

ADC HISTORICAL STUDY NO. 18



**INTERCEPTOR
MISSILES
1962-1963**

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INTERCEPTOR MISSILES, 1962-1963

SUMMARY

(b)(3) 42 USC § 2162 (Atomic Energy Act of 1954)

DOE
(b)(3)

In 1955 ADC had planned to deploy 4,800 BOMARC missiles at 40 sites around the eastern, northern and western borders of the United States. The eight sites finally built in the northeastern quadrant were equipped with 347 missiles (174 of the early IM-99A model and 170 of the longer-range IM-99B) as of late August 1963. The total number of missiles

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(b)(3) 42 USC § 2162 (Atomic Energy Act of 1954)

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DOE
(b)(3)

Since the BOMARC became fully operational at the prescribed eight U.S. sites in 1962, it might have been logical to assume that testing of the missile had been completed at that time, but such was not the case. To be sure, all testing of the IM-99A and Category II testing of the IM-99B was completed in 1962, but Category III testing of the IM-99B continued until August 1963. * Test activity was much diminished in 1962 and 1963 in comparison with 1961. While 61 test missiles were launched in 1961, only 19 were sent aloft in 1962, and only seven in 1963.

The rapidity with which air defense weapons became obsolescent was graphically demonstrated in August 1963. On 19 August the BOMARC test program was completed with the

(b)(3) 42 USC § 2162 (Atomic Energy Act of 1954)

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DOE
(b)(3)

* Category I testing was primarily a contractor effort under the supervision of AFSC. Category II testing was, in a sense, acceptance testing, primarily an AFSC effort with assistance from the contractor. Category III was intended to indicate how the weapon would operate in a normal tactical squadron environment. It was primarily an ADC effort with assistance from AFSC and the contractor. During Category I and II testing the Joint BOMARC Test Organization (JBTO) was supervised by AFSC. During Category III the JBTO was an ADC unit.

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launching of the final IM-99B Category test missile. Two days later, 21 August, USAF announced that the Secretary of the Air Force had forwarded to the Department of Defense on 8 July a USAF recommendation the IM-99A be phased out of the USAF missile inventory during Fiscal 1965. USAF added, on the strength of expected DOD approval, that valuable operating funds could be saved by commencing phase-out actions in Fiscal 1964. Department of Defense approval was obtained by the end of August and USAF directed ADC to provide, by 1 October 1963, a detailed plan for disposition of the IM-99A. ² The first IM-99A missile had been declared operational on 1 September 1959.

IM-99A TESTING

The last three missiles allotted to the IM-99A test program were launched during the first half of 1962. One of these was the often-postponed demonstration of the capability of the IM-99A against the GAM-77 (Hound Dog) air-to-surface missile carried by B-52 bombers.

Only the first of the three 1962 launchings of the IM-99A could be regarded as successful. On 1 February an

2. Msg AFXOPN 88661, USAF to ADC, 21 Aug 1963 [DOC 2]; Msg ADOOP-WM 3012, ADC to CONAD, 23 Aug 1963 [DOC 3]; Msg AFOAPD 90654, USAF to ADC, 29 Aug 1963 [DOC 4].

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IM-99A was sent against an unaugmented QF-104 drone maneuvering at an altitude of 35,000 feet and at a speed of 1.15 Mach. In this instance the test missile made a direct hit at a range of 120 miles. At this point a long series of delays prevented the launching of the second test missile. Between 1 February and early May 1962, eight attempts were made to launch the last of the Category III missiles, but three times the weather interfered, three times the target drone developed mechanical or control problems, once there was a conflict with an IM-99B launching and once the missile control frequency encountered interference from an unknown source. Finally, the missile was launched on 10 May. Again the target was a QF-104 drone, this time at an altitude of 20,000 feet and a speed of 1.08 Mach. But because of malfunctions within the flight control system, the missile missed the target by 1,700 feet. At this distance the proximity fuze would not react.

3. ██████████, Msg 4751CCR 2-044, Eglin Test Br to AFSC, 8 Feb 1962 [DOC 5]; 4751 AD Wg to ADC, "Status of the BOMARC Test Program as of 28 February 1962," 13 Mar 1962 [DOC 6]; 4751 AD Wg to ADC, "Status of the BOMARC Test Program as of 30 Mar 1962," 13 Apr 1962 [DOC 7]; 4751 AD Wg to ADC, "Status of the BOMARC Test Program as of 30 April 1962," 10 May 1962 [DOC 8]; 4751 AD Wg to ADC, "Status of the BOMARC Test Program as of 31 May 1962," 11 Jun 1962 [DOC 9].

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It was originally intended, when the matter of a GAM-77/BOMARC demonstration was first broached by USAF in December 1961, that the IM-99B would be used. So many difficulties were currently being experienced with the IM-99B, however, that it was decided in early 1962 that the IM-99A would be utilized in the demonstration.

