC nuclear directives, once codified in final form, were incorporated into the -136 technical manual series. A nuclear inspection and assistance team was organized by the 26th Air Division in late 1960 to visit BOMARC sites quarterly for purposes of standardizing procedures and enforcing close adherence to pertinent JCS, USAF, and ADC directives and regulations. Besides these and other measures, the USAF and ADC inspectors

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* The "Black Bear" communications system entailed the special transmission of instructions to the field regarding nuclear activities, receiving preferential, expeditious treatment that automatically included among addressees all units directly involved. Procedural changes, for instance, instead of facing delays and possible omissions resulting from retransmissions down the chain of command, reached the pertinent tactical units directly, thereby assuring practically instantaneous implementation.

[redacted]

general made nuclear safety a special subject for investigation by their inspection teams.[14]

Inspections. To check the methods by which nuclear warheads were handled, loaded, stored and protected at BOMARC squadrons, USAF and ADC inspection teams regularly conducted Initial Capability Inspections, Capability Inspections, and Nuclear Weapon Spot Checks. The Initial Capability Inspection was held 30 or more days before the squadron was scheduled to receive nuclear ordnance, to determine whether or not it was ready to receive them. Capability Inspections which accounted for the majority of inspections performed, were conducted within 90 days after the unit obtained nuclear weapons, and thereafter at intervals not exceeding 18 months. When possible, the capability inspection was performed in conjunction with an Operational Readiness Inspection (ORI). Nuclear weapon Spot Checks, on the other hand, were performed on any unit at any time. For the most part, the inspection, and particularly the Capability Inspections, covered the following nuclear weapon activities: compliance with published safety rules, technical instructi and authorized check lists; security system (including the intrusion alarm network as well as implementation of the

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14. Msg 26MLP-8-833, 26 AD to ADC, 19 Aug 1960 [Doc 228 in Hist of ADC, Jul-Dec 1960].

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"two-man concept"); warhead storage, maintenance and assembly; nuclear safety measures; warhead mating, testing and handling; and weapons personnel certification. Other phases of the inspections covered warhead supply, base logistical and administrative support, warhead training programs, and Explosive Ordnance Disposal (EOD) -- sometimes tested in conjunction with a simulated "Broken Arrow" exercise. While in most instances, the inspections resulted in satisfactory ratings, they served to uncover defects and reveal shortcomings which, if left uncorrected, might lead to serious consequences. Units adjudged unsatisfactory were relieved of their combat-ready status until proved proficient with nuclear weapons within 90 days after failing an inspection.[15]

Although USAF had singled out nuclear safety as a special subject for inspection in late 1959, months elapsed before qualified teams could be organized at USAF and ADC to bring this about. Until 1961 (when CIM-10B squadrons began phasing in), only the CIM-10A squadrons were involved. These became operational as follows: McGuire (September 1959), Suffolk County (December 1959); Otis (March 1960); Dow (June 1960); and Langley (October 1960) -- demonstrating

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15. AFR 123-9, 31 Aug 1960 [Doc 620 in Hist of ADC, Jul-Dec 1961]; AFR 123-6, 16 Nov 1961 [Doc 621 in Hist of

[redacted]

beforehand or soon after, a capability to maintain, handle and process MK-40 warheads, along with fulfilling other functions associated with their care and safety. In addition, the 46th ADMS (McGuire) was subjected to, and passed a capability inspection between 22 May and 3 June 1960, while various aspects of nuclear safety were included in an Operational Readiness Inspection passed by the 6th ADMS (Suffolk County) in July 1960.[16]

One spot inspection, six capability and four initial capability inspections (conducted at seven BOMARC units) comprised the sum of BOMARC nuclear inspection during 1961. Four units received two inspections each. Seven of the 11 inspections were conducted by ADC; the others were performed by USAF. The findings, though largely encouraging, occasionally revealed serious defects.

An Initial Capability Inspection at the 22nd ADMS (Langley) from 11 to 13 January ended in a satisfactory

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[Cont'd] ADC, Jul-Dec 1961]; ADCR 122-2, "Missile/Nuclear Safety Criteria," 8 May 1961 [Doc 622 in Hist of ADC, Jul-Dec 1961].

16. Msg AFCRM-A 6-820, USAF (IG Inspection Team) to USAF, 3 Jun 1960 [Doc 196 in Hist of ADC, Jan-Jun 1960]; Msg 26CIG 018, 26 AD to ADC, 22 Jun 1960 [Doc 199 in Hist of ADC, Jan-Jun 1960]; Rpt, 6ADMS ORI, Operation Readiness Inspection of 26 AD, 22 Jul 1960, pp. E-21 to E-25 [Doc 246 in Hist of ADC, Jul-Dec 1960].

[redacted]

rating for that unit, while a Capability Inspection at the 30th ADMS (Dow) the following month revealed shortcomings in its security system. They were not serious enough, however, to deprive the 30th of a satisfactory score. From 2 to 4 May, the 22nd ADMS (Langley) demonstrated for a second time in 1961 a satisfactory ability to maintain and handle its nuclear warheads, despite the uselessness of its acid facility, which at the time was closed down for repairs. An Initial Capability Inspection of the 37th ADMS (Kincheloe) in early June indicated it was ready to receive nuclear warheads.[17]

This pattern of universally satisfactory inspections continued through early November. The 74th ADMS (Duluth) proved capable of receiving nuclear warheads following an Initial Capability Inspection from 26 to 28 July. The 37th