Various attempts were made to conduct the GAM-77/BOMARC demonstration in April, May and early June of 1962, but malfunctions in the IM-99A and its control system and recurring problems affecting Hound Dog missiles prevented the actual test. Both weapons systems were never ready at the same time until 27 June when the IM-99A missile set aside for the demonstration was finally launched. The BOMARC reached its preliminary altitude of 69,000 feet without difficulty, but a power failure during the mid-course phase of flight made it necessary to destroy the missile after it was airborne only 306 seconds and long before it reached the area where the Hound Dog was to be encountered. This, of course, was not a valid demonstration of the capability of the IM-99A against the GAM-77. There was little possibility of re-scheduling the GAM-77/BOMARC demonstration, because the failed IM-99A missile was the last of those scheduled for

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test use. In the test series which extended back to September 1952, the test organization had launched 134 IM-99A missiles.

IM-99B TESTING

The test program for the IM-99B ended 1961 on a note of frustration. Three of the last four missiles launched in 1961 failed to complete the mission because of a perplexing series of control system malfunctions. The IM-99B launched 17 October 1961 rolled abnormally during the early stages of flight and crashed 12 miles from the launcher. The mission of 21 November failed when the flight control system directed the missile to engage in such violent maneuvers that it disintegrated at 30,000 feet. On 13 December the test missile rose to 71,000 feet, transitioned to level flight, then went into a series of rolls that ended with an uncontrolled dive into the Gulf. None of the malfunctions followed a pattern that gave test personnel a good clue as to the specific

4. 4751 AD Wg to ADC, "Status of the BOMARC Test Program as of 30 April 1962," 10 May 1962 [DOC 8]; 4751 AD Wg to ADC, "Status of the BOMARC Test Program as of 31 May 1962," 11 Jun 1962 [DOC 9]; Det 1, MOADS to ADC, "Status of the BOMARC Test Program as of 30 June 1962," 11 Jul 1962 [DOC 10]; Msg 4751 ODC-TI-013, 4751 AD Wg to ADC, 3 Jan 1962 [DOC 11]; Msg ADOOP-WM 101, ADC to 4751 AD Wg, 12 Jan 1962 [DOC 12]; Msg SCSAD-23-1-37, AFSC to SAC, 23 Jan 1962 [DOC 13]; Msg AFORQ-AD 95075, USAF to AFSC, 23 Jan 1962 [DOC 14]; Msg ASZDBT-20-2-51, ASD to IM-99B Field Test Br, 20 Feb 1962 [DOC 15].

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problem. All that could be said was that the control system, in general, was not working as it should. Also, the test program was behind schedule at the end of 1961. Earlier schedules had called for the completion of Category II testing of the IM-99B in 1961. At the end of the year, however, five Category II test missiles remained to be launched. In addition, 18 Category III launches were expected in 1962.

Category II testing of the IM-99B was completed in May 1962, but seven Category III missiles still remained to be launched in 1963, although the schedule in effect at the beginning of 1962 called for the completion of all BOMARC testing by 1 November of that year. In all, 16 IM-99B test missiles were launched in 1962, an average of slightly more than one a month.

The test organization attacked the problem of flight control anomalies by requiring more stringent pre-launch inspection of test missiles. And in the face of three successful test missions (all Category II) during the first three months of 1962, it appeared that this approach to flight control problems had been appropriate. On 31 January 1962 a test IM-99B was launched at an augmented QF-104 flying at Mach 1.2 at an altitude of 35,000 feet and a range of 125

5. Hist of ADC, Jul-Dec 1961, pp. 231-32.

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miles. The missile passed within 25-50 feet of the target. This mission was also noteworthy in that it marked the first flight of the re-designed (ECP 2200) target seeker. A week later, on 7 February, a test missile made a direct hit on a maneuvering QB-47 target fitted with ECM gear. This target was subsonic, flying at Mach .75. Target altitude was 35,000 feet and range was 257 miles. On 21 March 1962, the IM-99B was successful against a much more difficult target -- an unaugmented and maneuvering QF-104 flying at Mach 1.2 in an ECM environment. The test missile passed close enough to the target that the fuze fired. Altitude was 35,000 feet and range was 224 miles.⁶

It was a somewhat different story, however, when the first of the 1962 Category III missiles was launched on 23 March 1962. A power failure which occurred when the missile reached its high cruise altitude (73,000 feet) threw it into such violent maneuvers that the missile broke apart. A similar situation resulted when the next IM-99B missile was launched on 8 April. The mission was a failure

6. ~~XXXXXXXXXXXXXXXXXXXX~~ A, Msg ASZDBF-ME 1-21, Eglin Test Br to AFSC, 3 Feb 1962 [DOC 16]; 4751 AD Wg to ADC, "Status of BOMARC Test Program as of 28 February 1962," 13 Mar 1962 [DOC 6]; Msg ASZDBF-ME 22-3-22, Eglin Test Br to USAF, 23 Mar 1962 [DOC 17]; 4751 AD Wg to ADC, "Status of the BOMARC Test Program as of 30 March 1962," 13 Apr 1962 [DOC 7].

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because the target seeker and fuze system apparently called for so much electrical power that the power system failed again.⁷

Because both the missions of 23 March and 8 April failed as the result of in-flight malfunctions in the electrical power system, the test organization halted testing on 11 April to permit Boeing to look into the problem. Boeing devised a series of 17 tests it conducted on a ground test missile located in Seattle, but concluded that no particular subsystem or combination of subsystems was at fault. Boeing merely recommended that missile handling techniques be reviewed and that subsequent test missiles be fitted with special telemetry equipment to check the in-flight operation of the high voltage power supply system. Boeing also recommended that test launchings be resumed.⁸

The 20th, and last, missile in the IM-99B Category II test series was therefore launched 16 May 1962. Whether or not the electrical power system would have acted properly

7. Msg ASZDBF-ME 24-3-23, Eglin Test Br to USAF, 26 Mar 1962 [DOC 18]; Msg ASXDBR-ME 30-3-27, Eglin Test Br to ADC, 31 Mar 1962 [DOC 19]; 4751 AD Wg to ADC, "Status of the BOMARC Test Program as of 30 March 1962," 13 Apr 1962 [DOC 7]; 4751 AD Wg to ADC, "Status of the BOMARC Test Program as of 30 April 1962," 10 May 1962 [DOC 8].

8. 4751 AD Wg to ADC, "Status of the BOMARC Test Program as of 30 April 1962," 10 May 1962 [DOC 8].

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was not determined, because the control system put the missile into such a steep climb that the ramjet engines "blew out" only 34 miles from the launch site. Category II testing thereby ended on a negative note.

At this point, ADC became concerned over the slow rate of IM-99B testing. Only six test missiles had been launched during the first five months of 1962, a rate that would definitely preclude completion of IM-99B testing by the scheduled date of 1 November 1962. Part of the delay, ADC contended, lay in the low priority given the IM-99B test program by the Gulf Test Range. ADC pointed out that the shortage of drones and the infrequency of the periods the range was available for IM-99B launches were both factors in the delays being experienced. AFSC responded promptly with promises that these problems would be corrected and ADC was satisfied with the AFSC response.

As a result of the ADC complaint and subsequent AFSC action, four test missiles were launched in June 1962. Only one of the four successfully completed a mission, however.

9. ~~SECRET~~ (NOFORN EX CANADA), Msg ASXDBF-ME 18-5-23, Eglin Test Br to USAF, 20 May 1962 [DOC 20]; 4751 AD Wg to ADC, "Status of the BOMARC Test Program as of 31 May 1962," 11 Jun 1962 [DOC 9].

10. Msg ADCCS 1422, ADC to 32 AD, 24 May 1962 [DOC 21]; Msg SCSAD 19-6-41, AFSC to ASD, 19 Jun 1962 [DOC 22].

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This was the first of the June launchings, accomplished on 5 June. On this occasion, the test missile intercepted a maneuvering QB-47 flying at Mach .75 at a range of 250 miles and an altitude of 35,000 feet. The missile passed within 58 feet of the target and the fuze fired. No power system malfunctions were noted. The remainder of the June launchings were failures. The missile launched 14 June encountered a malfunction in the variable frequency oscillator. As a result the target seeker never had a chance of acquiring the target. The mission of 27 June was a failure because the missile was given incorrect commands and never reached the target area. Also, the test missile was destroyed 11 seconds before the programmed time of interception. Destruction was not ordered from the ground, so the test organization was at somewhat of a loss as to why it occurred, although some malfunction in the electrical system was suspected. The following day, 28 June, the test missile did not intercept the target QF-104 because of erratic operation of the target seeker.

11. ~~SECRET/NOFORN~~, Msg ASZDBF-ME 766, Eglin Test Br to ADC, 8 Jun 1962 [DOC 23]; ~~SECRET/NOFORN~~, Msg ASXDBF-ME 15-6-10, Eglin Test Br to USAF, 16 Jun 1962 [DOC 24]; ~~SECRET/NOFORN~~, Msg ASXDBF-ME 29617, Eglin Test Br to SAGE Proj Off (New York), 30 Jun 1962 [DOC 25]; ~~SECRET/NOFORN~~, Msg ASZDBF 29615, Eglin Test Br to ADC, 1 Jul 1962 [DOC 26].

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It was again obvious, as it had been in April 1962, that something was radically wrong with the electrical system of the IM-99B, especially as it affected the target seeker. A concentrated effort to run down the source of these problems was made in late June and July. All target seekers were recycled through the Westinghouse plant in Baltimore to make sure that they met manufacturing specifications. Three missiles were sent back to the Boeing plant in Seattle for the same reason. The Mobile Inspection Units (MIU) were thoroughly examined in an attempt to discover why missiles were able to pass the MIU ground test but fail in flight. This intensive investigation of the causes of test failures made it impossible to accomplish any test launches between 28 June and 10 August 1962 and made it increasingly unlikely that the BOMARC test program would be completed by 1 November 1962.