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17. FORMERLY RESTRICTED DATA, Msg ADCIG-I 1-2, ADC Insp Team (IG) to USAF, 13 Jan 1961 [Doc 689 in Hist of ADC, Jul-Dec 1961]; Msg AFIRI-A-3-2-46, USAF Insp Team (IG) to USAF, 22 Feb 1961 [Doc 690 in Hist of ADC, Jul-Dec 1961]; Msg 26CIG 016, 26 AD to ADC, 13 Mar 1961 [Doc 691 in Hist of ADC, Jul-Dec 1961]; Msg ADCIG-I-C 664, ADC to USAF, 30 Mar 1961 [DOC 692 in Hist of ADC, Jul-Dec 1961]; FORMERLY RESTRICTED DATA, Msg ADCIG-I X-54, ADC Insp Team (IG) to 26 AD, 4 May 1961 [Doc 693 in Hist of ADC, Jul-Dec 1961]; FORMERLY RESTRICTED DATA, ADCIG-I 1123, ADC to USAF, 29 May 1961 [Doc 694 in Hist of ADC, Jul-Dec 1961]; FORMERLY RESTRICTED DATA, ADCIG-I 0021, ADC Insp Team (IG) to USAF, 3 Jun 1961 [Doc 695 in Hist of ADC, Jul-Dec 1961].

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ADMS (Kincheloe) underwent its second inspection of the year in October and was found clear of major flaws. And although the 74th ADMS (Duluth) during its second inspection (1 to 3 November) was observed to lack a nuclear weapons officer and to have certain undesirable peculiarities in its security system, it, too, was awarded a satisfactory grading.[18]

The first unsatisfactory rating did not come until mid-November, when the USAF inspection team declared the 6th unsatisfactory because six of its shelters were without a working intrusion alarm system, while all its shelters lacked an operating alarm system on the back doors. Since a manned guard system had not been implemented to substitute for the defective alarm system, the squadron was ruled vulnerable to sabotage. A manned security guard was immediately organized at the 6th to serve until the alarm deficiency was remedied; and on November 18, just three days after the first inspection, the squadron satisfactorily

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18. FORMERLY RESTRICTED DATA, Msg ADCIG-I 61-2897, ADC Insp Team (IG) to Dep IG for Insp (USAF), 28 Jul 1961 [Doc 696 in Hist of ADC, Jul-Dec 1961]; Msg 37-CCR 10-72, ADC Insp Team (IG) to USAF, 26 Oct 1961 [ADCIG files]; Msg 74 CAS 74-61-383, 74 ADMS to USAF, 4 Nov 1961 [Doc 697 in Hist of ADC, Jul-Dec 1961]; Msg T/30/CIG 311, 30 AD to ADC, 28 Nov 1961 [Doc 698 in Hist of ADC, Jul-Dec 1961]; Msg ADCCS 2892, ADC to USAF, 22 Dec 1961 [Doc 699 in Hist of ADC, Jul-Dec 1961].

[redacted]

passed a second inspection. Work soon began on the alarm system which entailed removing alarm connections from the shelter floor where accumulations of water had corroded and shorted them out, then installing new ones on shelter doors. By mid-January 1962, this work was completed and the intrusion alarm system at the 6th ADMS became operational.[19]

Although the next inspection, conducted at the 46th ADMS (McGuire) in November 1961, ended satisfactorily, the final inspection of the year resulted in another unsatisfactory rating. The 35th ADMS (Niagara), during an Initial Capability Inspection conducted between 27 November and 1 December, was discovered to possess a sizeable catalogue of failings, including insufficient manning in the special weapons section, inadequate administrative procedures, and substandard supervision in the warhead maintenance and processing areas. The squadron, moreover, was found short on

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19. Msg 880, 52 Ftr Gp to USAF, 16 Nov 1961 [Doc 700 in Hist of ADC, Jul-Dec 1961]; Memos for Rec, Col O.G. Cellini, ADCIG 15-17 Nov 1961 [Doc 701 in Hist of ADC, Jul-Dec 1961]; Interview with W. Jones, ADIEC-WB, 18 Mar 1961; Msg ADCIG 2568, ADC to NYADS, 16 Nov 1961 [Doc 702 in Hist of ADC, Jul-Dec 1961]; Msg NYCCR 4925, NYADS to USAF, 17 Nov 1961 [Doc 703 in Hist of ADC, Jul-Dec 1961]; Msg ADCIG 57469, ADC to USAF Dep IG for Insp, 11 Dec 1961 [Doc 704 in Hist of ADC, Jul-Dec 1961]; Msg ADCCS 2804, ADC to USAF Dep IG for Insp, 13 Dec 1961 [Doc 705 in Hist of ADC, Jul-Dec 1961]; IOC, ADIDC to ADCIG-I-AC, "Report of Capability Inspection, 6th ADMS,...13-15 Nov 1961," 20 Dec 1961 [Doc 706 in Hist

equipment, on technical publications, an on certain tools vital to its mission; while its security was assessed as under par for various reasons. In all, some 17 shortcomings were listed. The 35th, consequently, was declared "not ready to receive nuclear warheads."[20]

But these gloomy findings did not prove permanently disabling. Proper tools and technical publications were procured, intensive training of supervisory personnel was vigorously pursued, and various defects in the squadron's security situation were eliminated. The 26th Air Division's weapons standardization team spent several days at the 35th during December. Re-inspection occurred on 10 January 1962 and the 35th, with little difficulty, passed its initial capability re-inspection. Accordingly, the squadron was pronounced, "ready for receipt of nuclear warheads."[21]

[Cont'd] of ADC, Jul-Dec 1961]; Msg ADCCS 2936, ADC to USAF, 27 Dec 1961 [Doc 707 in Hist of ADC, Jul-Dec 1961]; Msg ADCIG-I 123, ADC to USAF, 16 Jan 1962 [Doc 708 in Hist of ADC, Jul-Dec 1961].

20. Msg NYMVC 61S-4928, NYADS to USAF, 18 Nov 1961 [Doc 709 in Hist of ADC, Jul-Dec 1961]; FORMERLY RESTRICTED DATA, Msg ADCIG-I 61-474, ADC (IG Insp Team) to USAF, 3 Dec 1961 [Doc 710 in Hist of ADC, Jul-Dec 1961].

21. FORMERLY RESTRICTED DATA, Msg 26CIG 052, 26 AD to ADC, 29 Dec 1961 [Doc 711 in Hist of ADC, Jul-Dec 1961]; FORMERLY RESTRICTED DATA, Msg ADCIF-I 62-38, ADC (IG Insp Team) to USAF, 12 Jan 1962 [Doc 712 in Hist of ADC, Jul-Dec

During 1962, 12 nuclear inspections of BOMARC units were accomplished, nine of which were conducted by ADC inspectors and the others by USAF inspectors. While most BOMARC squadrons were discovered to have one or more limiting deficiencies, they were generally not serious enough, except at two squadrons, to warrant an unsatisfactory rating. The deficiencies, in practically all cases, were corrected with alacrity. Although the Canadian government still prohibited MK-40 nuclear warheads on Canadian soil during this time, one of the two Canadian BOMARC sites was given, and successfully passed, an Initial Capability Inspection. Lt. General W. H. Blanchard, the USAF Inspector General, was apparantely impressed when he personally witnessed BOMARC technicians in action,[22] declaring:

> I saw operating room technique in the mating of a nuclear warhead on air defense missile BOMARC. The strictness of the technique went something like this: One man reading the check list, another airman picking up and passing the proper tool to a mechanic who performed the operation, the check list man being sure that the function was properly executed - 'scalpel, suture, sponge!'

[Cont'd] 1961]; FORMERLY RESTRICTED DATA, Msg ADCIG-I 164, ADC to USAF, 22 Jan 1962 [Doc 713 in Hist of ADC, Jul-Dec 1961].

22. ADC Munitions Bulletin, No. 63-5, 15 May 1963, p. 1 [DOC 26].

[redacted]

An operating room technique practiced daily by our nuclear Air Force technicians.

The two sites that did not have so easy a time of it during their first tests of 1962 were the 22nd ADMS (Langley) and 30th ADMS (Dow). The 22nd was found blameworthy for permitting uncertified loading crew members and supervisors to mate and detach nuclear warheads -- guilt for which, taken alone, constituted grounds for an unsatisfactory rating. Moreover, management and supervision of the weapons training program proved unacceptable, partly because a qualified nuclear armament officer had not yet been assigned. The squadron, accordingly, was stigmatized with an unsatisfactory rating by the inspection team in September. Personnel changes were soon effected at the 22nd and an intensive retraining program was completed, whereupon armament personnel were recertified for handling and servicing nuclear warheads. About six weeks after the unsatisfactory test, from 31 October to 1 November, the squadron was subjected to, and passed, a re-inspection of its nuclear activities.

The 30th ADMS at Dow had committed certain censurable mistakes during an inspection in early October for which it, too, received an unsatisfactory rating. Besides having

an uncertified person handling nuclear armament, the 30th lacked a positive safeguard for barring unauthorized personnel access to warhead areas, and certain weapons tools had not been procured. Most of these deficiencies were sufficiently remedied within three weeks time, so that the 30th ADMS, upon re-inspection on 1 to 2 November, passed and was re-stored to its previous nuclear-alert status.[23]

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23. FORMERLY RESTRICTED DATA, Msg ADCIF-I 62-38, ADC to USAF, 12 Jan 1962 [Doc 712 in Hist of ADC, Jul-Dec 1961]; Interview with Lt Cols R.E. Dent, Jr. (3 May 62) and H.R. Junker (9 May 62), ADCIG; Msg AFOOP-DE 93997, USAF to ADC, 19 Jan 1962 [DOC 27]; Msg ADCIG-I-W 343, ADC to USAF, 6 Feb 1962 [DOC 28]; FORMERLY RESTRICTED DATA, Msg ADCIG-I 456, ADC to USAF, 15 Feb 1962 [DOC 29]; Msg ADCIG-I 74-62-234, ADC to USAF, 23 Feb 1962 [DOC 30]; Msg ADCIG-I 764, ADC to USAF, 20 Mar 1962 [DOC 31]; FORMERLY RESTRICTED DATA, Msg 26CIG 007, 26 AD to ADC, 22 Mar 1962 [DOC 32]; FORMERLY RESTRICTED DATA, Msg ADCIG-W 62-549, ADC to USAF, 24 May 1962 [DOC 33]; FORMERLY RESTRICTED DATA/NOFORN EX CANADA, Msg ADCIG ORI Fld Unit 45-62, ADC to USAF, 9 Jun 1962 [DOC 34]; FORMERLY RESTRICTED DATA/NOFORN, Msg ADCIG Fld Insp Team W-62-1, ADC to USAF, 13 Sep 1962 [DOC 36]; NOFORN, Msg 26CIG 032, 26 AD to ADC, 5 Oct 1962 [DOC 37]; Msg ADCIG-W-62-8, ADC to USAF, 2 Nov 1962 [DOC 38]; FORMERLY RESTRICTED DATA/NOFORN, Msg 26CIG 043, 26 AD to ADC, 23 Nov 1962 [DOC 39]; FORMERLY RESTRICTED DATA, Msg ADCIG 3354, ADC to USAF, 4 Dec 1962 [DOC 40]; FORMERLY RESTRICTED DATA, Msg ADCIG-W-62-4, ADC to USAF, 9 Sep 1962 [DOC 41]; FORMERLY RESTRICTED DATA/NOFORN, Msg 26CIG 035, 26 AD to ADC, 26 Oct 1962 [DOC 42]; FORMERLY RESTRICTED DATA, Msg ADCIG-W 62-9, ADC to USAF, 2 Nov 1962 [DOC 43]; FORMERLY RESTRICTED DATA/NOFORN, Msg 26CIG 041, 26 AD to ADC, 20 Nov 1962 [DOC 44]; FORMERLY RESTRICTED DATA/NOFORN, Msg ADCIG 3157, ADC to USAF, 16 Nov 1962 [DOC 45]; Msg AFIWI-C-2C432-62, USAF (Dep IG for Insp) to USAF, 7 Nov 1962 [DOC 46]; Msg AFIWI-C-2 62-1200, USAF (Dep IG for Insp) to USAF, 9 Nov 1962 [DOC 47].