12. Msg ASZDB 6-7-14, ASD to AFPRO Boeing (Seattle), 6 Jul 1962 [DOC 27]; Msg MOB-PO 7-5, Eglin Test Br to ADC, 10 Jul 1962 [DOC 28]; Msg MOB-P 1-7-14, Eglin Test Br to ASD, 17 Jul 1962 [DOC 29]; Msg MOB-P 23-7-21, Eglin Test Br to ADC, 23 Jul 1962 [DOC 30]; Det 1, MOADS to ADC, "Status of the BOMARC Test Program as of 30 Jun 1962," 11 Jul 1962 [DOC 10]; Det 1, MOADS to ADC, "Status of the BOMARC Test Program as of 31 July 1962," 10 Aug 1962 [DOC 31]; Msg ADOOP-WM 1922, ADC to Air Divs, 18 Jul 1962 [DOC 32]; Msg ADOOP-WM 1988, ADC to ASD, 26 Jul 1962 [DOC 33].

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After the extensive effort devoted to investigation of quality control procedures, the failure of the 10 August mission was a particular disappointment. The target on this occasion was especially difficult, however, being a maneuvering, unaugmented QF-104 at a range of 224 miles, an altitude of 48,000 feet and a speed of 1.2 Mach. At any rate, although the missile detected the target at a range of 17 miles, the interception was not completed. The missile was launched on a course so far to the right of the course of the target that it was not possible to make corrections rapidly enough to give the target seeker a really good chance to acquire the target.

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Because the time remaining before the 1 November deadline for the completion of testing was growing short, Headquarters ADC, in August 1962, assumed direct control of the Category III test effort. No test missions were to be flown without ADC approval. Launches for the sole purpose of checking SAGE performance were to be halted. No missions were to be flown where the chance of success was less than 95 per cent. A second missile processing crew was to be established and every effort was to be made to have a back-up missile ready for launching whenever a malfunction developed

13. [REDACTED], Msg MOBE 14811, Eglin Test Br to ADC, 15 Aug 1962 [DOC 34].

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in the primary missile. Later in August, four acceptable test mission profiles were established by ADC:

- (1) QB-47 target, head-on at an altitude of 35,000 feet.
- (2) QB-47 target at 35,000 feet turning 27 degrees 40 seconds before the missile began its transition from high search altitude (approximately 70,000 feet) to low search altitude (40,000 feet).
- (3) QF-104 target, augmented with a nine-inch Luneberg lens, head-on at 35,000 feet.

When the IM-99B had progressively scored successes in connection with the first three missions it was to be permitted to attempt the interception of an unaugmented QF-104 in a head-on attack at 48,000 feet. Theoretically, the chance of success of the first three missions was 99 per cent. The probability of success of Mission 4 was figured at 90 per cent. Meanwhile, although AFSC approved of the measures being taken by ADC to expedite completion of BOMARC testing, the unreality of the 1 November deadline had become manifest. On 28 August 1962, AFSC extended the test deadline to 1 January 1963.

14. Msg ADODC 2231, ADC to MOADS, 23 Aug 1962 [DOC 35]; Msg ADODC 2329, ADC to ASD, 31 Aug 1962 [DOC 36]; Msg SCSE 28-8-119, AFSC to ASD, 28 Aug 1962 [DOC 37].

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The interim test program outlined by ADC in August 1962 was generally accomplished in five IM-99B test mission flown between 31 August and 17 October. On 31 August the test missile made a direct hit on a non-maneuvering QB-47 target at a range of 250 miles and an altitude of 35,000 feet. The program called for a second mission against the QB-47, but since none of the subsonic targets were available, the launching of 13 September involved an augmented non-maneuvering QF-104 at 35,000 feet. On this occasion, however, the missile overshot the target because of the failure of the microwave oscillator in the target seeker. This mission was re-run on 27 September, but apparent success (the missile passed within 25-35 feet of the target) was turned to failure when the fuze failed to fire.

ADC was "gravely concerned" over the two consecutive failures to intercept the relatively uncomplicated target presented by the augmented and non-maneuvering QF-104,

15. ~~SECRET/NOFORN~~, Msg MOBE 31830, Eglin Test Br to AFSWC, 1 Sep 1962 [DOC 38]; Msg MOBE 6936, Eglin Test Br to ADC, 7 Sep 1962 [DOC 39]; Det 1, MOADS to ADC, "Status of the BOMARC Test Program as of 31 August 1962," 14 Sep 1962 [DOC 40]; ~~SECRET/NOFORN~~, Msg MOBE 14-47, Eglin Test Br to ASD, 15 Sep 1962 [DOC 41]; ~~SECRET/NOFORN~~, Msg 17-9-49, Eglin Test Br to ADC, 18 Sep 1962 [DOC 42]; ~~SECRET/NOFORN~~, Msg PGYI 27-9-153, APGC to USAF, 27 Sep 1962 [DOC 43]; Det 1, MOADS to ADC, "Status of the BOMARC Test Program as of 30 September 1962," 12 Oct 1962 [DOC 44].

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especially in light of the failure of the fuze to operate properly during the second mission. On the third attempt, however, this particular mission was successful. The missile, launched 4 October 1962, made a direct hit on the target at a range of 225 miles. The test organization was therefore free to send the IM-99B against an unaugmented, but non-maneuvering, QF-104 at an altitude of 48,000 feet. This was done on 17 October 1962. Again, despite the smallness of the target, the mission was a complete success. The missile passed within eight feet of the target and the fuze¹⁶ fired.

Although it had not been planned that way, 1962 testing of the IM-99B ended at that point. The difficulty over Cuba erupted at that time and the SAGE center at Montgomery, Alabama, was required in active air defense. The emergency ended in early December and eight test missions were scheduled during the latter half of that month, but no missiles were actually launched. At the test deadline of 1 January 1963, therefore, seven Category III missiles

16. Msg ADODC 2673, ADC to ASD, 5 Oct 1962 [DOC 45]; ~~XXXXXXXXXX~~, Msg PGYI 17-10-160, APGC to USAF, 17 Oct 1962 [DOC 46]; Det 1, MOADS to ADC, "Status of the BOMARC Test Program as of 31 October 1962," 14 Nov 1962 [DOC 47].

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remained in the test inventory. The test deadline was extended to 31 March 1963.¹⁷

In January 1963, after a hiatus of two-and-a-half months, test launchings were resumed and long-delayed BOMARC/ALRI testing was begun. ALRI (Airborne Long Range Input) was an airborne radar platform expected, among other things, to make possible the use of the IM-99B at extremely low altitudes. The ALRI modification had been completed on selected RC-121 aircraft of the AEW&C (Airborne Early Warning and Control) fleet and the time had come to see whether or not the ALRI equipment could actually direct an IM-99B missile in a mission against a low-flying target.

The initial ALRI test (also the 20th launching in the Category III test series) occurred 2 January 1963. The target was a QB-47 drone flying at an altitude of 500 feet and a speed of 300 knots. The objective of the test was to make a head-on interception of the target at a range of 250 miles. The ALRI aircraft was stationed about 50 miles from the target area at an altitude of 15,000 feet. From an ALRI

17. Det 1, MOADS to ADC, "Status of the BOMARC Test Program as of 31 October 1962," 14 Nov 1962 [DOC 47]; Det 1, MOADS to ADC, "Status of the BOMARC Test Program as of 30 November 1962," 3 Dec 1962 [DOC 48]; Det 1, MOADS to ADC, "Status of the BOMARC Test Program as of 31 December 1962," 9 Jan 1963 [DOC 49].

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standpoint, the mission was highly successful. The airborne radar acquired the target without difficulty and directed the missile to the target. The action of the missile, however, raised some questions. The missile passed within 2,000-3,000 feet of the target, barely within the lethal envelope of the simulated nuclear blast, and was considered to have successfully intercepted the target. It appeared likely, however, that the fuze had fired as the result of radar reflections from the water rather than reflections from the target, but this phenomenon caused no immediate concern, since it was the first attempt at ALRI/BOMARC collaboration and there was a sense of gratification that ALRI had performed so well.

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At this point the BOMARC test organization shifted from simulated combat against a low-altitude subsonic target to testing involving a high-altitude target which increased in speed as it approached the area where interception was planned. On 10 January an IM-99B was launched against a QF-104 target that cruised initially at subsonic speed at an altitude of 35,000 feet. After the missile was launched

18. ~~SECRET/NOFORN~~, Msg PGYI 2-1-1, APGC to USAF, 2 Jan 1963 [DOC 50]; ~~SECRET/NOFORN BR CANADA~~, Msg ADODC 65, 8 Jan 1963 [DOC 51]; ~~SECRET/NOFORN BR CANADA~~, Msg MOBE 3-1-1, Eglin Test Br to USAF, 4 Jan 1963 [DOC 52].

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the target was shifted into high gear until it reached an altitude of 55,000 feet and a speed of 1.6 Mach. Interception was planned at a range of 275 miles.

The interception did not take place, however, because of incompatibility between the SAGE control system and the control system in the missile. The Montgomery SAGE Sector had recently been converted to what was known as the Model 9.1 configuration, while the Ground-to-Air Transmitter (GAT) serving the Gulf Test Range was attuned to the earlier SAGE model. In effect, therefore, SAGE was transmitting on one channel while the GAT was receiving on another. As a consequence the GAT was unable to forward mid-course guidance from SAGE to the missile and the missile was destroyed by range safety personnel after it passed well behind the target.