1962 INSPECTIONS

Unit	Base	Month	Result	Type Inspection
35 ADMS	Niagara Falls	Jan	Satisfactory	ADC Initial Capability Re-Inspect.
446 SAM (Canada)	North Bay	Feb	Satisfactory	ADC Initial Capability Inspection
74 ADMS	Duluth	Feb	Satisfactory	ADC Capability
26 ADMS	Otis	27 Feb-2 Mar	Satisfactory	USAF Spot Inspection
35 ADMS	Niagara Falls	May	Satisfactory*	ADC Capability
46 ADMS	McGuire	Jun	Satisfactory	ADC Capability
22 ADMS	Langley	Sep	Unsatisfactory	ADC Capability
30 ADMS	Dow	Oct	Unsatisfactory	ADC Capability
22 ADMS	Langley	31 Oct-1 Nov	Satisfactory	ADC Capability Re-Inspection
30 ADMS	Dow	Nov	Satisfactory	ADC Capability Re-Inspection
6 ADMS	Suffolk	Nov	Satisfactory*	USAF Spot Inspect.
35 ADMS	Niagara Falls	Nov	Satisfactory*	USAF Spot Inspect.

* No major defects found to limit the squadron's capability.

The number of BOMARC inspections conducted during 1963 amounted to eleven, all of which were performed by ADC inspectors. Ten of the eleven ended with satisfactory grades. Seven of the units earned satisfactory ratings without shortcomings serious enough to limit their operational capability; the three squadrons that passed but possessed pronounced defects soon corrected them. Since Canada, in late 1963, agreed to accept nuclear warheads under U.S. control, as noted above, Canadian BOMARC squadrons were scheduled thereafter for periodical inspection.[24]

24. FORMERLY RESTRICTED DATA/NOFORN, Msg ADCIG ORI Fld Unit 63-3-11, ADCIG ORI Team to USAF, 15 Mar 1963 [DOC 48]; FORMERLY RESTRICTED DATA, ADC ORI of Bangor ADS, Capa Insp of 30 ADMS 4-7 Mar 1963, 16 Mar 1963, pp. D-14, D-17 [DOC 49]; FORMERLY RESTRICTED DATA/NOFORN, Msg ADCIG-R 1547, ADC to USAF, 16 Apr 1963 [DOC 50]; FORMERLY RESTRICTED DATA/NOFORN, Msg ADCIG-R 1665, ADC to USAF, 26 Apr 1963 [DOC 51]; FORMERLY RESTRICTED DATA/NOFORN, Msg ADCIG ORI Fld Unit 19-1-2 1383, ADC ORI Team to USAF, 29 Aug 1963 [DOC 52]; FORMERLY RESTRICTIVE DATA, Msg ADMDC 4019, ADC to 26 AD, 5 Sep 1963 [DOC 53]; FORMERLY RESTRICTED DATA/NOFORN, Msg 26CIG 178, 26 AD to ADC, 19 Sep 1963 [DOC 54]; FORMERLY RESTRICTED DATA/NOFORN, Msg ADCIG ORI Fld Unit 63-21-2, ADCIG ORI Team to USAF, 16 Sep 1963 [DOC 55]; FORMERLY RESTRICTED DATA/NOFORN, Msg ADCCS 5328, ADC to USAF, 18 Oct 1963 [DOC 56]; FORMERLY RESTRICTED DATA/NOFORN, Msg ADCIG ORI-CI Fld Unit 63-24-2, ADC ORI Team to USAF, 18 Oct 1963 [DOC 57]; FORMERLY RESTRICTED DATA/NOFORN, Msg ADCIG IG Fld Unit 63-26-1, ADCIG ICI Team to USAF, 8 Nov 1963 [DOC 58]; FORMERLY RESTRICTED DATA/NOFORN, Msg ADCIG ORI-CI Fld Unit 63-30-2, ADC ORI Team to USAF, 23 Nov 1963 [DOC 59]; FORMERLY RESTRICTED DATA/NOFORN, Msg ADCIG ORI Fld Unit 63-33-1, ADCIG IG Team to USAF, 16 Dec 1963 [DOC 59A].