Obviously, testing could not continue so long as there was incompatibility between the SAGE program in effect at Montgomery and the control system utilized in BOMARC testing. The test program was therefore delayed nearly a month while the Electronic Systems Division (ESD) and the

19. ~~SECRET/NOFORN~~, Msg PGYI 10-1-3, APGC to USAF, 10 Jan 1963 [DOC 53]; ~~SECRET/NOFORN~~, Msg MOBE 11-1-5, Eglin Test Br to USAF, 14 Jan 1963 [DOC 54]; ~~SECRET/NOFORN~~, Msg MOBE 15-1-7, Eglin Test Br to USAF, 16 Jan 1963 [DOC 55]; Det 1, MOADS to ADC, "Status of the BOMARC Test Program as of 31 January 1963," 15 Feb 1963 [DOC 56].

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Aeronautical Systems Division (ASD) of AFSC, Boeing and ADC's Computer Programming and Systems Training Office (APASTO) worked to iron out the serious differences revealed during the test mission of 10 January. Although the compatibility problem was not immediately solved, sufficient progress had been made by early February 1963 that it was believed possible to proceed with the Category III IM-99B test program, already months behind schedule.

On 8 February the mission of 10 January was repeated. Again the missile failed to make the planned interception, although the reason for failure was almost totally unexpected. In this instance the QF-104 target responded to an unexplained signal which caused it to zoom prematurely to an altitude of 52,000 feet and then stall. The target seeker of the missile could not detect the target because of the unfavorable missile-to-target geometry. While the test mission was unsuccessful, there was no hint of incompatibility between SAGE and the IM-99B control system.

20. Msg ADOOP-EO 412, ADC to ADC Computer Programming and Systems Training Office (APASTO-Santa Monica), 7 Feb 1963 [DOC 57]; Msg ADOOP-EO 413, ADC to APASTO, 7 Feb 1963 [DOC 58]; Msg ADOOP-EO 414, ADC to APASTO, 7 Feb 1963 [DOC 59].

21. ~~SECRET~~, Msg PGYI 8-2-9, APGC to USAF, 8 Feb 1963 [DOC 60]; ~~SECRET~~, Msg MOBE 12-2-21, Eglin Test Hr to USAF, 12 Feb 1963 [DOC 61].

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Five days later, 13 February, the test organization made a third attempt to intercept the relatively sophisticated target represented by an accelerating, high-altitude QF-104. This time everything went according to plan, except that the interception was made at the shorter range of 240 miles because the drone encountered high headwinds. SAGE positioned the missile correctly, the QF-104 did what was expected of it and all subsystems of the missile, including the target seeker and fuze, operated properly. This was the 23rd launching of the Category III test series.

The following day, the test organization returned to the low-altitude BOMARC/ALRI program involving a low (500 feet), slow (300 knots) QB-47. Again the ALRI equipment worked well, as it had during the initial ALRI mission of 2 January, but again there was trouble during the terminal phase of the interception when the target seeker had difficulty maintaining contact with the target at extremely low altitude, apparently because it was confused by radar reflections from the surface of the water. While the mission of 2 January was considered a qualified success since the

22. ~~SECRET~~, Msg PGYI 13-2-11, APGC to USAF, 13 Feb 1963 [DOC 62]; Det 1, MOADS to ADC, "Status of the BOMARC Test Program as of 28 February 1963," 12 Mar 1963 [DOC 63].

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missile passed within lethal range of the target, the mission of 14 February had to be classed as a failure because the missile missed the target by a much wider margin.

The similarity in the performance of the target seekers during the 500-foot missions of 2 January and 14 February 1963, as well as parallel performance during a 1,500-foot Category I mission of 14 April 1961, raised the possibility that the target seeker of the IM-99B was incapable of adequate low-altitude work. A design deficiency was indicated. On 21 February 1963, therefore, ADC concurred in a MOADS recommendation that Category III launchings be suspended until the available data on the low-altitude problems of the target seeker could be further evaluated. Only two test missiles remained in the Category III test inventory and it was thought wise to hold these for use in testing an improved target seeker should the development agencies decide that a redesigned target seeker was required.

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23. ~~SECRET~~ ~~SECRET~~ ~~SECRET~~, Msg PGYI 14-2-12, APGC to USAF, 14 Feb 1963 [DOC 64]; ~~SECRET~~ ~~SECRET~~ ~~SECRET~~, Msg MOBE 12-2-24, Eglin Test Br to USAF, 15 Feb 1963 [DOC 65]; Det 1, MOADS to ADC, "Status of the BOMARC Test Program as of 28 February 1963," 12 Mar 1963 [DOC 64].

24. Msg MOB 15-2-23, Eglin Test Br to ASD, 15 Feb 1963 [DOC 66]; Msg MOB 20-2-25, Eglin Test Br to ASD, 20 Feb 1963 [DOC 67]; Msg ADODC 558, ADC to MOADS, 21 Feb 1963 [DOC 68].