1963 INSPECTIONS

Unit	Base	Month	Result	Type Inspection
30 ADMS	Dow	Mar	Satisfactory*	ADC Capability
6 ADMS	Suffolk County	Apr	Satisfactory*	ADC Capability
37 ADMS	Kincheloe	Apr	Satisfactory*	ADC Capability
74 ADMS	Duluth	Jul	Unsatisfactory	ADC Capability
74 ADMS	Duluth	Aug	Satisfactory*	ADC Capability Re-Inspection
26 ADMS	Otis	Aug	Satisfactory	ADC Capability
22 ADMS	Langley	Sep	Satisfactory	ADC Capability
35 ADMS	Niagara Falls	Oct	Satisfactory*	ADC Capability
446 SAM (Canada)	North Bay	Nov	Satisfactory*	ADC Initial Capability
46 ADMS	McGuire	Nov	Satisfactory	ADC Capability
447 SAM (Canada)	La Macaza	Dec	Satisfactory*	ADC Initial Capability

* No major defects found to limit the squadron's capability.

The single instance of an unsatisfactory rating during 1963 stemmed from an ADC Capability Inspection of the 74th ADMS (Duluth), held from 10 to 13 July. Discrepancies abounded in several categories of activity. Maintenance had been performed on war reserve warheads by airmen whose certification for this work had lapsed; inadequacies cropped up in the training program and in the administration and management of the armament section; and weaknesses were detected in the security control system. The 30th Air Division thereupon rushed certified armament personnel from the 37th ADMS (Kincheloe) to the 74th to perform warhead maintenance until corrective measures were completed. Within a month's time, all that had been found wrong was righted: armament personnel underwent rigorous training concluding with their proper certification; and the training program, among other things, was extensively revamped. From 13 to 15 August, the 74th ADMS underwent, and successfully passed, a capability re-inspection without detection of any major shortcomings that would hamper the squadron's future operational capability.[25]

25. FORMERLY RESTRICTED DATA, ADC ORI of 74 ADMS, Capa Insp Portion, 17 Jul 1963, pp. 11-14 [DOC 60]; NOFORN EX CANADA, Msg 30-NOOP S-1133-63, 30 NORAD Rgn to NORAD, 16 Jul 1963 [DOC 61]; Msg 30-MME-D-S-1164-63, 30 AD to ADC,

[redacted]

NUCLEAR MISHAPS

Regardless of how carefully safety rules and check lists were composed and disseminated, how assiduously inspection teams checked tactical BOMARC sites, and how thoroughly nuclear weapon technicians were trained in the art of handling and working with warheads, the command was sure to suffer mishaps. Although the accident rate objective never ceased being zero per cent, ADC personnel handled hundreds of warheads every month. The opportunity for error was manifold and the Law of Chance had to be reckoned with. But despite the growing number of BOMARC CIM-10A/B missiles integrated into the command from late 1959 to 1963, the number of mishaps involving ADC's MK-40 warheads declined, especially after 1961, testifying to the effectiveness of the nuclear operating, training, inspection and safety programs. Four years skipped by without a nuclear catastrophe -- that most decisive of all criteria for judging the success or failure of ADC's nuclear safety efforts.

[Cont'd] 14 Aug 1963 [DOC 62]; Msg 74-63-590, 74 ADMS to USAF, 15 Aug 1963 [DOC 63]; FORMERLY RESTRICTED DATA/NOFORN, Msg ADCCS 3004, ADC to USAF, 21 Aug 1963 [DOC 64].

[redacted]

Only CIM-10A missiles were involved in mishaps during 1960 since CIM-10B squadrons were not formed and equipped until 1961-62. Some 48 episodes in all were reported in 1960, involving accidents, incidents, one-time instances of damage, and hazards mostly minor in nature. Among those involving tactical CIM-10A's in ready storage, equipped with warheads, were several inadvertent erections. Without purposely actuating them, the roofs of four shelters, on 1 May, 24 May, 30 July and 30 September 1960, suddenly parted and the CIM-10A's theretofore laid out horizontally rose upright in their coffin-like structures. In most cases, certain electrical plugs and jacks had corroded, causing a short-circuiting that resulted in the erections. The corroded elements were quickly exchanged for good ones to prevent further mishaps of this kind. Fortunately, no damage ensued.[26]

Two accidents occurred in 1960 that did result in serious damage, however. The first, which took place at the 46th ADMS (McGuire) on 7 June 1960, was the worst BOMARC accident as of this writing, and perhaps the worst involving all of ADC's nuclear weapons, the MB-1 and GAR-11 included.

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26. RESTRICTED DATA, Rpt, ADC Proj 10B, "Summary of the ADC Missile/Nuclear Accident Safety Experience for 1960," 27 Jan 1961 [Doc 714 in Hist of ADC, Jul-Dec 1961].

[redacted]

A CIM-10A fitted with MK-40 warhead caught fire and burned. Both missile and warhead were destroyed, the fire being caused by a defective helium tank that exploded, scattering fragments in all directions. While fortunately no atomic detonation ensued, a chain of events was started that, in effect, partially disabled the CIM-10A force for more than a year. The helium tanks of all CIM-10A missiles in ready storage were, for safety's sake, depressurized from 4,300 pounds per square inch (psi) to recovery pressure at 2,150 psi -- about half their operational readiness and launching pressure -- relegating CIM-10A's to a limited standby capacity since it would take hours to restore all missiles to full 4,300 psi. Helium tanks were inspected by a field team and an inspection board at Boeing, and defective ones were replaced. But, laboratory tests conducted on helium tanks to simulate a decade of service life in a few month's time demonstrated that the tanks, though seemingly flawless, were subject to rupture when kept at 4,300 psi. Then, in 1961, a solution was adopted in Engineering Change Proposal (ECP) 391-4. By adding a 7,000 psi external helium "top-off" tank to each CIM-10A shelter, and maintaining the shelter's missile at only 3,000 psi helium pressure, ECP 391-4 promised both restoration

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of the system to its intended two-minute alert capability, and protection of the system from the hazards of exploding helium tanks. Subsequent to the application of ECP 391-4, the helium pressure within the combat-ready missile was boosted from its regular 3,000 psi to full 4,300 psi pressure during the last 30 seconds before launch. By the end of October 1961, the modification of all CIM-10A shelters was completed, and the missiles, after more than a year on standby status,[27] resumed a two-minute alert status.

The danger from exploding helium tanks, however, was not the sole cause for anxiety as regards CIM-10A safety. BOMARC accidents, of course, could stem from other causes, such as the one responsible for the second 1960 accident at the Suffolk site in August. During a launch equipment check-out (LECO) of an CIM-10A, the missile was erected by the erector arm, as programmed. But then the nose clamps on the erector arm failed to release the missile once it reached its vertical firing position. Consequently, when the erector arm returned to its horizontal position, the

27. Msg NYCVC 2799, NYADS to DFMSR (Norton AFB), 24 Jun 1961 [Doc 192 in Hist of ADC, Jan-Jun 1960]; Hist of ADC, Jan-Jun 1960, pp. 113-17; Hist of ADC, Jul-Dec 1960, pp. 181-87; Hist of ADC, Jan-Jun 1961, pp. 161-64; Hist of ADC, Jul-Dec 1961, pp. 251-52.

[redacted]

CIM-10A, instead of remaining upright, was pulled down too. Although the aft end of the boattail was badly damaged, there was no apparent damage to the launch shelter, and more important, to the nuclear warhead. Since the nose of the CIM-10A remained clenched between the nose clamps of the erector arm, technicians were forced to dig out the warhead by cutting through an access panel. The nose clamp unlock relay was repaired to prevent similar accidents in the future.[28]

Although the number of BOMARC mishaps amounted to more than forty-five during 1961, only three, as regards tactical BOMARCS, were more than minor in nature. The first of these occurred 28 March at the 6th ADMS (Suffolk County), when a CIM-10A, fully fueled and containing a safetied warhead, damaged its chilled water hoses which failed to disengage from the missile during an erection cycle. Again in July at the same squadron, a CIM-10A in ready storage erected inadvertently because of water seepage

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28. Msg 26MME-DC 8-321, 26 AD to Air Def Sectors, 16 Aug 1960 [Doc 224 in Hist of ADC, Jul-Dec 1960]; Msg AFCNS-O-A-8-65-60E, Dep IG for Safety (Suffolk) to Dep IG for Safety (Kirtland), 17 Aug 1960 [Doc 225 in Hist of ADC, Jul-Dec 1960]; RESTRICTED DATA, Rpg, ADC, Project 10B, "Summary of the ADC Missile/Nuclear Accident Safety Experience for 1960," 27 Jan 1961 [Doc 714 in Hist of ADC, Jul-Dec 1961].

[redacted]

that had short-circuited various electrical connections. And, on 6 September, at the 26th ADMS (Otis), the chilled water "quick disconnect" hydraulic cylinder failed to retract properly during a missile erection sequence, and some damage ensued.[29]

BOMARC units, counting both test and tactical squadrons, experienced fewer mishaps in 1962 than the year before, as might be expected because of improved safety factors and the increased experience gained by armament technicians. There were 17 mishaps reported in all. The more serious ones during 1962 occurred at the 22nd ADMS (Langley) on 30 January and 13 August, the 35th ADMS (Niagara) on 15 June, the 6th ADMS (Suffolk County) on 21 September, and the 46th ADMS (McGuire) on 27 December. The two at Langley involved

29. Msg CSA-642, 6 ADMS to USAF, 28 Mar 1961 [Doc 757 in Hist of ADC, Jul-Dec 1961]; Msg OONATI 38203, OOAMA to ADC, 16 May 1961 [Doc 758 in Hist of ADC, Jul-Dec 1961]; Missile Hazard Rpt, 6 ADMS to NYADS, 21 Jul 1961 [Doc 759 in Hist of ADC, Jul-Dec 1961]; Msg ADCSA-M 44328, ADC to 26 AD, 5 Sep 1961, [Doc 760 in Hist of ADC, Jul-Dec 1961]; Msg MNS 1348, 26 ADMS to USAF, 15 Sep 1961 [Doc 761 in Hist of ADC, Jul-Dec 1961]; Msg OONATI 68793, OOAMA to 26 ADMS, 5 Oct 1961 [Doc 762 in Hist of ADC, Jul-Dec 1961]; Msg WSM 1405, 26 ADMS to USAF, 15 Sep 1961 [Doc 763 in Hist of ADC, Jul-Dec 1961]; IOC, ADCSA-A to ADMME-DB, "Missile/Nuclear Accident Experience 1961," 8 Dec 1961 [Doc 715 in Hist of ADC, Jul-Dec 1961]; IOC, ADCSA-M to Members Missile/Nuclear Safety Council, "Minutes of Missile/Nuclear Safety Council Meeting," 10 Aug 1961 [Doc 588 in Hist of ADC, Jul-Dec 1961].