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Before technical work on a "fix" could be started, it was necessary to define the problem in detail. Therefore, representatives of Boeing, Westinghouse (manufacturer of the target seeker), the Joint BOMARC Test Organization (JBTO) and ASD met 1 March 1963 and decided that investigation of the target seeker would have to continue to determine exactly what energy was received by the target seeker during a low-altitude mission and exactly how the target seeker reacted to it. It was not considered necessary to launch further IM-99B missiles in order to define the problem, since experience in the development of the ASG-18 fire control system (originally intended for the F-108) would probably provide sufficient information. According to the tentative schedule established during the conference of 1 March, ASD would approve the "fix" technique established by Boeing and Westinghouse by 20 March. The improved target seeker would be installed in the two remaining Category III test missiles by 15 April and the first of the two missiles would be launched by 22 April. Meanwhile, the date for completion of Category III

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testing of the IM-99B was extended from 31 March to 31 May
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1963.

At a subsequent meeting of 18-19 March, correction of the target seeker difficulty appeared to be proceeding according to plan. Boeing and Westinghouse proposed technical improvements that appeared satisfactory to ASD, so the plan to launch the first missile with the improved target seeker on 22 April was confirmed. By early April, however, doubts as to the adequacy of the proposed improvements began to be expressed. While ASD was convinced that the addition of an offset filter and "sawtooth" sweep would improve the low-altitude capability of the target seeker, there was concern that a third improvement -- continuous pulse recurrence frequency (PRF) switching -- might produce side effects that would degrade the total capability of the target seeker. On 5 April 1963, ASD decided to proceed with the incorporation of the first two changes in the test missiles, but continue the investigation of continuous PRF switching in an effort to determine whether or not the same effect could be produced by some other means. As a consequence, the date for the launching of the first test missile

25. Msg ASZDB 6-3-7, ASD to AF Plant Rep (Boeing), 6 Mar 1963 [DOC 69]; Msg ASZDB 8-3-10, ASD to AF Plant Rep (Boeing), 9 Mar 1963 [DOC 70]; Msg ADOOP-WM 800, ADC to ASD, 18 Mar 1963 [DOC 71].

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containing the redesigned target seeker was postponed to
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 the first week of May.

But despite best-laid plans, the engineering of the required improvements in the target seeker consumed the remainder of April, all of May and most of June. Unfortunately, Boeing and Westinghouse developed conflicting data in simulated operations with the redesigned target seeker and it was necessary to recheck all aspects of the improvement program. For that reason the date of 31 May 1963 for completion of Category III testing was also unrealistic and a new date of 30 Sep-
 27
 tember 1963 was established.

Finally, after four-and-one-half months were consumed in an attempt to provide a target seeker that would be adequate at low altitudes, the next-to-last IM-99B test missile was launched 27 June. Again the target was a QB-47 flying at 500 feet above the surface of the Gulf and at a speed of

26. Msg ASZDB 22-3-23, ASD to JBTO, 22 Mar 1963 [DOC 72]; Msg ASZDB 9-4-7, ASD to JBTO, 9 Apr 1963 [DOC 73]; Det 1, MOADS to ADC, "Status of the BOMARC Test Program as of 31 Mar 1963," 12 Apr 1963 [DOC 74].

27. Msg ADODC 1941, ADC to USAF, 24 May 1963 [DOC 75]; Msg ADODC 1953, ADC to 26 AD, 24 May 1963 [DOC 76]; Det 1, MOADS to ADC, "Status of the BOMARC Test Program as of 30 April 1963," 15 May 1963 [DOC 77]; Det 1, MOADS to ADC, "Status of the BOMARC Test Program as of 31 May 1963," 15 Jun 1963 [DOC 78].

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[REDACTED]

325 knots. Interception was planned at a range of 85 miles. ALRI was utilized in positioning the missile. Whether or not the mission was a success became a matter of debate. While SAGE and ALRI cooperated efficiently in positioning the missile, the operation of the modified target seeker was the subject of some differences of opinion. The missile was 1850 feet from the target when the fuze fired and would have theoretically killed the target. Therefore, Boeing concluded that the modified target seeker had performed satisfactorily. On the other hand, the Eglin Test Branch contended that not much had changed. While admitting that the modified target seeker was an improvement over the earlier version, the Test Branch was of the opinion that the image problem still remained. During the final phase of the interception the target seeker first locked on the target's reflection on the water, then on the target, then back to the reflection, making the transfer several times before the missile finally hit the Gulf.

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28. [REDACTED], Msg PGYI 27-6-19, APGC to USAF, 27 Jun 1963 [DOC 79]; [REDACTED], Msg MOBE 28-6-10, Eglin Test Br to USAF, 28 Jun 1963 [DOC 80]; Msg MOB 5-7-2, Eglin Test Br to MOADS, 5 Jul 1963 [DOC 81]; Msg ADOOP-WM 2642, ADC to JBTO, 9 Jul 1963 [DOC 82]; [REDACTED], Msg AFPRO (Boeing) to ASD, 10 Jul 1963 [DOC 83].