[redacted]

missile erections, the first an unintentional CIM-10B erection during an FCO check because of a circuitry malfunction, and the second a scheduled erection ending with a damaged CIM-10A. During the episode on 30 January at Langley, the CIM-10B involved, before reaching the height of its involuntary journey (60 to 70 degrees up), knocked over a personnel radiation screen, scooped up cables and other accessories, and broke the chilled water connector and external hydraulic pressure line bracket. To prevent future accidents of this sort when circuitry malfunctions occurred, ADC directed that prior to starting an FCO check, the shelter hydraulic system be inactivated and the pressure reduced to zero. The CIM-10A damage at Langley in August resulted when noseclamp open-limit switches, in the course of a missile erection cycle, failed to operate, causing the missile to strike the erector boom as the boom swung down. A check on 148 other shelters revealed another 16 faulty noseclamp open-limit switches. A new switch was devised to avert future mishaps of this kind. A warhead-equipped CIM-10B undergoing a periodic inspection at the 35th ADMS in June suffered damage to its right elevator and horizontal stabilizer because a control surface lock had not been

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previously unfastened as called for. The trouble occurring in September at the 6th ADMS was caused by broken tubing in a CIM-10A that allowed acid to leak from the missile. And near the end of the year, on December 27, a CIM-10B in ready storage at the 46th ADMS (McGuire), with warhead mated, was discovered to have had a squib that accidentally fired, a programming timer that ran down to T minus two seconds, and ammonia that exuded from the missile.[30]

Calendar year 1963 enjoyed considerable relief from nuclear mishaps, experiencing but 14 in all. And most of these were trivial by comparison with the mishaps of former years. The four of most consequence involved: (1) shredded insulation discovered on a warhead detonator cable at the 6th ADMS (Suffolk) on 7 May; (2) ramjet flares that ignited

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30. Msg 22CAS 1-05, 22 ADMS to USAF, 31 Jan 1962; Msg ADMME DC (no #) ADC to 30 AD, et al, 1 Feb 1962 [ADCSA files]; RESTRICTED DATA, Msg CSA-35 62-675, 35 ADMS to USAF, 26 Jun 1962 [DOC 65]; Rpt, OAMA to Dep IG for Safety USAF, "Report of Missile Incident Involving IM-99A, 59-1941, 13 Aug 1962," 18 Dec 1962 [ADCSA files]; Msg 6CSA 1516, 6 ADMS to ADC, 27 Sep 1962 [DOC 66]; Msg 46CSA 1-10, 46 ADMS to USAF, 3 Jan 1962 [DOC 67]; Msg 46CSA 1-21, 46 ADMS to USAF, 4 Jan 1962 [DOC 68]; ADC, Charts and Graphs, ADCSA, "Summaries of 1961-62 Air-to-Air and Ground-to-Air Accidents/Incidents," n.d. ca. Jan 1963 [Doc 313 in ADC Historical Study No. 20, Nuclear Armament: Its Acquisition, Control and Application to Manned Interceptors 1951-1963].

on CIM-10A (containing a warhead) at this same squadron on 16 June because of a short circuit arising from a corroded electrical connection; (3) two cracks found in the neutron generator of a warhead at the 37th ADMS (Kincheloe) on 9 October resulting from a materiel defect; and (4) leaking ammonia that discolored the warhead of a CIM-10A at the 46th ADMS (McGuire) on 18 November.[31]

31. RESTRICTED DATA, Msg 6CSA-S82-3, 6 ADMS to NYADS, 8 May 1963 [ADCSA files]; FORMERLY RESTRICTED DATA, Msg 63SAWMT S 20319, SAAMA to DNS (Kirtland), 26 Jul 1963 [ADCSA files]; FORMERLY RESTRICTED DATA, Msg 6CSA-C25-63, 6 ADMS to USAF, 16 Jun 1963 [DOC 69]; RESTRICTED DATA, Msg 37CCR 96/36, 37 ADMS to USAF, 10 Oct 1963 [ADCSA files]; RESTRICTED DATA, Msg 37-MME/QC 103/63, 37 ADMS to OOAMA, 16 Oct 1963 [ADCSA files]; Msg ADMME-EB 5678, ADC to 26 and 30 AD, 21 Nov 1963 [DOC 70].

Summarized in tabular form, the cumulative experience of BOMARC mishaps from 1960 to 1963* involving test missiles without warheads and tactical missiles with warheads, were as follows:[32]

	Materiel Failures	Personnel Errors	Total
1960 (CIM-10A's)	31	17	48
1961 (CIM-10A's and B's)	38	16	54
1962 (CIM-10A's and B's)	11	6	17
1963 (CIM-10A's and B's)	8	6	14

32. RESTRICTED DATA, Rpt, ADC, Proj 10B, "Summary of the ADC Missile/Nuclear Accident Safety Experience for 1960," 27 Jan 1961 [Doc 714 in Hist of ADC, Jul-Dec 1961]; IOC, ADCSA-A to ADMME-DB, "Missile/Nuclear Accident Experience 1961," 8 Dec 1961 [Doc 715 in Hist of ADC, Jul-Dec 1961]; ADC, Charts and Graphs, ADCSA, "Summaries of 1961-62 Air-toAir and Ground-to-Air Accidents/Incidents," n.d. ca. Jan 1963 [Doc 313 in Historical Study No. 20, Nuclear Armament: Its Acquisition, Control and Application to Manned Interceptors 1951-1963]; ADC Chart, ADCSA "BOMARC-Drone Missile Incidetn Summary 1963," as of 12 Dec 1963 [DOC 71].

* Most of the mishaps were incidents, one-time damage reports, and hazardous situations; no mishaps in the more serious accident category occurred during 1962 and 1963, and very few accidents occurred in 1960 and 1961.