While there was talk, during July, of raising the test altitude from 500 to 1,500 feet in order to provide better information on the target seeker's proclivity to lock-on images reflected from the water (since the target and the image would be further apart), the final Category III test missile, launched 19 August 1963, again undertook to intercept a QB-47 at 500 feet. As before, SAGE and ALRI performed satisfactorily. The missile apparently hit the water near the planned point of interception, but detailed analysis of the performance of the modified target seeker was not immediately available.²⁹

Sixteen test missiles were launched in 1962 and seven in 1963 to complete the IM-99B test program. Five of these were Category II shots (Category II testing ended in May 1962), with the remainder falling into Category III. During the 11-year test program which began in September 1952 and ended in August 1963, a total of 213 test missiles (134 IM-99A and 79 IM-99B) were launched.

29. Msg MOB 5-7-2, Eglin Test Br to MOADS, 5 Jul 1963 [DOC 81]; Msg ADOOP-WM 2642, ADC to JBTO, 9 Jul 1963 [DOC 82]; ~~SECRET/NOFORN~~, Msg PGYI MOBI 19-8-29, APGC to USAF, 19 Aug 1963 [DOC 84].

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BOMARC TESTING BEYOND CATEGORY III

Although the date for the completion of formal testing of the BOMARC had been shoved back a number of times, it was obvious in late 1962 that the end was near. It was time for decision as to the future status of the Hurlburt/Santa Rosa test facility. Three possibilities were considered. The test equipment could be "pickled" and re-opened every 18 months for test launches designed to proof test missile/SAGE modifications and provide confidence in the tactical BOMARC system as deployed around the northeastern United States. Conversion of the test facility to tactical configuration, thus providing a ninth tactical site within the United States, was also possible. Finally, it was possible to retain Hurlburt/Santa Rosa in its current status, but on a much reduced scale, to launch perhaps one missile a month. Continuing proof and confidence testing could be conducted in this manner and tactical units could be brought to the Gulf Test Range approximately once a year to maintain their proficiency through actual launch of a missile.

The "pickling" proposal would save money, since it was determined that 174 people would be required to maintain

30. Det 1, MOADS to ADC, "Status of the BOMARC Test Program as of 31 October 1962," 14 Nov 1963 [DOC 47].

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the test facility on a "one-launch-a-month" basis. Also, there was logic in conversion of Hurlburt/Santa Rosa to tactical configuration in view of the threat posed by Cuba, only 90 miles off the Florida coast. In the final analysis, however, it was decided in December 1962 that most would be gained by retaining the test complex as a continuing entity, with tactical BOMARC squadrons alternating in the launching of one missile a month, beginning in April 1963. This program would eventually lessen total BOMARC combat capability in that it would be necessary to begin removing IM-99B missiles from tactical shelters beginning in Fiscal 1965 and from IM-99A sites in Fiscal 1966. ADC, however, believed that gains in the way of proof testing and training would outweigh the risk involved. Furthermore, ADC promised to re-evaluate the risk before emptying any tactical shelters.

As of the end of 1962, the schedule for the first 15 months of post-Category III test and training program was as follows:

31. ~~SECRET/NOFORN~~ ~~XXXXXXXXXX~~, Msg ADCCS 3405, ADC to APGC, 8 Dec 1962 [DOC 85]; ~~SECRET/NOFORN~~ ~~XXXXXXXXXX~~, Msg ADODC 3557, ADC to USAF, 28 Dec 1962 [DOC 86]; Det 1, MOADS to ADC, "Status of the BOMARC Test Program as of 31 December 1962," 9 Jan 1963 [DOC 49].

32. Det 1, MOADS to ADC, "Status of the BOMARC Test Program as of 31 December 1962," 9 Jan 1963 [DOC 49].

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<u>Date</u>	<u>Unit</u>	<u>Missile</u>	<u>Base</u>
April 1963	22 ADMS	IM-99A	Langley
May 1963	26 ADMS	IM-99A	Otis
June 1963	37 ADMS	IM-99B	Kincheloe
July 1963	46 ADMS	IM-99A	McGuire
August 1963	30 ADMS	IM-99A	Dow
September 1963	22 ADMS	IM-99B	Langley
October 1963	26 ADMS	IM-99B	Otis
November 1963	35 ADMS	IM-99B	Niagara
December 1963	6 ADMS	IM-99A	Suffolk
January 1964	74 ADMS	IM-99B	Duluth
February 1964	46 ADMS	IM-99B	McGuire
March 1964	22 ADMS	IM-99A	Langley
April 1964	26 ADMS	IM-99A	Otis
May 1964	37 ADMS	IM-99B	Kincheloe
June 1964	46 ADMS	IM-99B	McGuire

The program outlined in late 1962 did not take effect, however. First, the extension of the IM-99 Category III test series to August 1963 made impossible the commencement of training launches in April 1963 as planned. Then, also in August, came the announcement of the proposed phase-out of the IM-99A in Fiscal 1965. There was obviously little to be gained in testing the proficiency of launching crews assigned to a weapon soon to leave the inventory of active weapons, so the IM-99A portion of the training program was a dead letter. As of August 1963, therefore, the shape of the post-Category III test and training program was unknown, although ADC still planned to proceed with advanced BOMARC testing and training in one form or another.

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