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GLOSSARY OF TERMS USED IN MILITARY CHARACTERISTICS FOR A 22 INCH OUTSIDE DIAMETER ATOMIC WARHEAD FOR AIR DEFENSE USE

The following terms and definitions thereof, which are in consonance with existing AEC/DOD definitions, are included for clarity of purpose and prevention of misunderstandings.

1. Nuclear System -- That portion of the warhead which provides the nuclear reaction. This system normally consists of all of the nuclear and non-nuclear material contained in the capsule, pit, pit liner, tamper and trap door. Some of the listed items may or may not be used depending on the design.

2. Nuclear Safing System -- That portion of a weapon that integrally contains all the apparatus which, on receipt of proper signals from the arming system or by manual operation, functions so as to place the nuclear system in an armed or safed condition.

3. Implosion System -- That portion of the atomic weapon which provides the compression necessary to cause the nuclear system to function. This system will normally consist of the high explosive, detonators and the necessary structure to combine these parts into an entity.

4. Firing System -- That portion of the weapon which, upon signal from the arming system, transforms, stores, and, upon signal from the fuzing system, discharges this stored electrical energy to detonate the implosion system. This system will normally consist of the firing set, firing switch, load coils, load plates, detonator cables, other interconnecting cables and structures.

5. Warhead -- Includes the nuclear system, nuclear safing system, implosion system, firing system, plus the hardware required to hold these parts together, cabling to interconnect the internal electrical circuits and the necessary electrical connectors to join the warhead systems to the adaption kit. The power supply, derivation of arming and firing signals and special hardware needed to mount the warhead in its compartment are specifically excluded.

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6. Arming System -- That portion of the weapon which derives (originates) the signals required to arm, safe or re-safe the firing system and the fuzing system and to actuate the nuclear safing system. The arming system will normally consist of pullout systems, arming baros or similar components.

7. Fuzing System -- That portion of the weapon which derives the signals which discharge the firing system. This system normally consists of such components as pressure, proximity, time or acceleration sensing elements.

8. Power Supply -- This is the basic source of power which provides the electrical energy needed for the operation of an atomic weapon.

9. Adaption Kit -- Those items peculiar to the warhead installation less the warhead; namely, the arming and fuzing systems, power supply and all hardware, adaptors, etc., required by a particular installation.

10. Warhead Installation -- Consists of the warhead and the adaption kit.

11. Warhead Dud Probability -- The probability that the warhead fails to produce a nuclear detonation after receipt of the proper signals from the adaption kit.

12. Warhead Premature Probability -- The probability of a nuclear detonation prior to receipt of a firing signal from the adaption kit at the intended point along the trajectory of the warhead carrier.

13. Warhead Delay Probability -- The probability of a delayed nuclear detonation after receipt of a firing signal from the adaption kit at the intended point along the trajectory of the warhead carrier.

14. Nuclear Disaster Zone -- That portion of a missile trajectory below the safe burst height, including both the location of the launcher and any possible point of ground impact.

15. Safe Burst Height -- That height, above which, if a nuclear explosion occurs, only an acceptable degree of damage will occur to ground installations.

16. Warhead Functional Readiness Condition -- That condition of the warhead requiring only vacuum tube warmup time to use it in combat.

WEAPON PERFORMANCE CHARACTERISTICS

	BOMARC CIM-10A	BOMARC CIM-10B
Boost Propulsion	40 sec-thrust integral liquid rocket motor. 35,000 lb thrust at sea level.	25 sec-thrust integral solid rocket motor. 50,000 lb thrust at sea level.
Cruise Propulsion	Twin Ramjets. 0 thrust at sea level. 3,000 lb thrust at 65,000 ft.	Twin Ramjets. 4,000 lb thrust at sea level.
Cruise Altitude	65,000 ft.	71,000 ft.
Cruise Speed	Mach 2.6	Mach 2.7
Maximum Intercept Altitude	65,000 ft.	82,000 ft.
Minimum Intercept Altitude	10,000 ft.	0 ft.
Tactical Range	230 NM.	420 NM (High alt) 280 NM (Low alt)
Warhead	Nuclear, proximity fuse detonation	Nuclear, proximity fuse detonation.
"G" Limits	1.5 - 7.5 Mid-course 3.0 - 7.5 dive	1.5 - 7.5 Mid-course 3.0 - 7.5 dive
Reaction Time	1 min. 30 sec. warm-up, 30 sec. launch cycle.	30 sec. warm-up and launch cycle.

	BOMARC CIM-10A	BOMARC CIM-10B
Guidance		
- Initial	Internal pre-set; gimbaled booster.	Internal pre-set; booster exhaust deflection vanes.
- Mid-course	Special GAT radio. Command Data Link.	SAGE radio. Data Link system.
- Terminal	Active pulse-type homing radar.	Active pulse-doppler homing radar.
Influence Fuse Range	400 ft.	3,000 ft.

The CIM-10 (BOMARC) is a pilotless, all-weather, supersonic, Boeing long range interceptor missile. Two models of the BOMARC are produced, the CIM-10A and CIM-10B. The CIM-10A contains a liquid rocket booster, while the CIM-10B has a solid propellant boost system. The characteristics of propellants and missile design changes result in differences of speed, range and altitude and, consequently, necessitate changes in operational and supply procedures affecting the training, manpower and organization and installation of requirements. A CIM-10B site will have 28 launcher shelters for each 29 missiles; however, Niagara will be augmented with an additional 20 missiles and 20 launcher shelters for a full complement of 49 missiles and 48 launcher shelters.